INTRODUCTION

Endometriosis usually affects reproductive-aged women and can be responsible for pain symptoms (1-3) and infertility (4,5). It is classically defined as the presence of endometrial gland tissue and stroma outside the uterus (6). Microscopic cyclic bleeding with the subsequent inflammatory response, neovascularization, and fibrosis formation, is responsible for the clinical consequences of the disease. When the blood touches the adjacent fibromuscular pelvic structures (uterus, intestinal wall, bladder, ureters, posterior vaginal fornix, and ligamentary structures) there is a smooth muscle proliferation and fibrous reaction, leading to the formation of nodules as well as retractile infiltrative tissue.

Deep infiltrating endometriosis (DIE) is defined as endometriosis that penetrates more than 5 mm under the peritoneal surface. In this situation, endometriotic implants may involve the uterine ligaments (utero-sacral and/or round ligaments), the retrocervical area, the rectovaginal septum, the rectum, the vagina, and the bladder. The pre-operative assessment of such lesions is required to plan full surgical excision of the disease. Endometriotic lesions have some typical imaging patterns on transvaginal ultrasound and magnetic resonance imaging enabling pre-operative mapping of the disease. In this paper the authors report the imaging features of deep infiltrating endometriosis and the laparoscopic correlation of such lesions.

Key words: Endometriosis, Laparoscopy, Magnetic resonance imaging, Transvaginal ultrasound

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ORIGINAL ARTICLE

Deep infiltrating endometriosis: imaging features and laparoscopic correlation

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ABSTRACT

Endometriosis usually affects reproductive-aged women and can be responsible for pain symptoms and infertility. Deep infiltrating endometriosis may involve the uterine ligaments (utero-sacral and/or round ligaments), the retrocervical area, the rectovaginal septum, the rectum, the vagina, and the bladder. The pre-operative assessment of such lesions is required to plan full surgical excision of the disease. Endometriotic lesions have some typical imaging patterns on transvaginal ultrasound and magnetic resonance imaging enabling pre-operative mapping of the disease. In this paper the authors report the imaging features of deep infiltrating endometriosis and the laparoscopic correlation of such lesions.

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Images (for assessment of the entire pelvic anatomy and the pathologic changes), and axial T1-weighted gradient-echo images in and out of phase and with fat suppression (for differentiation between blood and fat).

Postcontrast imaging

Gadolinium chelate (Dotarem; Guerbet, Villepinte, France) is administered intravenously followed by the dynamic acquisition of axial and sagittal volumetric fat-saturated T1-weighted sequence. The MR imaging parameters are shown in Table I.

Whenever there is a suspicion of ureteral injury (paracervical lesion ≥2 cm in diameter) MR urography is also performed. For urographic imaging, we apply a coronal 3D volumetric T1-weighted gradient-echo sequence.

Transvaginal ultrasound protocol

Bowel preparation is not used routinely in our patients because it may cause patient discomfort and most of the lesions can be detected without this preparation. Ultrasound gel is injected vaginally (60 mL) to distend the dome of the vagina. The transvaginal exam is performed using a 5-9 MHz transducer in order to assess the ovarian and adnexal regions, the uterus, all the structures and spaces of the anterior pelvic compartment (bladder, vesico-vaginal sep-
DIE AND IMAGING FINDINGS

On MR imaging, the endometriotic lesions appear isointense to the myometrium on T1-weighted images, hypointense on T2-weighted images, and minimally enhanced after injection of the gadolinium based-contrast. Some lesions may have dilated endometrial glands with or without hemorrhage. On T1-weighted images the hemorrhagic content appears as hyperintense spots (12). In this situation the lesion is highly suggestive of an endometriotic lesion. Wherever the lesion is located in the pelvis, it may generally follow some “patterns”:

- Nodular pattern (Fig. 2A)
  - Retractile or nonretractile;
  - Regular or irregular contours;
  - With or without endometriotic glands.

The rectosigmoid is usually assessed transvaginally; however, another possibility is ultrasonographic assessment using an endoanal probe.

In the event of any doubt concerning the posterior compartment, the TVUS is re-scheduled and a bowel preparation is performed as follows:

- On the day before the TVUS the patient is requested to have a low-residue diet and administered a mild oral laxative;
- One hour prior to the examination a rectal enema consisting of 120 mL of sodium diphosphate is performed.

<table>
<thead>
<tr>
<th>Plane and Pulse Sequence</th>
<th>TR/TE (msec)</th>
<th>Saturation</th>
<th>FOV (cm)</th>
<th>Thickness (mm)</th>
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**Fig. 2** - (A) Retrocervical endometriotic lesion – nodular pattern. (B) Retrocervical endometriotic lesion – plaque-like pattern. In addition, there is an obliteration of the posterior cul-de-sac and a uterine retroflexion.
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The presence of dense content inside the cyst is suggestive of previous hemorrhage. Obviously, MR imaging is more sensitive for this finding. Wherever the lesion is located in the pelvis, once again it may generally follow some “patterns”:

- **Nodular pattern (Fig. 3)**
  - Retractile or nonretractile;
  - Regular or irregular contours;
  - With or without endometriotic glands.

- **Plaque-like pattern (Fig. 4)**
  - Retractile;
  - Infiltrative;
  - Ill-defined margins;
  - With or without endometriotic glands.

- **Endometrioma** – described below.

**ANTERIOR PELVIC COMPARTMENT**

DIE located in the anterior compartment may infiltrate the bladder, the anterior uterine serosa (vesico-uterine fold), the round ligaments, and vesico-vaginal septum. These lesions may be symptomatic in up to 75% of cases, mostly with irritative voiding symptoms, suprapubic discomfort (16), or cyclic hematuria (17). Women with recurrent irritative voiding symptoms attributed to recurrent urinary tract infections, but never microbiologically confirmed, should be investigated for DIE in the anterior compartment.

On TVUS the DIE implant has a hypoechoic or isoechoic echotexture compared with the myometrium. Dilated endometrial glands may be seen inside the endometriotic lesion appearing as a hypoechoic/anechoic cyst. The

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**Fig. 3** - (A) Regular and nonretractile endometriotic nodule on the anterior surface of the rectum. (B) Irregular and striated retrocervical endometriotic nodule.

**Fig. 4** - Plaque-like endometriotic lesion in the retrocervical area infiltrating the anterior rectal wall.
The urinary tract is affected in 0.03% to 5% of women with endometriosis (19-23). Within the urinary system, the bladder is the most commonly affected (80% to 84%), followed by the ureter (15%), kidney (4%), and urethra (2%) (24). Urinary tract endometriosis is associated with lesions in other pelvic locations in up to 50% to 75% of cases (25-27). The possibility of DIE affecting the bladder should be considered in those patients with cyclic irritative bladder symptoms. Urine cultures are usually negative in these patients. The absence of hematuria and normal cystoscopy do not exclude the possibility of bladder endometriosis.

In the bladder, the endometriotic lesion can infiltrate from the outside (serosal surface) towards the inside (mucosa) (28). Whenever the detrusor muscle is affected, there is a fibromuscular proliferation of this layer, leading to the formation of an infiltrative solid nodule with irregular boundaries (29), usually located at the posterior aspect of the bladder in contact with the anterior serosa of the uterus, in the midline (Fig. 5). The most common pattern of the endometriotic lesion affecting the bladder is solid; however, in some cases these lesions may have a mixed pattern because of the presence of cystic areas, with or without hemorrhagic content (12). The TVUS (Fig. 6) is the most accurate imaging technique to identify bladder endometriotic implants enabling the measurement of the size of the lesion and assessment of

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**Fig. 5** - Sagittal (a) and coronal (b) T2-weighted fast spin echo images demonstrating a solid nodule with irregular contours and retractable, hypointense appearance, containing a small endometriotic gland, infiltrating the bladder dome and the anterior uterine wall, obliterating the anterior cul-de-sac (yellow arrow).

**Fig. 6** - TVUS showing a hypoechoic solid nodule (white arrows) with irregular borders, infiltrating the bladder dome (B) and adhered to the anterior uterine wall (U).
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Another finding of round ligament involvement is the thickening of this structure compared with the contralateral ligament (Fig. 8) or the presence of nodularity. Contrast enhancement may occur because of inflammatory reaction (18, 31).

Other findings at the anterior compartment

Anterior cul-de-sac obliteration results from extensive adhesions caused by endometriotic implants located between the bladder and the serosa of the anterior uterine wall (vesico-uterine fold). Anterior flexion of the uterus may take place. Lesions at the vesico-vaginal septum present as irregular nodules similar to the bladder lesions.

Anterior uterine serosa and round ligaments

Deep infiltrating implants affecting the round ligaments and the anterior uterine serosa may have an infiltrative pattern with ill-defined margins and a retractile aspect. Plaque-like rather than nodular morphologic features are more commonly seen. These lesions may have small cystic areas or bright foci (12).

the depth of infiltration into the detrusor muscle (30). In the presence of deep infiltration of the detrusor muscle, partial cystectomy is required (Fig. 7). The patient should be informed pre-operatively about the need to open the bladder to ensure complete removal of the disease.

Fig. 7 - (A) Bladder endometriosis represented in yellow. (B) Laparoscopic bladder resection. In yellow we can see the limits of the resection in the vesico-vaginal septum. (C) Final aspect after the bladder excision. (D) Final aspect after suturing the bladder.
• Plaque-like lesions infiltrating the posterior uterine serosa (Fig. 2B) from the uterine fundus to the isthmus. They are usually associated with uterine retroflexion.
• Irregular and retractile solid nodules (Fig. 2A).
• Mixed nodules with cystic areas with hemorrhagic content.

Utero-sacral ligaments, posterior vaginal fornix, and rectovaginal septum

An endometriotic lesion infiltrating the utero-sacral ligament usually affects its insertion near the uterus and is characterized by an irregular thickening of the ligament or by an extension of nodular retrocervical lesions. Morphologic features include (11):
• Uni or bilaterality (Fig. 9D);
• Asymmetry between the two ligaments (Fig. 10);
• Diffuse or localized thickening;
• Nodule with a regular or stellate margin.

Rectovaginal endometriotic lesions are found between the posterior vaginal wall and the anterior rectal wall, below the peritoneum of the pouch of Douglas (11,18). Such lesions are usually small and account for 10% of retroperitoneal endometriotic lesions. It has been suggested that these lesions may originate from metaplasia of mullerian remnants.

POSTERIOR PELVIC COMPARTMENT

The posterior pelvic compartment is frequently affected by DIE and the assessment of some spaces/areas is vital to accurate diagnosis: retrocervical space (uterine torus) and pouch of Douglas, utero-sacral ligaments, posterior vaginal fornix, rectovaginal septum, and rectosigmoid (12).

Retrocervical space and pouch of Douglas

These are the sites most commonly affected by DIE (12). Frequently, DIE infiltrates the retrocervical area and the utero-sacral ligaments as well as the posterior vaginal fornix and the anterior rectal wall.

Whenever the retrocervical endometriotic lesion (Fig. 9) extends to the anterior rectal wall there is an obliteration of the posterior cul-de-sac, which may be complete (Fig. 2B) or partial and may or may not result in the presence of suspended or lateralized fluid collection (14) that may have a hemorrhagic pattern suggestive of endometriosis.

DIE located in the retrocervical area and in the pouch of Douglas may have different patterns (12).

• Irregular and retractile thickening close to the cervical insertion of the utero-sacral ligaments (Fig. 9A). They may promote medial and posterior retraction of the ovaries.

Fig. 8 - (A) Coronal T2-weighted fast spin echo image showing the left round ligament (yellow arrows), the uterus (U), and the bladder (B). The right round ligament (red arrow) is retracted over the bladder and a hypointense plaque-like lesion with an infiltrative pattern is visible at its insertion near the uterus. (B) The red circle shows the right round ligament affected by the endometriotic lesion, which is retracting the peritoneum over the bladder (B). The uterus (U) and the left round ligament (yellow arrow) are normal.
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The most common patterns of vaginal endometriosis include:

- Regular or irregular nodules (Fig. 11) containing dilated endometriotic glands or hemorrhagic foci;
- Irregular thickening of the superior third of the posterior vaginal wall.

Resection of the posterior vaginal fornix for the treatment of DIE lesions is required in 20% to 100% of cases located in the rectovaginal septum (29).

Endometriotic lesions affecting the posterior vaginal fornix are frequently associated with deep lesions affecting other pelvic sites, especially the retrocervical area and the rectum (11). They may appear as nodular or polypoid masses involving the posterior vaginal fornix. Adequate imaging of the posterior vaginal fornix requires the injection of ultrasound gel vaginally. The vaginal distension enables better definition of the endometriotic lesions as well as the local anatomy. The most common patterns of vaginal endometriosis include:

- Regular or irregular nodules (Fig. 11) containing dilated endometriotic glands or hemorrhagic foci;
- Irregular thickening of the superior third of the posterior vaginal wall.

**Fig. 9** - (A) Axial T2-weighted fast spin echo image showing the rectum (R) and the cervix (C). The green arrow shows the hypointense endometriotic lesion retracting both utero-sacral ligaments (red arrows) resulting in a tent-shaped aspect of these ligaments. (B) Sagittal T2-weighted fast spin echo image showing the same endometriotic lesion infiltrating the retrocervical area (red arrow) and the anterior recto-sigmoid wall (green arrow). B = bladder, V = vagina, U = uterus, R = rectum. (C) TVUS showing an infiltrative hypoechoic lesion at the retrocervical area. C = cervix, V = posterior vaginal fornix, R = rectum. (D) On laparoscopy, the endometriotic lesion affects the retrocervical area (red circle), both utero-sacral ligaments (red arrows) and the anterior rectal wall (R). U = uterus.
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Fig. 10 - (A) Axial T2-weighted fast spin echo image demonstrating a hypointense endometriotic lesion in the retrocervical area infiltrating the left utero-sacral ligament (yellow arrow) and the left antero-lateral rectal wall. The right utero-sacral ligament is normal (red arrow). (B) On laparoscopy, there is an asymmetry between the affected left utero-sacral ligament (yellow arrow) and the disease-free right utero-sacral ligament (red arrow). The endometriotic nodule penetrates beyond the posterior cul-de-sac and infiltrates the anterior rectal wall.

Fig. 11 - Sagittal T2-weighted fast spin echo image showing an endometriotic nodule infiltrating the posterior vaginal fornix, the retrocervical area and the anterior rectal wall. Uterine (U) adenomyosis. (B) On vaginal examination it is possible to see some black spots and some polypoid lesions, suggestive of vaginal endometriosis. (C) Laparoscopic posterior vaginal fornix excision.

(8, 32-36). Full surgical resection of DIE with excision of adjacent tissue of the posterior vaginal fornix improves quality of life with persistence of long-term results in patients unresponsive to nonsurgical treatment (34).

A study performed in Clermont-Ferrand (32) revealed that in women with rectovaginal endometriotic nodules larger than 2 cm in diameter, the distance between the vaginal epithelium and endometriotic glands was <1 mm in 49.2% of cases, <2 mm in 70%, and <5 mm in 98.4% of cases, which provides histologic evidence that resection of the posterior vaginal fornix is necessary to completely remove large volume rectovaginal endometriotic nodules. Whenever the lesion is visible in the posterior vaginal fornix, whether in the form of a bluish cyst or a pseudo-polypoid appearance, resection of the vaginal wall’s entire thickness is essential. If the lesion is not visible but palpation shows an infiltration of the vaginal mucosa, it is also necessary to resect the posterior vaginal fornix to achieve full treatment (37). TVUS and MRI current protocols can more accurately predict whether or not resection of the posterior vaginal fornix will be necessary.
Multiple pelvic locations (uterine-sacral ligaments, ovaries, vagina, bladder, and pelvic sidewall) (12,22). In addition, in the bowel, multiple foci of deep endometriosis may be found in the same patient. Chapron et al (22) found a mean of 1.6 endometriotic nodules per patient in the rectum and/or sigmoid. Goncalves et al (8) also discovered 1.5 nodules per patient with intestinal disease. In those patients with rectal and/or sigmoid DIE lesions, the rate of associated multiple pelvic locations.

**Recto-sigmoid**

The incidence of bowel infiltration among women with endometriosis ranges from 3.8%-37% (38). The most frequently affected sites are the rectum and rectosigmoid junction (9,38,39) (Figs. 12 and 13). The ileum, appendix (Fig. 14), and cecum may also be affected. Intestinal endometriosis is commonly associated with severe DIE in imaging in deep endometriosis.

![Fig. 12](image1.png)

(A) Sagittal T2-weighted fast spin echo images demonstrating an endometriotic lesion (red arrow) infiltrating the anterior recto-sigmoid wall. (B) TVUS showing the deep endometriotic lesion (red arrow) infiltrating the muscularis propria. The hyperecogenic submucosa (green squares) is preserved. (C) The lesion was laparoscopically resected by means of a rectal shaving and the muscular layer of the rectum was sutured.

![Fig. 13](image2.png)

(A) TVUS showing the deep endometriotic lesion (red arrows) infiltrating the muscularis propria and the submucosa and retracting the anterior surface of the recto-sigmoid. (B) Sagittal T2-weighted fast spin echo images demonstrating the same extensive deep endometriotic implant leading to uterine retroflexion, complete obliteration of the posterior cul-de-sac, and infiltration of the anterior recto-sigmoid wall. (C) The endometriotic lesion (red circle) was freed from the posterior uterine wall (U) and both ureters (Ur), remaining attached to the anterior surface of the rectum/sigmoid (RS). (D) Surgical specimen of a segmental bowel resection for intestinal endometriosis (red circle).
Fig. 14 - (A) TVUS showing an ill-defined hypoechoic nodule at the top of the appendix. (B) Laparoscopic appendectomy.

Fig. 15 - (A to C) Sagittal T2-weighted fast spin echo images demonstrating an endometrioma (E), the bladder (B), the dilated left ureter (Ur) and an extensive paracervical endometriotic lesion (red arrow) infiltrating the anterior rectal wall and obstructing the pelvic ureter. (D) The same paracervical endometriotic lesion (red arrow) in a coronal T2-weighted fast spin echo image. The uterus (U) is retracted towards the lesion. (E) Ureteral (Ur) obstruction (red arrow) because of a paracervical endometriotic lesion. (F) The lesion (in red) was released from the posterior uterine wall (U) and the posterior vaginal fornix (V). The ureter (Ur) was resected along with the nodule and a ureteral reimplantation was performed.
right intestinal involvement (ileum and/or cecum) may be as high as 28% (9).
In the series by Piketty et al (9), they observed a total of 75 patients (56%) with histologically proven intestinal involvement among 134 patients with DIE. Only 34 patients (45.3%) presented a single intestinal lesion. The mean number of intestinal DIE lesions per patient was 2.7. The rectum was affected in 96%, the sigmoid in 38.7%, the ileum in 22.7%, the cecum in 10.7%, the appendix in 10.7%, and the omentum in 4% of the patients with intestinal DIE. The intestinal DIE lesions were associated with other DIE lesions (uterosacral, vagina, bladder, ureter) in 93.3% of patients.
Endometriotic implants usually adhere to the serosal surface of the bowel and may infiltrate the muscular layer (Fig. 12), eliciting marked smooth muscle proliferation and fibrous reaction, resulting in solid nodule formation (29). These nodules may have different morphologic features, as described above. Whenever these lesions reach the deeper layers of the bowel wall (submucosa, muscularis mucosa, and/or mucosa) they lead to loss of the stratified echo pattern related to the affected layer on TVUS. For instance, if the lesion involves the submucosal layer, it demonstrates a striated aspect or areas of interruption in the hyperechoic intestinal layer on TVUS (11) (Fig. 14). These findings cannot be assessed by MR imaging, except by using an anal endocoil. This methodology is not used for endometriosis because it causes significant discomfort to the patient and is not superior to methods with transvaginal and transrectal ultrasound.
The radiologist may be able to give the surgeon some important data when bowel endometriosis is identified:
- Longitudinal extension of the disease;
- The layers affected (serosa, muscularis propria, submucosa, muscularis mucosa, and mucosa) in the bowel wall;
- The distance between the inferior lesion margin and the anal border;
- The affected bowel circumference;
- Number of lesions.
These data will help the surgeon to choose between radical (segmental bowel resection) and conservative treatments (shaving or discal resection) for bowel endometriosis.

URETERAL ENDOMETRIOSIS

Ureteral endometriosis is estimated to occur in about 0.08% to 4.6% of patients with endometriosis (19,40-42). It can be differentiated into extrinsic or intrinsic disease (40). The former accounts for 80% of the cases and is caused by gradual enclosure of the ureters by endometriotic tissue. Intrinsic ureteral endometriosis is histologically defined by the presence of endometriotic glands and stroma in the ureteral muscularis (11,40). Ureteral involvement should be suspected whenever paracervical DIE lesions greater than 2 cm and/or large retrocervical DIE lesions are found. In the series by Donnez et al (42), ureteral endometriosis was found in 11.2% of women with retrocervical endometriotic nodules ≥3 cm in diameter.
Patients with ureteral endometriosis may require concomitant procedures during DIE surgery, including ureterolysis, uretero-ureterostomy, nephrectomy or ureteral reimplantation (43,44). This should be scheduled pre-operatively in order to achieve full treatment of the disease in a single procedure.

OVARIAN ENDOMETRIOMA

The ovaries may be affected by endometriosis leading to two different patterns of lesions (11):
- Superficial fibrotic implants with fibrous adhesions confined to the ovarian surface that may be underdiagnosed at imaging because of the microscopic size of the lesions;
- Chronic retention cysts with cyclic bleeding so-called endometriomas (Fig. 16).
Superficial or deep ovarian endometriosis is a marker for the presence of more extensive pelvic and intestinal disease (45-47). Surgeons diagnosing and treating only ovarian endometriosis may be underdiagnosing and undertreating their patients (47).
Endometriomas are thick-walled cysts with a dark, dense content that represents degenerated blood products. Adhesions between the endometrioma and the posterior surface of the uterus, the utero-sacral ligament, and/or the pelvic sidewall are commonly present. The cysts may be solitary or multiple, and they are bilateral in 50% of cases. Blood clots may be adhered to the inner surface of the cyst wall and they appear as peripheral pseudonodules with no flux at doppler-sonography. Fluid-fluid levels may be present and they represent recent hemorrhage. A multilocular appearance may consist of multiple contiguous cysts (11). The presence of hyperechogenic wall foci in the cyst wall is highly predictive for ovarian endometrioma (48) and helps in the differential diagnosis with other complex cystic ovar-
ian lesions (dermoid cysts, hemorrhagic cysts, and cystic neoplasms) (28).
Characteristically, endometriomas have uniform low-echo content, with high resistive index within the cyst wall and no internal flux at doppler-sonography (Fig. 16D). Hyperchogenic wall foci, thin or thick septa, hyperechogenic peripheral nodules (blood clots), and fluid-fluid levels may also be observed.

MR imaging is the imaging modality of choice for diagnosing endometriomas because of its high specificity to detect aged hemorrhagic content (49), especially in those lesions smaller than 2.0 cm or in complex endometriomas. On T1-weighted images the endometriotic cyst shows high signal intensity because of the hemorrhagic content. Fat saturated T1-weighted images are particularly useful to identify the presence of typical fat from ovarian dermoid cysts. On T2-weighted images the endometrioma typically shows low signal intensity; however, intermediate signal intensity may also be seen (shading sign) because of the chronic nature of the cyst (Figs. 16A to 16C). Cyclic bleeding lead to the accumulation of old blood products, which contain extremely high iron and protein concentrations, as well as methemoglobin and reduce T2 relaxation time. The low signal peripheral halo refers to the fibrous capsule or hemosiderin deposition.

COMMENTS

MR imaging, transrectal ultrasound (TRUS) and TVUS have been used to perform the pre-operative assessment of infiltrative endometriotic lesions. It seems that in the hands of experts, the TVUS examination is an important pre-operative examination for the diagnosis of deep retrocervical and rectosigmoid endometriosis (9,13).

Abrao et al (13) assessed the capacity of digital vaginal examination, TVUS and MR imaging to diagnose rectosigmoid and retrocervical involvement by DIE. With respect to the rectosigmoid and retrocervical sites, respectively, digital vaginal examination had a sensitivity of 72% and 68%, specificity of 54% and 46%, positive predictive value (PPV) of 63% and 45%, negative predictive value (NPV) of 64%
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of the vagina and rectum with ultrasound gel significantly improved the sensitivity of MR imaging for the detection of deep endometriosis, enabling better delineation of the pelvic organs. This was especially apparent for lesions in the vagina and rectovaginal septum. It is important to remember that these methods are operator-dependent. A close communication between surgeons and radiologists must be established so that they can gradually understand the needs of surgeons and better interpret the images of infiltrating endometriosis. To conclude, pre-operative mapping of DIE is feasible by means of TVUS and/or MR imaging. This helps the surgeon to plan the surgical procedure and explain the complexity of the treatment to the patient. Therefore, nowadays there are no excuses to indicate a diagnostic laparoscopy for patients with DIE. The DIE lesions must be identified pre-operatively and, if the surgical treatment is indicated, the surgeon must be able to perform the full surgical excision.

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