

# Evaluation of Deeply Infiltrating Endometriosis by Preoperative Magnetic Resonance Imaging in Patients with Adenomyosis

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## Abstract

**Objectives:** Before endometriosis surgery, it is important to identify deep infiltrating endometriosis (DIE) to assess the surgical difficulty. Preoperative magnetic resonance imaging (MRI) was used to determine which findings are useful in predicting DIE.

**Materials and Methods:** Between 2008 and 2016, 54 patients with adenomyosis underwent total laparoscopic hysterectomy at our hospital. We retrospectively evaluated the intraoperative findings and magnetic resonance imaging (MR) images. The MR images were scored based on the presence of five findings: retroflexed uterus, elevated posterior vaginal fornix, intestinal tethering in the direction of the uterus, faint strands between the uterus and intestine, and fibrotic nodules covering the serosal surface of the uterus.

**Results:** Of the five findings, intestinal tethering and faint strands between the uterus and intestine showed a sensitivity of 73% and a specificity of 91%–100%, indicating the usefulness of these findings for detecting deep endometriosis lesions. However, finding a retroflexed uterus did not contribute to DIE lesion detection. The sensitivities of an elevated posterior fornix and fibrotic nodules covering the surface of the uterus were as low as 46%–59%, and their specificities were as high as 84%–91%.

**Conclusion:** Preoperative preparation is essential for patients with intestinal tethering or faint strands between the uterus and intestine on preoperative MRI after obtaining appropriate informed consent.

**Keywords:** Adenomyosis, deeply infiltrating endometriosis, magnetic resonance imaging

## INTRODUCTION

Diagnostically, adenomyosis is the endometrial stroma and glandular tissue present within the smooth muscle of the myometrium causing pain, infertility, and uterine bleeding.<sup>[1-3]</sup>

Endometriosis is ectopic endometrium tissue outside the uterine cavity,<sup>[4-6]</sup> with major phenotypes being ovarian endometrioma, superficial peritoneal endometriosis, and deep infiltrating endometriosis (DIE).<sup>[7-9]</sup> DIE is endometriosis involving >5 mm of peritoneal infiltration based on the infiltration depth and pain intensity.<sup>[10]</sup>

Adenomyosis and DIE often coexist and can be noninvasively diagnosed via ultrasound (US) or magnetic resonance imaging (MRI).<sup>[11]</sup> This study assessed the utility of MRI

findings for the preoperative diagnosis of DIE during adenomyosis surgery.

## MATERIALS AND METHODS

This retrospective study followed the guidelines of the Declaration of Helsinki and was approved by the ethics committee of our hospital (approval number 4232). Ultrasonography was used to diagnose adenomyosis at the first visit, and MRI was performed for patients scheduled for surgery. When patients requested surgery for adenomyosis at our hospital, total laparoscopic hysterectomy (TLH) was selected for those with symptoms, such

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as dysmenorrhea, chronic pelvic pain, menorrhagia, and uterine bleeding, and for those who did not need to preserve fertility. At our hospital, we used four ports, a diamond-shaped trocar, and a 10 mm direct scope. In all cases, the Rumi® II system (Cooper Surgical, Inc.) was inserted into the uterine cavity, and a Koh cup was used as a guide during the incision of the vaginal wall using a powered device (Harmonic ACE@, Johnson and Johnson Services, Inc.). The vaginal stump was sutured with a continuous two-layer absorbable suture.

We reviewed 54 patients who underwent TLH for adenomyosis between January 2008 and December 2016. Data collected included age, diagnosis, operative method (TLH and concurrent surgery, such as salpingo-oophorectomy or cystectomy for endometrioma), preoperative gonadotropin-releasing hormone (GnRH) agonist use, operative time, bleeding volume, and the presence of DIE. The presence of DIE in the pelvic cavity, for example, the uterosacral ligaments, rectovaginal septum, rectosigmoid, or pouch of Douglas, was confirmed from surgical records.

MRI was performed in all patients. The five findings suggesting posterior cul-de-sac obliteration reported by Kataoka *et al.*, including retroflexed uterus, elevated posterior vaginal fornix, intestinal tethering or tethered appearance of the rectum in the direction of the uterus, faint strands between the uterus and intestine, and fibrotic plaques or nodules covering the serosal surface of the uterus,<sup>[11]</sup> were detected in the sagittal planes of T2-weighted images. We classified these five findings into

three categories (0, 1, and 2 points), as shown in Table 1, and scored them up to 10 points. (1) Retroflexed uterus: 0 point, no findings were found; 1 point, the angle between the line formed by the cervical canal and the uterine cavity was <45°; and 2 points, the angle was 45° or more [Figure 1a]. (2) Elevated posterior vaginal fornix: 0 points, no findings were found; 1 point, the position of the posterior vaginal fornix was <1/2 of the cervical canal [Figure 1b]; and 2 points, the position was upper the 1/2 position of the cervical canal [Figure 1c]. (3) Intestinal tethering or tethered appearance of the rectum in the direction of the uterus: 0 points, no findings; 1 point, tethering was limited to the surface of the intestinal tract [Figure 1d]; and 2 points, tethering extended to the intestinal lumen [Figure 1e]. (4) Faint strands between the uterus and intestine: 0 points, no findings; 1 point, the faint strand was limited to one spot [Figure 1f]; and 2 points, two or more spots were found [Figure 1g]. (5) Fibrotic plaque or nodule covering the serosal surface of the uterus: 0 point, no findings; 1 point, the nodule was <1 cm [Figure 1h]; and 2 points, the nodule was 1 cm or more [Figure 1i].

Statistical analyses were performed using Excel statistical software (Microsoft, Redmond, WA, USA) and Student’s *t*-tests. *P* < 0.05 was considered statistically significant.

## RESULTS

The characteristics and perioperative outcomes of the 54 patients are summarized in Table 2. The average age of

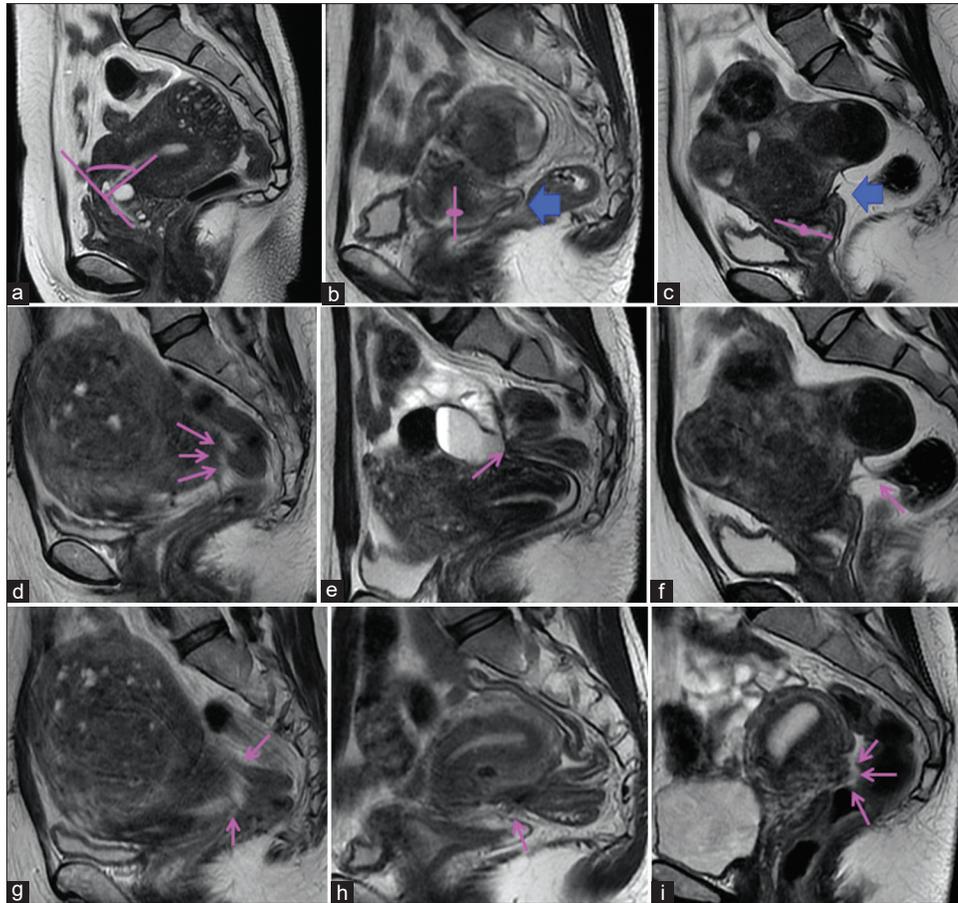
**Table 1: Scoring of DIE**

Score	0	1	2
1) Retroflexed uterus	-	<45°	45°≤
2) Elevated posterior vaginal fornix	-	<Cervix1/2	Cervix1/2 ≤
3) Intestinal tethering in direction of uterus	-	mild	moderate ≤
4) Faint strands between uterus and intestine	-	1	≤2
5) Fibrotic nodule covering serosal surface of the uterus	-	< 1cm	≤1 cm

**Table 2: Patients characteristics and perioperative outcomes**

	DIE (+) n=22	DIE (-) n=32	Total n=54
Age (y.o.)	45 (38-51)	44.5 (39-50)	44.7 (39-51)
Diagnosis			
Adenomyosis	5	18	23
Adenomyosis + endometrioma	14	9	23
Adenomyosis + uterine myoma	3	5	8
GnRH agonist (course)	2.3 (0-6)	2 (0-6)	2.1 (0-6)
Operation method			
TLH	6	22	28
TLH + SO/cystectomy	14	9	23
TLH→ATH	2	1	3
Operation time (min)	201 (125-342)	174 (84-385)	185 (84-385)
Bleeding (ml)	167 (0-1600)	116 (0-1360)	137 (0-1600)

Mean (range). DIE; deep infiltrating endometriosis TLH; Total laparoscopic hysterectomy SO; Salpingo-oophorectomy, ATH; abdominal total hysterectomy



**Figure 1:** Magnetic resonance imaging finding in the sagittal planes of T2-weighted images of patient with deep infiltrating endometriosis. Retroflexed uterus: 2 points (a), the angle between the line formed by the cervical canal and the uterine cavity was  $45^\circ$  or more (purple arrows point to each other findings). Blue arrows indicate the elevated posterior vaginal fornix. Elevated posterior vaginal fornix: 1 point (b), the position of posterior vaginal fornix was under 1/2 of the cervical canal; and 2 points (c) was upper the 1/2 position of the cervical canal. Intestinal tethering or tethered appearance of rectum in direction of uterus: 1 point (d), the tethering was limited to the surface of the intestinal tract; and 2 points (e), it was extended to the intestinal lumen. Faint strands between uterus and intestine: 1 point (f), the faint strand was limited one spot; and 2 point (g), two or more spots were found. Fibrotic plaque or nodule covering serosal surface of the uterus: 1 point (h), the nodule was  $<1$  cm; and 2 points (i), the nodule was 1 cm or more. MR: Magnetic resonance

the patients was 44 years, and the average preoperative GnRH agonist use was 2.1 courses. Twenty-three patients underwent salpingo-oophorectomy or cystectomy for endometrioma, and eight patients had uterine leiomyoma. Three patients were switched to laparotomy because of bleeding  $>500$  ml (940–1360 ml). Three patients had heavy uteruses weighing 650 g, 650 g, and 1010 g. The mean operation time was 185 min, and the average total bleeding was 137 ml. Moreover, in 22 patients, DIE was observed in the uterosacral ligaments, rectovaginal septum, rectosigmoid, and pouch of Douglas, while DIE was not found in the pelvic cavity of 32 patients.

After scoring each of the five MRI findings, no significant difference was observed regarding the retroflexed uterus between the presence and absence of DIE. There was a significant difference between the scores for the other four findings and the total scores for the five [Table 3].

Regarding sensitivity and specificity, finding a retroflexed uterus had a sensitivity of 55% and a specificity of 59% [Table 4]. Although the other four findings had sensitivities ranging from 46% to 73%, they had high specificities ranging from 84% to 100%.

In assessing the positivity rate for each of the five MRI findings, a retroflexed uterus was identified in 40% of patients without DIE [Figure 2]. The four other findings were found in 46%–73% of the patients with DIE but were less frequently detected in patients without DIE (0%–16%). The proportion of patients with and without DIE who had any of the five findings was 100% and 50%, respectively.

## DISCUSSION

In a Japanese study, the prevalence of endometriosis in women of reproductive age was 6.8%.<sup>[12]</sup> In another study,

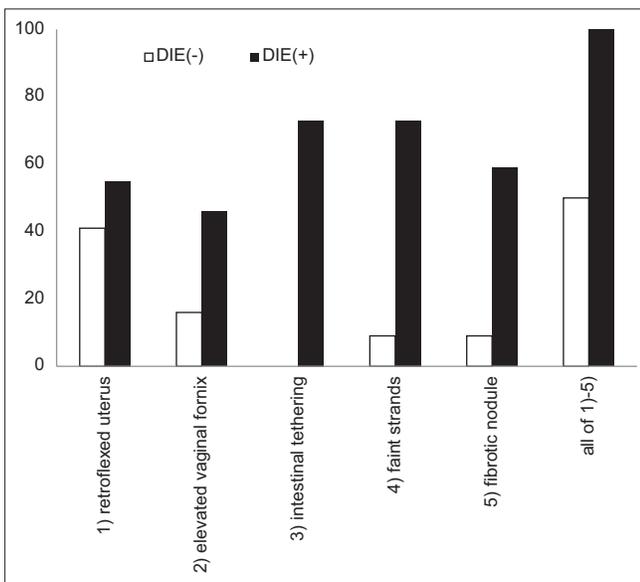
**Table 3: MRI score of patients**

Score	Mean of MRI score (range)		P
	DIE (+) n=22	DIE (-) n=32	
1) Retroflexed uterus	0.9 (0-2)	0.7 (0-2)	NS
2) Elevated posterior vaginal fornix	0.7 (0-2)	0.2 (0-2)	0.01
3) Intestinal tethering in direction of uterus	1.1 (0-2)	0 (0)	<0.001
4) Faint strands between uterus and intestine	1.0 (0-2)	0.1 (0-1)	<0.001
5) Fibrotic nodule covering serosal surface of the uterus	0.9 (0-2)	0.1 (0-1)	<0.001
Total	4.6 (1-10)	1.1 (1-5)	<0.001

NS; not significant

**Table 4: Sensitivity and Specificity**

	Sensitivity (%)	Specificity (%)
1) Retroflexed uterus	55 (12/22)	59 (19/32)
2) Elevated posterior vaginal fornix	46 (10/22)	84 (27/32)
3) Intestinal tethering in direction of uterus	73 (16/22)	100 (32/32)
4) Faint strands between uterus and intestine	73 (16/22)	91 (29/32)
5) Fibrotic nodule covering serosal surface of the uterus	59 (13/22)	91 (29/32)



**Figure 2:** Positivity rate of magnetic resonance imaging findings. A retroflexed uterus was identified in 40% of patients without deep infiltrating endometriosis (DIE). The four other findings were found in 46%–73% of patients with DIE. These findings were less frequently detected in patients without DIE (0%–16%). DIE: Deep infiltrating endometriosis, MRI: Magnetic resonance imaging

a short menstrual cycle, family history of endometriosis, genetic polymorphisms, smoking, lower body mass index, and lower parity were associated with the risk of developing endometriosis.<sup>[13]</sup> Surgery for DIE is one of the most difficult gynecological surgeries. DIE includes bladder and lateral infiltration, such as ureteral compromise, sigmoid affection, and rectovaginal nodules. The ureteral involvement is estimated to affect 10–14% of cases. Asymptomatic loss of renal function has also been reported; therefore, it is

important not to ignore signs of silent hydronephrosis during conservative therapy.<sup>[14]</sup> According to guidelines, DIE lesions should be completely resected for DIE treatment.<sup>[15]</sup> Although this may be difficult if the woman desires to preserve her fertility, 41.2% of women who underwent surgical resection for rectovaginal endometriosis treatment were reported to become pregnant after surgery.<sup>[16]</sup> DIE lesion resection may also positively impact fertility in women with rectovaginal endometriosis. It is reported that key points in the laparoscopic excision of DIE lesions are identifying the retroperitoneal space and ureter, correcting the abnormalities in the pelvic anatomy, and performing complete surgical excision without the need for a reoperation.<sup>[17]</sup> These procedures require technical knowledge and distinguished surgical skills and often require collaboration with gastrointestinal surgeons and urologists. Consequently, detecting DIE lesions before the surgery guides necessary preoperative preparation, leading to improved outcomes.

DIE is often observed during surgery for adenomyosis, and the lesions were noted in 40% of patients undergoing hysterectomy in the present study. The symptoms (dysmenorrhea, dyspareunia, dyschezia, and chronic pelvic pain) and a related medical history (infertility, previous medical treatment, or surgery for endometriosis) are considered important for DIE diagnosis. However, previous reports indicate that the poor correlation between patient symptoms and the severity of endometriosis lesions makes the clinical diagnosis challenging.<sup>[18-20]</sup> In addition, 2%–50% of patients may have asymptomatic endometriosis.<sup>[18-20]</sup>

There are currently no accurate serum markers for endometriosis. It was reported that serum levels of CA125 and

CA19-9 were significantly higher in endometriosis, but their sensitivity and specificity are 65% and 66%, respectively.<sup>[21]</sup>

US is useful for diagnosing endometrioma, with a reported sensitivity and specificity of 83% and 89%, respectively.<sup>[22]</sup> However, the sensitivity and specificity of transvaginal US for DIE detection in the pelvic cavity (uterosacral ligaments, rectovaginal septum, vagina, and bladder) are between 53% and 93%.<sup>[23]</sup>

The first report of the clinical diagnosis of endometriosis using MRI (sensitivity, 64%; specificity, 60%) was published by Arrivé *et al.* in a prospective assessment of 30 patients with symptomatic disease. Most endometriomas were identified by MRI. In contrast, only 48% of adhesions cases and 13% of peritoneal implant cases were diagnosed using MRI. Therefore, it was concluded that the MRI findings did not correlate with the severity of endometriosis revealed by surgery.<sup>[24]</sup>

Current advances in imaging technology, primarily transvaginal US and MRI, have enabled accurate preoperative DIE diagnosis. In a recent review, transvaginal US examination had a sensitivity and specificity of 79% and 94%, respectively, approaching the criteria for a triage test.<sup>[25]</sup> Moreover, it was revealed that MRI for pelvic endometriosis diagnosis had a sensitivity and specificity of 94% and 77%, respectively. Particularly in the diagnosis of rectal endometriosis, MRI offered high sensitivity and specificity for the diagnosis of DIE (92% and 96%, respectively).

The most common sites of endometriosis are the adnexae and Douglas pouch. Therefore, this study focused on Douglas pouch lesions, which contribute to surgical difficulty. Furthermore, MRI findings for identifying posterior Cul-de-sac obliteration, the association of a retroflexed uterus, an elevated posterior vaginal fornix, intestinal tethering in the direction of the uterus, faint strands between the uterus and intestine, and a fibrotic nodule covering the serosal surface of the uterus have been reported.<sup>[18]</sup> We investigated the findings that indicate DIE occurrences in the Douglas pouch during preoperative MRI diagnosis. A retroflexed uterus was not a notable finding, with a sensitivity of 55% and specificity of 59%. The other four findings had modest sensitivities ranging from 46% to 73% but specificities ranging from 84% to 100%, suggesting the usefulness of these findings for diagnosing DIE [Table 4]. Twenty-two patients with DIE had one or more of the four preoperative MRI findings.

The present study has some limitations. First, the study was retrospective; therefore, a randomized controlled trial may be required to substantiate its findings. In addition, DIE lesions were macroscopically resected during laparoscopic surgery, and histological evidence was unavailable in all cases.

Furthermore, the number of patients was small, reflecting the results from a single institution. Detailed analysis is essential for diagnosing DIE to excise the lesions completely and avoid surgical complications. Thus, further accumulation of cases and histological demonstrations are required to fully evaluate the presence or absence of DIE lesions.

## CONCLUSION

Our results demonstrate that two findings in the sagittal planes of T2-weighted images, intestinal tethering in the direction of the uterus and faint strands between the uterus and intestine, are useful for estimating DIE lesions in the pouch of Douglas. Preoperative MRI is important for assessing the difficulty of surgery, estimating surgical time, and selecting the surgical method. Sufficient preoperative informed consent and preparation are necessary, especially for patients with suspected DIE.

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## Data availability statement

All data generated or analyzed during this study are included in this published article.

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Nil.

## Conflicts of interest

There are no conflicts of interest.

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