

# Chapter 21

## Classification of Endometriosis

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**Abstract** As endometriosis is a chronic disease which debilitates women of reproductive age and has a negative impact on work force and quality of life in general, a disease classification would help to estimate the extent of impact on various aspects.

The most common classification has been established by the American Fertility Society and finally revised as American Society of Reproductive Medicine Classification. It is based on a laparoscopic evaluation and scoring and stages from I to IV can be applied, reflecting the extent of disease.

Since this rASRM classification does not clearly reflect a prognosis for infertility patients, the endometriosis fertility index (EFI) was developed, which is based on the rASRM classification, but in addition includes predicted ovarian and tubal function and historical parameters.

Since these two scoring algorithms do not consider deep infiltrating endometriosis, a classification, the Enzian classification was developed according to the TNM classification for cancer. It describes the extent of disease within three different pelvic compartments classified into three sizes.

The development of MRI led to an accurate preoperative mapping of respective endometriotic lesions and enabled an MRI-based radiological classification system

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(MARIE) that reflects both the localisation of endometriosis and concomitant reproductive function.

Up to date no classification exists that concludes all aspects of the disease, the pathophysiology, localisation, progression, pain and infertility, treatment, prognosis and recurrence.

**Keywords** Adhesions • Classification • Deep infiltrating endometriosis • Pain • Sterility

## 21.1 Introduction

Since the first descriptions of endometriosis by Lockyer et al. in 1918 [1] and Sampson et al. in 1921 [2] it became necessary to classify the disease with the aim to include histological differentiation as well as differentiation according to location and severity of the disease. Ideally, a classification has a common language that specifies the diagnosis, thereby allowing a standardisation of disease assessment. Furthermore, it enables research, as well as the clinical community to compare findings.

The early classification systems were based on the anatomical localisation of the disease and its similarity to malignancy. The classification systems before 1973 described mainly the anatomical distribution of endometriosis and did not correlate with the clinical outcome; thus they have not received widespread acceptance. The Acosta classification [3] was the first one where a direct relationship could be established with different stages of the disease and clinical pregnancy rates. As a further development, the staging system of Kistner [4] tried to reflect the natural progression of the disease with moving from early peritoneal implants to ovarian and fallopian tube-ovarian involvement and dissemination within the pelvis. One of the most precise and detailed classification systems was the Buttram classification [5], which, however, has not received widespread acceptance. Table 21.1 gives an overview of the most common classification systems, which have been made since 1918.

An ideal classification would require that a consensus be reached over empirically as well as scientifically based data that are comprehensive for all cases. Terms would need to be defined unambiguously, and anatomic lesions, extent of disease, severity of pain, impact on fertility and organ function within the pelvis as well as social impact would need a simple translation into a verbal description. Founding variables would need to be recognised and the risk of complications should be indicated. Finally the ideal classification would also guide the treatment and estimate risk for recurrence.

To date, we are far from having an ideal endometriosis classification.

In this chapter we are introducing and analysing the currently used classification systems.

**Table 21.1** The most important historical classification systems of endometriosis

Year	Classification system	Characteristics
1918	Lockyer [1]	First descriptions of the disease
1921	Sampson [2]	
1949	Wicks and Larson [6]	<p>Grade I: The wall of the cavity is lined by large bloated phagocytic cells containing blood pigment and cellular debris, most abundant on the inner side of the wall</p> <p>Grade II: The epithelium remains and the individual epithelial cells appear atrophic. The stroma is partially or completely replaced by bloated phagocytic cells</p> <p>Grade III: Epithelium and stroma are both present. Neither the epithelium nor the stroma appears to be materially influenced by the cyclic hormonal situation of the ovary</p> <p>Grade IV: The lesion contains endometrium resembling that seen at some stage of the menstrual cycle as found in the uterus. Glands are always present and are supported by an abundant endometrial stroma</p>
1951	Huffman [7]	<p>Stage I</p> <ul style="list-style-type: none"> <li>a. Limited to uterosacral ligaments and/or</li> <li>b. Limited to ovaries and/or</li> <li>c. Superficial peritoneal implants</li> </ul> <p>Stage II</p> <ul style="list-style-type: none"> <li>a. Extensive involvement of one ovary, with lesser involvement of second ovary and/or</li> <li>b. Superficial implants both ovaries and/or</li> <li>c. Superficial bowel implants and/or</li> <li>d. Infiltrating lesions of uterus and uterosacral ligaments</li> </ul> <p>Stage III</p> <ul style="list-style-type: none"> <li>a. Extensively infiltrating both ovaries and/or</li> <li>b. Bilateral ovarian endometriotic cysts and/or</li> <li>c. Deeply invading rectovaginal lesions and/or</li> <li>d. Infiltrating nonobstructing bowel implants</li> </ul> <p>Stage IV</p> <ul style="list-style-type: none"> <li>a. Vesical invasion and/or</li> <li>b. Intestinal invasion, obstructive and/or</li> <li>c. Ureteral involvement</li> </ul>
1954	Sturgies and Call [8]	<p>Stage I: Early development</p> <p>Stage II: Active development</p> <p>Stage III: Endometrial inactivity (postmenopause)</p>
1962	Riva [9]	Staging categories are defined according to the cumulative count of pelvic structures involved and surrounding adhesions. The first scale which tries to define who might benefit from the therapy
1966	Beecham [10]	<p>Stage I: Scattered, small (1–2 mm) spots anywhere in the pelvis at laparotomy</p> <p>Stage II: Uterosacral ligaments, broad ligaments, cervix and ovaries are, collectively or individually, fixed, tender, nodular and slightly enlarged</p>

(continued)

**Table 21.1** (continued)

Year	Classification system	Characteristics
1973	Acosta [3]	<p>Stage III: The same as stage II, with ovaries at least twice normal size; uterosacral ligaments, rectum and adnexa are confluent and the cul-de-sac is obliterated</p> <p>Stage IV: Massive involvement, internal pelvic viscera cannot be clearly distinguished by palpation</p> <p>Stages II–IV may be used to describe either the palpable finding at the physical examination or the palpable-visual findings at operation</p> <p>Mild</p> <ol style="list-style-type: none"> <li>1. Scattered, fresh lesions (i.e. implants not associated with scarring or retraction of the peritoneum) in the anterior or posterior cul-de-sac or pelvic peritoneum</li> <li>2. Rare surface implant on ovary, with no endometrioma, without surface scarring and retraction, and without periovarian adhesions</li> <li>3. No peritubular adhesions</li> </ol> <p>Moderate</p> <ol style="list-style-type: none"> <li>1. Endometriosis involving one or both ovaries, with several surface lesions, with scarring and retraction, or small endometriomas</li> <li>2. Minimal periovarian adhesions associated with ovarian lesions described</li> <li>3. Minimal peritubular adhesions associated with ovarian lesions described</li> <li>4. Superficial implants in the anterior/posterior cul-de-sac with scarring and retraction. Some adhesions, but not sigmoid invasion</li> </ol> <p>Severe</p> <ol style="list-style-type: none"> <li>1. Endometriosis involving one or both ovaries with endometrioma <math>&gt;2 \times 2</math> cm (usually both)</li> <li>2. One or both ovaries bound down by adhesions associated with endometriosis, with or without tubal adhesions to ovaries</li> <li>3. One or both tubes bound down or obstructed by endometriosis; associated adhesions or lesions</li> <li>4. Obliteration of the cul-de-sac from adhesions or lesions associated with endometriosis</li> <li>5. Thickening of the uterosacral ligaments and cul-de-sac lesions from invasive endometriosis with obliteration of the cul-de-sac</li> <li>6. Significant bowel or urinary tract involvement</li> </ol>
1977	Kistner [4]	<p>Stage I: Areas of endometriosis are present on the posterior pelvic peritoneum (cul-de-sac, uterosacral ligaments) or on the surface of the broad ligaments but do not exceed 5 mm in diameter. Avascular adhesions may involve the tubes, but the fimbriae are free. The ovaries may show a few avascular adhesions, but there is no ovarian fixation. The surfaces of the bowel and the appendix are normal</p> <p>Stage IIA: Areas of endometriosis are present on the posterior pelvic peritoneum (cul-de-sac, uterosacral ligaments) and the broad ligaments but do not exceed 5 mm in diameter. Avascular adhesions may involve the tubes, but the fimbriae are free. Ovarian involvement has been subclassified as follows: <i>IIA-1</i>, endometrial cyst or surface is 5 cm or less; <i>IIA-2</i>, endometrial cyst or surface is</p>

(continued)

**Table 21.1** (continued)

Year	Classification system	Characteristics
		over 5 cm; <i>IIA-3</i> , ruptured endometrioma, the bowel and the appendix are normal
		Stage IIB: The posterior leaf of the broad ligament is covered by adherent ovarian tissue. The tubes present adhesions not removable by endoscopic procedures. The fimbriae are free. The ovaries are fixed to the broad ligament and show areas of endometriosis over 5 mm in diameter. The cul-de-sac presents multiple implants, but there is no adherent bowel nor is the uterus in fixed position. The bowel and the appendix are normal
		Stage III: The posterior leaf of the broad ligament may be covered by adherent tube or ovary. The tubal fimbriae are covered by adhesions. The ovaries are adherent to the broad ligament, and tube may or may not show surface endometriosis or endometriomas. The cul-de-sac shows multiple areas of endometriosis, but there is no evidence of adherent bowel or uterine fixation. The bowel and the appendix are normal
		Stage IV: Endometriosis involves the bladder serosa, and the uterus is in fixed, third-degree retroversion. The cul-de-sac is covered by adherent bowel or is obliterated by the fixed uterus. The bowel is adherent to the cul-de-sac, uterosacral ligaments or uterine corpus. The appendix may be involved by the endometriotic process
1974	Mitchell and Farber [11]	Similar staging system to that used in gynaecological malignancies with stage V for malignant transformation
1979	Buttram [5]	<p>Stage I (Peritoneum)</p> <ul style="list-style-type: none"> <li>A. No peritoneal involvement</li> <li>B. Scattered superficial surface endometrial implants on the pelvic peritoneum (anterior or posterior cul-de-sac, uterosacral ligaments or the broad ligaments), which do not exceed 5 mm in diameter. Neither tubal nor ovarian involvement</li> <li>C. Same as for B, but invasive endometriosis or plaques or endometrial implants &gt;5 mm in diameter. Fine, filmy adhesion may be present that may be lysed without great danger of resultant adhesions</li> </ul> <p>Stage II (Ovarian): 1, right; 2, left; 3, bilateral</p> <ul style="list-style-type: none"> <li>A. No ovarian involvement</li> <li>B. Superficial surface endometrial implants of ovary of &lt;5 mm in diameter, which can be removed by scraping or fulguration without great danger of resultant adhesions. Fine, filmy adhesions may be present and lysed without great danger of resultant adhesions</li> <li>C. Invasive endometriosis (plaques or endometrioma) &gt;5 mm but &lt;2 cm that requires surgical removal. Fine, filmy adhesion may be present, which may be lysed without great danger of resultant adhesions</li> <li>D. Invasive endometriosis &gt;2 cm that requires surgical removal or a ruptured endometrioma of any size. Fine, filmy adhesion may be present, which may be lysed without great danger of resultant adhesions</li> <li>E. B, C or D with sufficient dense adhesions to fix ovary to adjacent tissue (usually posterior leaf of broad ligament)</li> </ul>

(continued)

**Table 21.1** (continued)

Year	Classification system	Characteristics
		Stage III (Tubal): 1, right; 2, left; 3, bilateral
		A. No tubal involvement
		B. Superficial endometrial implants on tube that do not exceed 5 mm in diameter and can be removed by scraping or fulguration without great danger of resultant adhesions. Fine, filmy adhesions may be present, which may be lysed without great danger of resultant adhesions
		C. Invasive endometriosis (plaques or endometrioma) >5 mm but <2 cm that requires surgical removal. Fine, filmy adhesions may be present, which may be lysed without great danger of resultant adhesions
		D. Tube involved with adhesions that distort tubal anatomy and/or limit tubal movement. Fimbriae are free and tube is patent. C may be present
		E. Fimbriae are covered by adhesions or distal end of tube is occluded. B, C or D may be present
		Stage IV (Cul-de-sac)
		A. Neither B nor C is present
		B. Invasive endometriosis of bladder or colon
		C. Posterior cul-de-sac obliterated and/or uterus fixed and retroverted. Bowel or adnexa may be adherent to cul-de-sac area. B is usually present

## 21.2 Classification of Superficial Endometriosis

### 21.2.1 *The rASRM Classification*

None of the classifications before 1978 have been widely accepted in the clinical practice, which motivated the American Fertility Society (AFS) to form a panel and introduce a new classification that has been published in 1979 [12]. The first revision was published in 1985 [13] and appeared in its final version in 1996 when the society had changed its name into American Society of Reproductive Medicine [14].

Even though it is called a classification, it rather is a scoresheet, where the peritoneum, the ovaries, the tubes and the cul-de-sac are listed (Fig. 21.1).

The size and depth of lesion corresponds to points, which by analogy are also assigned for adhesions on the ovaries and fallopian tubes as well as points for partial or complete obliteration of the cul-de-sac. A schematic drawing is provided where the localisation of lesions and adhesions can be drafted. The summing up of all points yields in a score, which then allows classifying the endometriosis into four grades of severity: stage I (minimal endometriosis: 1–5 points), stage II (mild endometriosis: 6–15 points), stage III (moderate endometriosis: 16–40 points) and



AMERICAN SOCIETY FOR REPRODUCTIVE MEDICINE  
REVISED CLASSIFICATION OF ENDOMETRIOSIS

Patient's Name \_\_\_\_\_ Date \_\_\_\_\_  
 Stage I (Minimal) - 1-5      Laparoscopy \_\_\_\_\_ Laparotomy \_\_\_\_\_ Photography \_\_\_\_\_  
 Stage II (Mild) - 6-15      Recommended Treatment \_\_\_\_\_  
 Stage III (Moderate) - 16-40  
 Stage IV (Severe) - >40  
 Total \_\_\_\_\_ Prognosis \_\_\_\_\_

PERITONEUM	ENDOMETRIOSIS	<1cm	1-3cm	>3cm
	Superficial	1	2	4
	Deep	2	4	6
OVARY	R Superficial	1	2	4
	Deep	4	16	20
	L Superficial	1	2	4
	Deep	4	16	20
POSTERIOR CULDESAC OBLITERATION		Partial	Complete	
		4	40	
OVARY	ADHESIONS	< 1/3 Enclosure	1/3-2/3 Enclosure	> 2/3 Enclosure
	R Filmy	1	2	4
	Dense	4	8	16
	L Filmy	1	2	4
TUBE	Dense	4	8	16
	R Filmy	1	2	4
	Dense	4	8	16
	L Filmy	1	2	4
	Dense	4	8	16

\*If the fimbriated end of the fallopian tube is completely enclosed, change the point assignment to 16.  
 Denote appearance of superficial implant types as red (R), red, red-pink, flamelike, vesicular blobs, clear vesicles], white (W), opacifications, peritoneal defects, yellow-brown], or black [(B) black, hemosiderin deposits, blue]. Denote percent of total described as R\_\_\_\_%, W\_\_\_\_% and B\_\_\_\_%. Total should equal 100%.

Additional Endometriosis: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

Associated Pathology: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

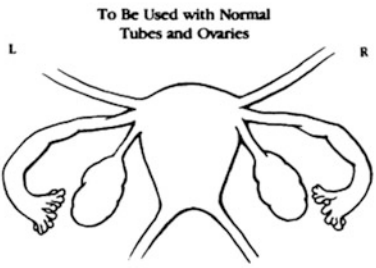
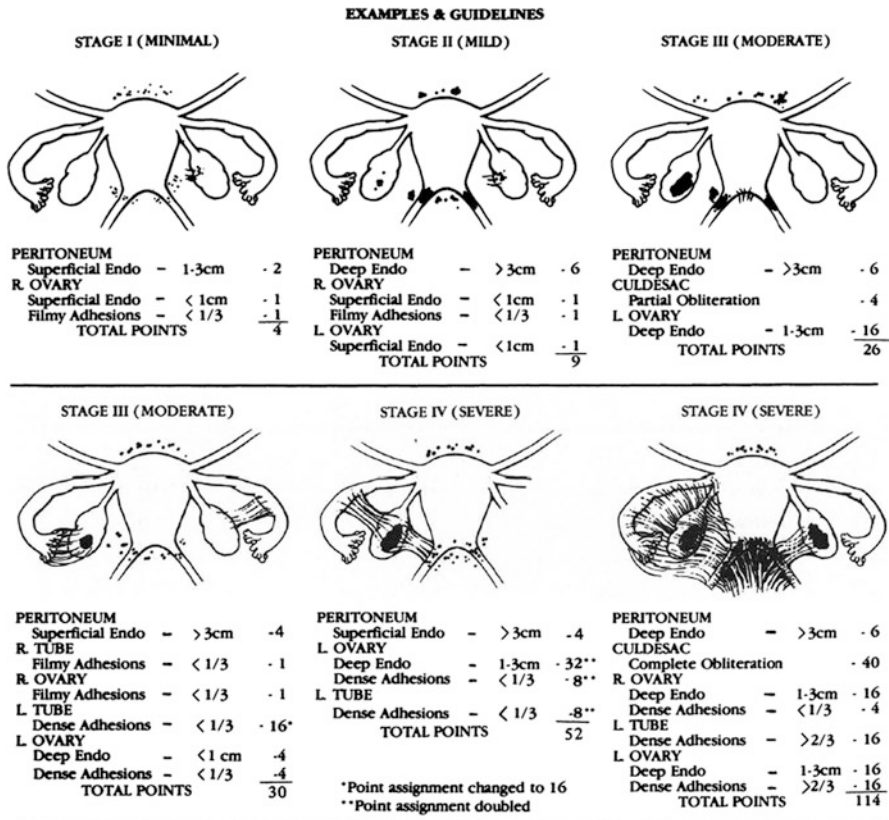


Fig. 21.1 The revised American Society for Reproductive Medicine classification of endometriosis. With permission from Elsevier (Fertility and Sterility, Licence number: 3184950406638)



Determination of the stage or degree of endometrial involvement is based on a weighted point system. Distribution of points has been arbitrarily determined and may require further revision or refinement as knowledge of the disease increases.

To ensure complete evaluation, inspection of the pelvis in a clockwise or counterclockwise fashion is encouraged. Number, size and location of endometrial implants, plaques, endometriomas and/or adhesions are noted. For example, five separate 0.5cm superficial implants on the peritoneum (2.5 cm total) would be assigned 2 points. (The surface of the uterus should be considered peritoneum.) The severity of the endometriosis or adhesions should be assigned the highest score only for peritoneum, ovary, tube or culdesac. For example, a 4cm superficial and a 2cm deep implant of the peritoneum should be given a score of 6 (not 8). A 4cm

deep endometrioma of the ovary associated with more than 3cm of superficial disease should be scored 20 (not 24).

In those patients with only one adenexa, points applied to disease of the remaining tube and ovary should be multiplied by two. \*\*Points assigned may be circled and totaled. Aggregation of points indicates stage of disease (minimal, mild, moderate, or severe).

The presence of endometriosis of the bowel, urinary tract, fallopian tube, vagina, cervix, skin etc., should be documented under "additional endometriosis." Other pathology such as tubal occlusion, leiomyomata, uterine anomaly, etc., should be documented under "associated pathology." All pathology should be depicted as specifically as possible on the sketch of pelvic organs, and means of observation (laparoscopy or laparotomy) should be noted.

Fig. 21.1 (continued)

stage IV (severe endometriosis >40 points). In order to exemplify the different stages of the disease, examples are given which show the mode of scoring and the summing up of points.

The rASRM classification is currently the best known and the most widely used system for clinical and scientific applications throughout the world. Especially with examples given, it is easy to use and the four stages of severity can easily be understood by health professionals as well as by patients.



Unfortunately, this staging system involves a major potential of observer errors and has to be regarded as an arbitrary scoring system. Its reproducibility is limited and it fails to consider the different morphological lesion types (e.g. black or dark bluish lesions, red spots, white opacification, red-flame-like lesions, yellowish patches), as it has been described by Mettler et al. [15]. With respect to correlation to clinical symptoms Vercellini [16] reported a poor correlation between the extent of the disease and pelvic pain and Fujishita [17] a poor correlation between the extent of the disease and infertility. In particular the rASRM classification does not take into account the involvement of reputable structures which in essence means that deep infiltrating endometriosis (DIE) as the most impacting endometriosis is not represented.

Despite the disadvantages of the rASRM classification for classifying endometriosis, it is still widely used as the most popular endometriosis scoring system. It is easy to apply and publications can compare stages of severity.

### ***21.2.2 The Endometriosis Fertility Index***

The most widely used rASRM and Enzian scores (see below) describe properly the anatomical distribution of the respective superficial and deep infiltrating endometriotic lesions and concomitant adhesions, but are not eligible to provide information about the clinical outcome, the pain reduction and the reproductive performance after surgery.

In 2010 Adamson and Pasta analysing the clinical characteristics and reproductive results after surgical intervention of 569 infertile endometriosis patients in the USA in a prospective study, proposed a new staging system, the endometriosis fertility index (EFI) [18]. EFI predicts pregnancy rates in patients with surgically scored endometriosis who attempt non-ART conception. EFI could be regarded as a specifically further developed form of the rASRM classification, focusing on the reproductive outcome, and is not intended to assess the pain symptoms or predict the pain-reducing effect of the surgery.

The EFI score is based on three “surgical factors” and on one “history factor” that are presented in Fig. 21.2.

In the first step the least function (LF) score at conclusion of surgery is defined. LF reflects the predicted function of the fallopian tubes, the fimbriae and the ovaries, each scored from 0 to 4, depending on absent or nonfunctional state, severe dysfunction, moderate dysfunction, mild dysfunction and normal state. Table 21.2 represents the description of least function terms.

The better the function the higher the score. Scores are added and give the least function score. The LF score is completed with the categorised and valued rASRM lesion score as well as the rASRM total score.

The historical factors contribute to age, duration of infertility and history of prior pregnancies. The lower the age, the lower the duration of infertility, and the higher the number of previous pregnancies, the higher the historical score (Fig. 21.2).

## ENDOMETRIOSIS FERTILITY INDEX (EFI) SURGERY FORM

### LEAST FUNCTION (LF) SCORE AT CONCLUSION OF SURGERY

Score	Description	Left	Right
4	= Normal	Fallopian Tube <input style="width: 40px; height: 20px;" type="text"/>	<input style="width: 40px; height: 20px;" type="text"/>
3	= Mild Dysfunction	Fimbria <input style="width: 40px; height: 20px;" type="text"/>	<input style="width: 40px; height: 20px;" type="text"/>
2	= Moderate Dysfunction	Ovary <input style="width: 40px; height: 20px;" type="text"/>	<input style="width: 40px; height: 20px;" type="text"/>
1	= Severe Dysfunction		
0	= Absent or Nonfunctional		

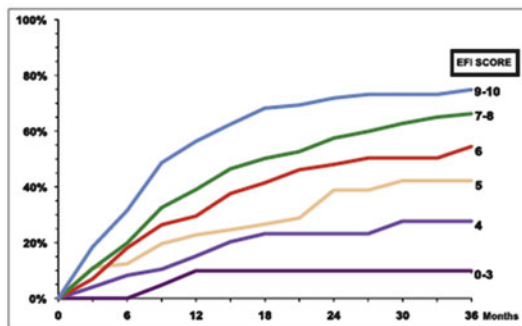
To calculate the LF score, add together the lowest score for the left side and the lowest score for the right side. If an ovary is absent on one side, the LF score is obtained by doubling the lowest score on the side with the ovary.

Lowest Score	Left	+ <input style="width: 40px; height: 20px;" type="text"/>	Right	= <input style="width: 40px; height: 20px; border: 1px dashed black;" type="text"/>	LF Score
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### ENDOMETRIOSIS FERTILITY INDEX (EFI)

Historical Factors			Surgical Factors		
Factor	Description	Points	Factor	Description	Points
<b>Age</b>	If age is ≤ 35 years	2	<b>LF Score</b>	If LF Score = 7 to 8 (high score)	3
	If age is 36 to 39 years	1		If LF Score = 4 to 6 (moderate score)	2
	If age is ≥ 40 years	0		If LF Score = 1 to 3 (low score)	0
<b>Years Infertile</b>	If years infertile is ≤ 3	2	<b>AFS Endometriosis Score</b>	If AFS Endometriosis Lesion Score is < 16	1
	If years infertile is > 3	0		If AFS Endometriosis Lesion Score is ≥ 16	0
<b>Prior Pregnancy</b>	If there is a history of a prior pregnancy	1	<b>AFS Total Score</b>	If AFS total score is < 71	1
	If there is no history of prior pregnancy	0		If AFS total score is ≥ 71	0
<b>Total Historical Factors</b>			<b>Total Surgical Factors</b>		
EFI = TOTAL HISTORICAL FACTORS + TOTAL SURGICAL FACTORS:			<input style="width: 60px; height: 20px;" type="text"/>	+ <input style="width: 60px; height: 20px;" type="text"/>	= <input style="width: 60px; height: 20px;" type="text"/>
			Historical	Surgical	EFI Score

### ESTIMATED PERCENT PREGNANT BY EFI SCORE



**Fig. 21.2** Endometriosis fertility index (EFI). With permission from Elsevier (Fertility and Sterility, licence number: 3184941294427)

The total historical as well as the total surgical scores sum up to a score ranging between 0 and 10, with 0 representing the poorest and 10 the best prognosis. A coloured graph shows the respective estimated percentage of pregnancy likelihood depending on time after surgery and EFI score.

**Table 21.2** Least function terms after Adamson and Pasta [18]

Structure	Dysfunction	Description
Tube	Mild	Slight injury to serosa of the fallopian tube
	Moderate	Moderate injury to serosa or muscularis of the fallopian tube; moderate limitation in mobility
	Severe	Fallopian tube fibrosis or mild/moderate salpingitis isthmica nodosa; severe limitation in mobility
	Nonfunctional	Complete tubal obstruction, extensive fibrosis or salpingitis isthmica nodosa
Fimbria	Mild	Slight injury to fimbria with minimal scarring
	Moderate	Moderate injury to fimbria, with moderate scarring, moderate loss of fimbrial architecture and minimal intrafimbrial fibrosis
	Severe	Severe injury to fimbria, with severe scarring, severe loss of fimbrial architecture and moderate intrafimbrial fibrosis
	Nonfunctional	Severe injury to fimbria, with extensive scarring, complete loss of fimbrial architecture, complete tubal occlusion or hydrosalpinx
Ovary	Mild	Normal or almost normal ovarian size; minimal or mild injury to ovarian serosa
	Moderate	Ovarian size reduced by one-third or more; moderate injury to ovarian surface
	Severe	Ovarian size reduced by two-thirds or more; severe injury to ovarian surface
	Nonfunctional	Ovary absent or completely encased in adhesions

Besides introducing the new EFI score, Adamson has prospectively validated and proven the effectiveness of the new scoring system analysing the predicted and actual reproductive results of 222 North American surgically treated endometriosis patients [18]. Three further external studies, performed in China, France and Belgium, have validated as well the clinical usefulness of the EFI score. In the study of Wei et al., 350 infertile patients were studied retrospectively. Within 3 years after surgery the cumulative pregnancy rates with EFI scores 8, 9 and 10 were 62.5, 69.8 and 81.1 % and with EFI scores 5, 6 and 7, 49.8, 43.9 and 41.6 % respectively, in accordance with the estimated pregnancy rates [19]. A French study of Yacoub et al. investigated in a retrospective study 132 infertile endometriosis patients and found that EFI showed a significant association between the severity of endometriosis, infertility and postoperative cumulative birth rates. However, the rASRM score fall short to predict pregnancies. The authors suggested that the EFI should be the main component in the choice of the postoperative ART management [20].

A further study performed in a Belgian population with 233 infertile endometriosis patients has also validated the effectiveness of the EFI and found the LF score the most important contributor to the total EFI score among all the other variables [21]. The authors concluded that the EFI classification system is a useful tool in counselling infertile endometriosis patients about their reproductive chances after surgery.

## 21.3 Classification of Deep Infiltrating Endometriosis

Several approaches have been published in the literature to classify deep infiltrating endometriosis (<http://www.endometriose-sef.de>) [22–24]. The intention of Chapron et al. was to propose a classification based on where the DIE lesions are located. The deep infiltrating lesions have been divided into two major compartments, anterior (DIE of the bladder) and posterior compartment (DIE of the sacrouterine ligaments, the vagina and intestines) and a subsequent operative procedure has been defined [22]. Another descriptive classification system of Koninckx tried to reflect all the possible manifestation and severity of endometriosis, classifying the so-called subtle, typical, cystic, deep and adenomyotic lesions [23]. In the meantime the group of German-speaking gynaecologist has developed a classification system, called Enzian, with the intention to describe deep infiltrating lesions in those compartments where the appropriate surgical removal can be performed.

### 21.3.1 *The Enzian Classification*

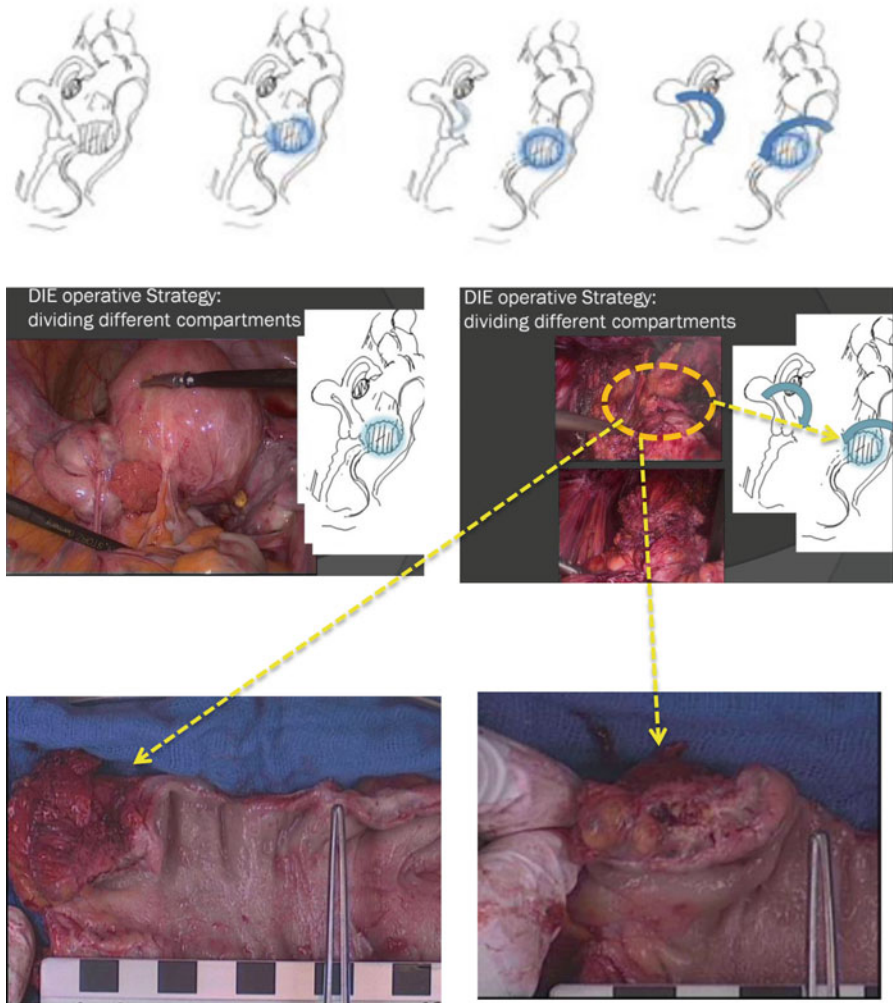
In 2005 Tuttlies et al. [24] published the Enzian classification, which has been revised in 2010 and 2011. The latest version was published in 2012 at the homepage of the SEF (“Stiftung für Endometriose-Forschung”) (<http://www.endometriose-sef.de>).

The Enzian classification is exclusively devoted to describe deep infiltrating endometriosis and is supposed to be used additionally with the rASRM classification. Enzian is not an acronym or abbreviation for endometriosis issues but refers to a beautiful blue-coloured flower and also to the name of a hotel in the Alpes, where a group of Austrian and German experts since 2002 annually meet under the patronage of the SEF in order to discuss endometriosis-related problems.

The development of this classification followed in the early versions the master model of the TNM classification for cervical cancer inspired by the fact that deep infiltrating endometriosis shows significant characteristics of a malignant tumour, like crossing organ boundaries and likely infiltrating adjacent structures like bladder, ureter or intestines.

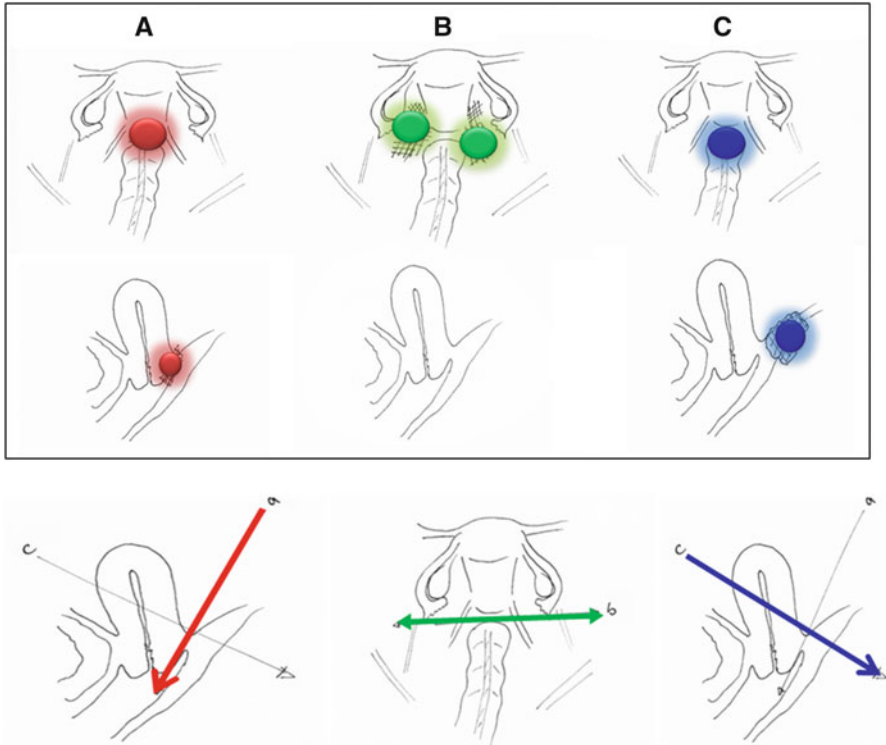
When comparing the rASRM classification, which has been established over decades, with the Enzian classification, the list of common sites demonstrates only little overlapping. The Enzian classification was designed to describe exclusively deep infiltrating endometriosis, which means that it is limited to a special, but challenging, clinically relevant situation. The Enzian classification is based on different topographic areas following a surgical way of separation of involved anatomic structures.

There are two main subclasses introduced to describe the clinical presentation of deep infiltrating endometriosis. On the one hand there is a group of three topographic relevant compartments in the posterior pelvis and on the other hand there



**Fig. 21.3** Example for surgical route for successful separation of compartments A and C. Segmental rectum resection of two transmural infiltrative endometriotic lesions of 4 and 2 cm, respectively, Enzian C3 FI Sigma

is a group of different typical endometriotic infiltrations in distant organ sites. The three pelvic compartments of the Enzian classification describe the topographic anatomy of the pelvis. Successful and secure performance of surgical procedures is based on the initial separation and demonstration of the relevant anatomic structures which are involved (Fig. 21.3); in other words, the anatomical compartments for the Enzian classification follow the surgical procedure lining up the structures that are equally involved in typical presentation of typical DIE. Radical surgery for the management of DIE depends on initial reconstruction of the anatomy.

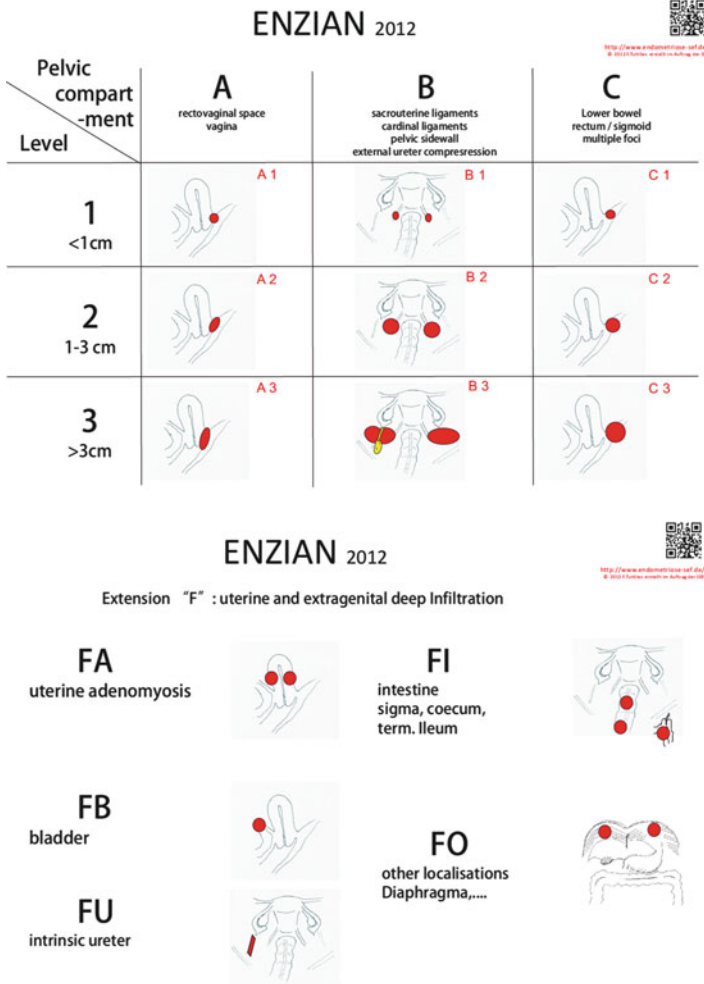


**Fig. 21.4** The Enzian compartments A, B and C

The three posterior pelvic compartments were entitled “A, B and C” (Fig. 21.4) and embrace the pelvic manifestation of deep infiltrating endometriosis including the rectovaginal space, the vagina, the rectum and also the sacrouterine ligament with the pelvic sidewall.

The second group with the capital letter F (“far”) was designed to add important information about the location of infiltrative endometriosis, which is not directly involved to the pelvic site or distant from the cardinal posterior compartments of the pelvis as described above. Only important and typical presentations of DIE are listed, such as infiltration of the bladder, intrinsic ureter endometriosis, adenomyosis as infiltration of the uterus and distant bowel infiltration.

Compartment A (signed with red colour) includes the rectovaginal space from the pouch of Douglas along a longitudinal direction downwards to the vagina. Compartment B (signed with green colour) follows a horizontal line divided in a left and a right part starting from the sacrouterine ligament; further lateral obstructions like the external ureter compression as well as the involvement of the cardinal ligament up to the pelvic sidewall are included. Involvement of the splanchnic nerves may also be an important issue in extended pelvic sidewall infiltration. Compartment C (signed with blue colour) describes the dimension of rectal



**Fig. 21.5** The Enzian classification system

infiltration with respect to histological confirmation of muscular layer infiltration as an indispensable prerequisite.

Multiple bowel infiltrations are summarised under the description Enzian “FI” (far intestine) with a topographic information, for example, “FI Sigma” or “FI terminal ileum”.

The three pelvic compartments A, B and C are subjected to a consistent metric level system; 1 indicates that the lesions are less than 1 cm, 2 indicates between 1 and 3 cm and 3 over 3 cm (Fig. 21.5). The metric system classifies the dimension of the infiltration in each compartment.

The presence of adenomyosis is classified as FA (far adenomyosis), the transmural infiltration of the bladder wall as FB (far bladder) and the very rare

presentation of intrinsic ureter endometriosis as FU (far ureter). The latter has to be distinguished from the more common extrinsic obstruction of the ureter, which would appear in the B3 group of the Enzian classification.

The Enzian classification of DIE is expressed as a multiple string code of the involved compartments starting with the initial Enzian letters. The involved compartments A, B and C are added with the appropriate metric level 1, 2 or 3, followed by the F subgroup. The complexity of the disease can be easily expressed by using an abstract code summarising the involved anatomical structures. The description of the more complex disease will result in an accordingly longer string.

An example of string may look like the following: *Enzian: A2, B3, C3, FA, FB, FI Sigma*, which means deep infiltrating endometriosis of the vagina 1–3 cm, ureter compression on one side by extrinsic endometriosis with dilatation of the urinating system above the obstruction, bowel infiltration of the rectum more than 3 cm, additional adenomyosis, infiltration of the bladder wall and bowel infiltration in the sigma.

With reference to the rASRM score peritoneal superficial endometriosis or the involvement of the fallopian tube-ovarian unit had been excluded from the Enzian scoring system and fertility aspects should be scored using the endometriosis fertility index (EFI). It is the distinguished purpose of the Enzian classification to describe the topographic manifestation of DIE and the size and extent of organ destruction; it is an easy-to-use system following an empiric pathway essential for a successful radical surgery.

## **21.4 Magnetic Resonance Imaging of Endometriosis (MARIE): Classification**

Of uppermost importance for the imaging of patients suffering from deep infiltrating endometriosis is the detection and description of all manifestations of endometriosis in order to provide a reliable roadmap for surgical and conservative therapy. MRI has been established for diagnostic and pretherapeutic imaging of patients suspected to suffer from endometriosis [25]. Inherent to the method in contrast to ultrasound, clinical examination or laparoscopy, which offers only a limited field of view, spaces of the pelvis are equally accessible. For complete diagnostic evaluation of all pelvic spaces including the rectum, retrocervical space and vaginal fornices, careful preparation of the patient is indispensable [26]. For most scanning protocols 50 mL aqueous gel (ultrasound gel) is administered intravaginally (for distension of the vaginal cavity, assessment of the retrocervical area and vaginal fornices) and 150–200 mL water is administered into the rectum to obtain distension and increase contrast between bowel wall and lumen. Scopolamine-*N*-butyl bromide is intravenously injected immediately prior to MRI in order to reduce bowel movements and contractions of the uterus [27]. The bladder should be filled



moderately, rendering the evaluation of the bladder wall possible. A reliable possibility to obtain moderate filling of the bladder is to ask patients not to empty the bladder one hour prior to scanning.

T2-weighted images in axial, sagittal and coronal orientation obtained with high resolution are crucial for the delineation of endometriotic lesions. T1-weighted 3D sequences with fat suppression are obtained prior and after intravenous injection of a gadolinium chelate contrast medium. On T1-weighted images obtained prior to the administration of contrast medium methaemoglobin appears with high signal intensity (bright). Methaemoglobin will be present in endometriosis 3 days up to 4 weeks after bleeding. Thereafter it is degraded into hemosiderin, which has low signal intensity on T1-weighted MR images. Fibrous components of endometriomas appear with low signal intensity on T2-weighted images and may enhance after the injection of contrast medium, depending on the size of the extracellular space in the lesions. Inflammatory lesions are also dark on T2-weighted images but strongly enhance after the injection of contrast medium on T1-weighted sequences. Endometriomas which do not contain predominantly blood or degraded blood components appear dark on T2-weighted sequences [25].

The involvement of the different anatomical structures in the pelvis has an unequal impact regarding fertility, physiologic function and required operative technique. Consequently a classification system for MRI should take these differences into account, and weighting of endometriotic lesions in different locations should be different regarding fertility and physiologic function (Table 21.3) [28]. In order to completely assess all present lesions, the compartments of the pelvis must be assessed in a systematic order. A structured report of a comprehensive MR scan for the detection of endometriosis should start with the description of site of lesions in the respective compartments, size of the lesion and structures involved. In the anterior compartment the bladder, vesicouterine pouch and vesicovaginal septum can be affected. The urethra is only rarely involved. Endometriosis of the anterior compartment usually does not cause infertility. Thus weighting regarding infertility is low (Table 21.3). On the other hand, the involvement of the urethra or bladder requires technically demanding operative strategies, so that weighting factor for structure is relatively high. The middle compartment contains the vagina, uterus, ovaries and uterine ligaments. The middle compartment is the most common site of endometriomas and the involvement of its structures often leads to infertility. This is mirrored in high scores regarding fertility for the respective anatomical structures of the middle compartment.

The rectovaginal pouch, uterosacral ligaments, posterior vaginal fornix and rectum are located in the posterior compartment. Most endometriotic lesions are located in the cul-de-sac [27]. The rectosigmoid is the most commonly affected part of the bowel. The involvement of the bowel requires technical demanding operation strategies and has a high impact on function, while fertility is rarely affected. Adhesions on the other hand might overlap the compartments and potentially have a high impact on fertility, depending on the structures involved.

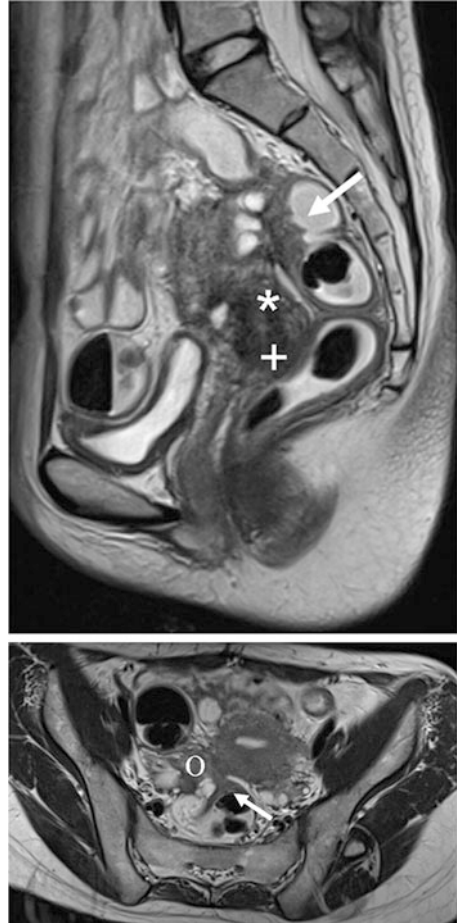
For performing the MARIE classification, the three compartments are systematically assessed for endometriosis, lesion location is described and the size of

**Table 21.3** Scoring system for MARIE classification

	≤1	1–2 cm	>2 cm
<i>Anterior compartment</i>			
Bladder	2 s	3 s	4 s
Vesicouterine pouch	0.5 s	1 s	1.5 s
Vesicovaginal septum	1 s	1.5 s	2 s
Urethra	3 s	4 s	5 s
<i>Middle compartment</i>			
Ovary (unilateral)	1 f	2 f	3 f
Ovaries bilateral, second side (value must be added to that of the first side)	3 f	4 f	5 f
Fallopian tube (unilateral)	4 f	4.5 f	5 f
Fallopian tubes, bilateral, second side (value must be added to that of first side)	7 f	8 f	9 f
Uterus (surface)	0.5 f	1 f	1.5 f
Vagina	0.5 s	1 s	1.5 s
<i>Posterior compartment</i>			
Rectovaginal septum	0.5 s	1 s	1.5 s
Cul-de-sac	1 s	2 s	3 s
Cul-de-sac and rectum	2 s	3 s	4 s
Rectum/sigmoid	3 s	4 s	5 s
Uterosacral ligament unilateral	1/0.5 s/f	2/1 s/f	3/1.5 s/f
Uterosacral ligament bilateral	1.5/1 s/f	2.5/1.5 s/f	3.5/2 s/f
<i>Other</i>			
Adhesions between bowel and ovaries/fallopian tubes	3/4 s/f	4/5 s/f	5/6 s/f
Adhesions between both ovaries	1/4 s/f	1.5/5 s/f	2/6 s/f
Adhesions between bowel and uterus	2/2 s/f	2.5/2.5 s/f	3/3 s/f
Adhesions without involvement of uterus, ovaries and fallopian tubes	2.5 s	3 s	3.5 s
Lesions outside the compartment of the pelvis but in pelvic region, except subcutaneous	2 s	3 s	4 s
Subcutaneous lesions, fascia not penetrated	0.5 s	1 s	1.5 s
Sciatic nerve	3 s	4 s	5 s
	Points	Class fertility	Class structures
<i>MARIE classification</i>			
	0.5–2	MARIE 1 f	MARIE 1 s
	2.5–6.5	MARIE 2 f	MARIE 2 s
	>7	MARIE 3 f	MARIE 3 s

lesions is measured. Points are added separately for *f* (fertility) and *s* (structures) according to Table 21.3 (Fig. 21.6 represents an example of MRI classification of a 28-year-old patient with deep infiltrating endometriosis). In cases of bilateral involvement (i.e. ovaries or fallopian tubes), first the more severely affected side is rated followed by the side with the smaller lesion. According to Table 21.3 MARIE classification for *f* and *e* values is assigned following the scheme MARIE × *f* × *s*.

**Fig. 21.6** Sagittal and axial T2-weighted images of a 28-year-old patient with deep infiltrating endometriosis. Lesions of both ovaries (right ovary diameter 3 cm, score 3f, left ovary 2 cm, score 4f), adhesion between right ovary and rectum with a diameter of 1.5 cm (score 4 s, 5f) lesion of the spatium rectovaginale (diameter 2 cm, score 1 s) and cul-de-sac (diameter 4 cm, score 3 s) are present (scores summing up to 12 f 8 s), resulting in MARIE 3 f 3 s



## 21.5 Discussion

Even though many classifications as well as scoring systems have been proposed since the first mentioning of endometriosis as a disease entity, no widespread agreement on a classification for endometriosis is obtained. This review describes four examples in more detail. The rASRM classification differentiates endometriosis in minimal, mild, moderate and severe stages and provides a score that includes superficial endometriotic implants as well as adhesions. The assignment of points according to the clinical situation was not developed on the basis of empirical data, but based on theoretical background and estimations. In case of a superficial non-infiltrating endometriosis, which is only manifested on the peritoneal surface, this scoring system including a graph makes a lot of sense; however, any sub- and retroperitoneal deep infiltrating manifestation is not considered with the rASRM classification. The most commonly used classification system to describe deep

infiltrating endometriosis is the Enzian string code, which is used additionally to the rASRM. In addition to the rASRM and Enzian classification Hackethal et al. [29] showed that even in stage 1 endometriosis (rASRM classification) 25 % of those patients were suffering from deep infiltrating endometriosis. Even though this is in accordance with the initial aim of the rASRM classification omitting DIE can lead to a marked misjudgement of the impact of the disease and necessary treatment [30]. Since the EFI is a specific further development of the rASRM classification, DIE with no peritoneal, ovarian or tubal infiltration would not have been reflected in the EFI score; however it could be responsible for infertility. This would apply to DIE of the rectovaginal space as well as adenomyosis. However, only limited data are available on the impact of such manifestations of DIE on fertility. Therefore, the EFI will likely not be suitable to fully reflect the impact of different locations and manifestations of endometriosis on fertility. It is probably because of this reason that EFI gives major importance on historical factors as it is very well known that the duration of infertility, age of a patient and prior history of pregnancies are extremely strong predictors.

Haas et al. [31] compared the rASRM classification with the Enzian classification. They clearly concluded that the Enzian classification is a clear supplement to the rASRM classification with regard to the description of the manifestations of DIE. They found an overlapping of description, especially in peritoneal disease of the pouch of Douglas or cul-de-sac, which could be repetitive in the Enzian classification as well as in rASRM classification.

The development of a radiological classification system is extremely useful in the preparation of the surgical procedure and counselling patients preoperatively about the required surgical steps. It has to be kept in mind that endometriosis surgery is almost never easy and straightforward. A presurgical adequate classification of disease can potentially improve patients' outcome by the organisation of multidisciplinary surgical teams or referral of patients to specialised surgical endometriosis centres.

Unfortunately there is no ideal classification of endometriosis at the moment that would be able to reflect all the aspects of endometriosis, the pathogenesis, anatomical distribution, clinical manifestation, progression and recurrence. The way to define the perfect classification system is long and lots of basic research as well as well-conducted clinical trials in a large multicentre set-up are needed to better understand the clinical nature of the disease and develop a classification system, which encompass all these aspects.

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