Review Article

Deep Infiltrating Endometriosis: Magnetic Resonance Imaging Diagnosis and Surgical Correlation

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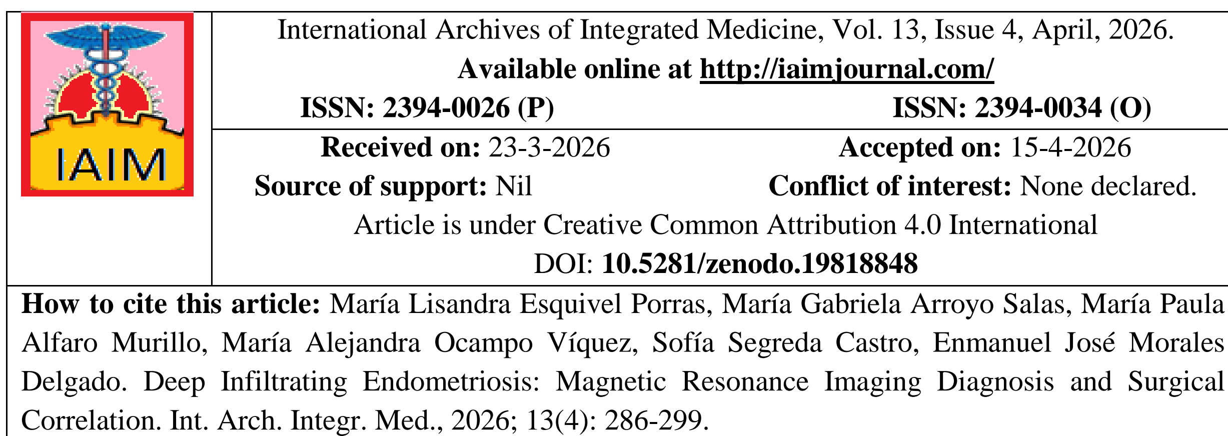
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Abstract

Deep infiltrating endometriosis is a severe form of endometriosis characterized by the presence of ectopic endometrial tissue that penetrates deeply into pelvic structures and is associated with significant fibrosis. Its pathophysiology involves multiple mechanisms, including retrograde menstruation, coelomic metaplasia, and lymphovascular spread, followed by a fibrotic response mediated by myofibroblasts and transforming growth factor-β. Hormonal dependence on estrogen and a chronic inflammatory microenvironment further promote lesion persistence and progression. The disease commonly affects the uterosacral ligaments, rectovaginal septum, rectosigmoid colon, and urinary tract, often presenting in a multifocal distribution that complicates both diagnosis and management. Clinically, deep infiltrating endometriosis manifests with chronic pelvic pain, dysmenorrhea, dyspareunia, dyschezia, and, in some cases, dysuria. However, symptoms are often

non-specific, and physical examination is frequently insufficient for accurate diagnosis. Imaging therefore plays a central role, with transvaginal ultrasound serving as the first-line modality and magnetic resonance imaging providing a more comprehensive assessment when further evaluation is required. Magnetic resonance imaging is essential for lesion characterization and mapping, demonstrating typical findings such as hypointense fibrotic nodules on T2-weighted sequences and hyperintense hemorrhagic foci on T1-weighted images. A compartment-based approach enhances diagnostic accuracy and facilitates correlation with surgical findings. Magnetic resonance imaging also plays a key role in preoperative planning by predicting lesion extent, depth of infiltration, and involvement of critical structures such as the bowel and ureters. Despite its limitations, including reduced sensitivity for small lesions and operator dependency, magnetic resonance imaging remains a cornerstone in the management of deep infiltrating endometriosis, improving diagnostic precision, guiding surgical strategy, and optimizing patient outcomes.

Key words

Deep infiltrating endometriosis, magnetic resonance imaging, pelvic pain, fibrosis, surgical correlation, compartment-based analysis.

Introduction

Endometriosis affects approximately 10% of women of reproductive age, and deep infiltrating endometriosis represents one of its most severe forms. Despite its clinical significance, this entity is frequently underdiagnosed, particularly in adolescent populations, where diagnostic limitations and the underestimation of symptoms contribute to delayed recognition. Although the exact prevalence of deep infiltrating endometriosis in adolescents remains poorly defined, the importance of early diagnosis and timely intervention is well established, as these measures are essential to prevent disease progression and to improve long-term quality of life outcomes [1].

From a clinical perspective, deep infiltrating endometriosis is strongly associated with a significant symptom burden, predominantly characterized by chronic pelvic pain, dysmenorrhea, and dyspareunia. These manifestations have a profound impact on daily functioning and overall quality of life, often leading to considerable physical and psychological distress [2]. In addition to pain, infertility represents a major concern in this population. Spontaneous fertility rates in women with deep infiltrating endometriosis have been reported to range between 2% and 10%, highlighting the reproductive implications of the disease. In this context, surgical intervention has demonstrated a beneficial role, with studies reporting a mean postoperative pregnancy rate of 52.6%, suggesting a significant improvement in reproductive outcomes following appropriate management [3]. Consequently, both pain control and fertility enhancement constitute central objectives in the management of deep infiltrating endometriosis, with evidence indicating that surgical resection combined with adhesion prevention strategies can lead to substantial reductions in pain and increased pregnancy rates [4].

Given the complexity and anatomical variability of deep infiltrating endometriosis, accurate preoperative evaluation is essential. Imaging modalities such as transvaginal ultrasound and magnetic resonance imaging play a fundamental role in the diagnostic process, as they provide detailed information regarding lesion location, depth of infiltration, and extent of disease, all of which are critical for adequate surgical planning. Among these techniques, magnetic resonance imaging offers a comprehensive assessment of the pelvic region, enabling the identification of extrapelvic involvement and facilitating the evaluation of potential malignant transformation

when suspected [5, 6]. Furthermore, the integration of imaging findings with intraoperative observations has been enhanced through classification systems such as the #Enzian classification, which combines magnetic resonance imaging data with surgical descriptions to improve diagnostic accuracy and optimize treatment planning in patients with deep infiltrating endometriosis [7].

The objective of this article is to analyze the role of magnetic resonance imaging in the diagnosis of deep infiltrating endometriosis and to evaluate its correlation with surgical findings, with the aim of improving diagnostic accuracy, optimizing preoperative planning, and enhancing clinical outcomes related to pain management and fertility.

Methodology

This manuscript was developed as a structured narrative review aimed at providing an updated and clinically integrated analysis of deep infiltrating endometriosis, with particular emphasis on magnetic resonance imaging findings and their correlation with surgical observations. The review was conducted in accordance with the SANRA (Scale for the Assessment of Narrative Review Articles) framework and followed a predefined methodological protocol established prior to literature screening. Given the marked heterogeneity in lesion distribution, symptom severity, imaging interpretation, and surgical presentation, a narrative interpretative synthesis was selected over quantitative pooling in order to integrate radiologic, gynecologic, and operative perspectives into a coherent and clinically applicable framework. Special attention was given to the diagnostic performance of magnetic resonance imaging, the value of compartment-based lesion mapping, the identification of multifocal and extrapelvic disease, and the concordance between preoperative imaging findings and intraoperative assessment. The objective was to provide a structured synthesis capable of supporting diagnostic accuracy, preoperative planning, and multidisciplinary decision-making in patients with deep infiltrating endometriosis.

A comprehensive literature search was conducted in PubMed, Scopus, and Web of Science, including peer-reviewed articles published in English or Spanish between January 2020 and March 2026. The final search was performed in March 2026. This timeframe was selected to capture contemporary advances in pelvic magnetic resonance imaging protocols, compartment-based classification systems, preoperative imaging assessment, and surgical management of deep infiltrating endometriosis. Foundational studies were incorporated when necessary to contextualize disease classification, anatomical distribution, and the evolution of imaging-based diagnostic approaches. The search strategy combined Medical Subject Headings and free-text terms using Boolean operators related to deep infiltrating endometriosis, endometriosis, magnetic resonance imaging, pelvic MRI, transvaginal ultrasound, surgical correlation, laparoscopy, #Enzian classification, bowel endometriosis, urinary tract endometriosis, rectovaginal endometriosis, lesion mapping, and preoperative planning. Searches were conducted in titles and abstracts as well as indexed subject headings to maximize sensitivity.

The initial search yielded 154 records. After removal of duplicates, 120 articles remained for title and abstract screening. Of these, 72 underwent full-text evaluation, and 30 studies were included in the final synthesis. Selection was performed independently by two authors, with disagreements resolved through discussion and consensus. Exclusion criteria comprised non-peer-reviewed publications, isolated case reports, editorials without original diagnostic or surgical data, purely technical imaging descriptions without clinical correlation, redundant datasets, and studies not directly addressing magnetic resonance imaging findings, surgical confirmation, or the diagnostic evaluation of deep infiltrating endometriosis.

Eligible studies included prospective and retrospective observational studies, diagnostic accuracy studies, systematic reviews, meta-analyses, expert consensus statements, and contemporary international guidelines from gynecology, radiology, and endometriosis societies. Priority was assigned to multicenter investigations, studies using standardized imaging terminology or compartment-based classification systems, and research evaluating lesion detection, anatomical concordance, disease extent, and implications for surgical planning. Extracted variables included study design, sample size, patient population, lesion location, magnetic resonance imaging protocol, compartment involvement, classification system used when applicable, surgical findings, diagnostic performance measures, and reported agreement between imaging and operative assessment. Methodological quality and internal validity were assessed narratively, considering risk of bias, sample size, imaging standardization, surgical reference standards, interobserver reproducibility, and consistency of reported outcomes. In cases of conflicting evidence, greater interpretative weight was assigned to higher-level evidence and guideline-supported recommendations.

Reference lists of included studies were manually screened to identify additional relevant publications. Given its narrative design, this review is subject to potential selection bias and does not provide pooled quantitative estimates. Artificial intelligence-based tools were used exclusively to assist in literature organization and structural coherence, whereas critical appraisal, synthesis, and final interpretation were conducted independently by the authors to preserve methodological rigor.

Pathophysiology and Anatomical Distribution

The pathophysiology of deep infiltrating endometriosis involves complex mechanisms that explain both the ectopic implantation of endometrial tissue and the subsequent development of fibrosis. Several theories have been proposed to account for the presence of endometrial tissue outside the uterine cavity, including retrograde menstruation, coelomic metaplasia, and lymphovascular dissemination, all of which contribute to the establishment of ectopic lesions [8]. Once implanted, these lesions undergo progressive structural and molecular changes, with fibrosis emerging as a defining feature of the disease. This process is driven by the activation of myofibroblasts and the excessive deposition of extracellular matrix components, resulting in a dense and stiff microenvironment. Transforming growth factor-β plays a central role in promoting this fibrotic response, further contributing to lesion persistence and tissue remodeling [9]. The fibrotic nature of these lesions is clinically relevant, as it not only contributes to chronic pain but also increases the complexity of surgical management [10].

These structural changes are closely influenced by both hormonal and inflammatory factors, which together sustain disease activity. Endometriotic lesions are strongly estrogen-dependent, with local production of estradiol mediated by increased aromatase activity within the lesions themselves. This hormonal milieu promotes cellular proliferation and perpetuates inflammatory signaling, thereby supporting lesion growth and maintenance [11]. In parallel, chronic inflammation plays a critical role in disease progression. The persistent presence of immune cells and the release of pro-inflammatory cytokines contribute to a self-sustaining cycle that enhances lesion survival, promotes fibrosis, and exacerbates symptom severity [8, 9].

From an anatomical perspective, deep infiltrating endometriosis demonstrates a predilection for specific pelvic structures. The uterosacral ligaments are among the most frequently involved sites, often harboring fibrotic nodules that can be accurately detected using transvaginal ultrasound. Similarly, the rectovaginal septum

and posterior vaginal fornix are commonly affected, with imaging modalities demonstrating high sensitivity and specificity in identifying lesions in these regions [12]. The bowel, particularly the rectosigmoid colon, represents another major site of involvement and is often associated with gastrointestinal symptoms, requiring meticulous imaging evaluation and careful surgical planning. In addition, the urinary tract may be affected, with infiltration of the bladder and ureters leading to urinary symptoms and potential complications if not promptly identified [13].

A notable characteristic of deep infiltrating endometriosis is its tendency toward multifocal disease. Lesions frequently occur simultaneously in multiple pelvic compartments, which significantly complicates both diagnosis and management. The presence of disease in one anatomical location, such as the uterosacral ligaments, is strongly associated with concurrent involvement of other sites, including the rectosigmoid colon [12]. Although less common, extragenital extension can also occur, further emphasizing the need for comprehensive imaging assessment. This multifocal and occasionally extrapelvic distribution underscores the importance of a systematic and thorough diagnostic approach to ensure accurate mapping of disease extent and optimal therapeutic planning [13].

Clinical Presentation and Indications for Imaging

Deep infiltrating endometriosis is characterized by a broad and often debilitating clinical presentation, with symptoms that significantly impact patients' quality of life. Among these, chronic pelvic pain and dysmenorrhea represent the most common manifestations, frequently leading to persistent discomfort and functional limitation in affected individuals [1, 14]. In addition to these symptoms, dyspareunia and dyschezia are commonly reported, reflecting the involvement of deeper pelvic structures such as the rectovaginal septum and bowel, and further contributing to the overall symptom burden [15]. Dysuria may also occur, particularly in cases where the urinary tract, including the bladder or ureters, is affected, highlighting the variable anatomical distribution of the disease and its corresponding clinical implications [14].

Despite this symptomatic profile, physical examination findings are often limited in their diagnostic utility. Although pelvic tenderness may be detected during examination, this finding is non-specific and does not reliably distinguish deep infiltrating endometriosis from other gynecological conditions [15]. Furthermore, the deep location and multifocal nature of the lesions frequently preclude adequate detection through physical examination alone, making it an insufficient standalone tool for diagnosis [1]. These limitations are compounded by the non-specific nature of symptoms, which often overlap with other pelvic pathologies, thereby complicating clinical assessment and contributing to delays in diagnosis [14].

Given these challenges, imaging plays a central role in the diagnostic pathway. The inability of clinical evaluation to accurately identify deep or small lesions underscores the importance of advanced imaging modalities for definitive assessment. Transvaginal ultrasound is typically employed as the first-line imaging technique due to its accessibility, cost-effectiveness, and capacity to perform dynamic maneuvers that aid in the evaluation of adhesions and organ mobility. It is particularly useful in assessing the depth of bowel wall invasion and provides high spatial resolution for certain pelvic structures [6, 14].

However, magnetic resonance imaging is recommended in specific clinical scenarios, including cases in which transvaginal ultrasound findings are inconclusive or negative despite persistent symptoms, as well as in preoperative evaluation or when symptoms continue after treatment. Magnetic resonance imaging offers a comprehensive assessment of the pelvis,

allowing for detailed evaluation of all pelvic compartments and facilitating the identification of extrapelvic disease involvement and features suggestive of malignancy [6, 16, 17]. This global perspective enhances pre-surgical planning and supports effective multidisciplinary communication, thereby improving overall management strategies in patients with deep infiltrating endometriosis [17, 18].

MRI Technique and Protocol Optimization

Adequate patient preparation is a fundamental step in optimizing magnetic resonance imaging for the evaluation of deep infiltrating endometriosis, as it directly influences image quality and diagnostic accuracy. Bowel preparation is commonly recommended to reduce artifacts and improve the visualization of pelvic structures, particularly those located in the posterior compartment. This preparation can be achieved through fasting and the administration of bowel-cleansing agents, which help minimize luminal contents and facilitate clearer delineation of adjacent tissues. In addition, the use of antiperistaltic agents plays a critical role in reducing bowel motility during image acquisition, thereby decreasing motion-related artifacts and enhancing overall image clarity [16].

Following appropriate preparation, the selection of imaging sequences is essential for comprehensive lesion characterization. T2-weighted imaging, performed in multiple planes, constitutes the cornerstone of magnetic resonance evaluation in this context. These sequences are particularly effective in depicting the fibrotic and stromal components of endometriotic lesions, which typically appear as hypointense areas. Multiplanar acquisition allows for a detailed assessment of lesion distribution across different pelvic compartments, thereby improving detection and anatomical localization [6, 16]. Complementarily, T1-weighted sequences, both with and without fat suppression, are crucial for identifying hemorrhagic components, which manifest as areas of high signal intensity. The addition of fat suppression enhances diagnostic specificity by distinguishing hemorrhagic foci from surrounding adipose tissue [19].

Although not routinely required in all cases, contrast-enhanced sequences may provide additional value in selected scenarios. These sequences can assist in differentiating endometriotic lesions from other pelvic pathologies and in evaluating lesion vascularity, particularly when there is diagnostic uncertainty or suspicion of alternative diagnoses [20].

Beyond sequence selection, several technical considerations are critical for optimal lesion detection. A compartment-based approach to image analysis, supported by the use of standardized reporting terminology, enhances diagnostic consistency and facilitates effective communication among clinicians involved in patient management [18]. Furthermore, the use of high-resolution imaging techniques improves the detection of small or subtle lesions and provides detailed anatomical information, which is essential for accurate preoperative planning [5]. Advanced imaging modalities, such as diffusion-weighted imaging, can further complement conventional sequences by offering additional insight into lesion characteristics and potential treatment response, thereby contributing to a more comprehensive evaluation of deep infiltrating endometriosis [19].

MRI Findings in Deep Infiltrating Endometriosis

Magnetic resonance imaging plays a central role in the characterization of deep infiltrating endometriosis, with specific signal features that allow for accurate identification and differentiation from other pelvic pathologies. One of the most characteristic findings is the presence of hypointense nodules on T2-weighted sequences, which reflect the dense fibrotic component surrounding ectopic endometrial glands. This low signal intensity is a key

diagnostic feature and contributes significantly to distinguishing deep infiltrating endometriosis from other lesions that may present with higher signal intensity on T2-weighted imaging [21, 22]. In addition to this fibrotic component, hemorrhagic foci within the lesions are commonly observed and appear as areas of high signal intensity on T1-weighted sequences. These hyperintense foci are indicative of cyclical bleeding associated with ectopic endometrial tissue and enhance the specificity of magnetic resonance imaging in confirming the diagnosis [6].

Beyond signal characteristics, deep infiltrating endometriosis demonstrates distinct morphological patterns that reflect its invasive behavior. Lesions may present as nodular or plaque-like structures, frequently exhibiting a retractile appearance as a consequence of progressive fibrosis. This retractile nature contributes to tissue distortion and is indicative of the chronic and infiltrative course of the disease [17, 18]. In more advanced cases, magnetic resonance imaging can reveal adhesions and significant distortion of pelvic anatomy, findings that are particularly relevant for surgical planning. These alterations not only indicate the extent of disease involvement but also provide insight into potential technical challenges that may arise during operative management [17, 23].

The evaluation of deep infiltrating endometriosis also requires careful assessment of organ-specific involvement, as the disease frequently extends beyond isolated lesions to affect multiple pelvic structures. The bowel, especially the rectosigmoid colon, is one of the most commonly involved sites. In this context, magnetic resonance imaging may demonstrate bowel wall thickening along with the characteristic "mushroom cap sign," which reflects serosal infiltration and is essential for determining the depth of invasion. Similarly, involvement of the urinary tract can be identified through the presence of nodular or plaque-like lesions on the bladder dome, which are critical findings for assessing the extent of disease and guiding surgical decision-making [5, 16]. Ureteral involvement represents another important manifestation, as it may lead to obstruction and subsequent hydronephrosis. The identification of such complications on magnetic resonance imaging is crucial, as it allows for timely intervention and helps prevent long-term renal damage [17, 18].

Compartment-Based MRI Assessment

A compartment-based approach to magnetic resonance imaging evaluation is essential for the accurate assessment of deep infiltrating endometriosis, as it allows for systematic lesion mapping and facilitates correlation with surgical findings. In the posterior compartment, the rectosigmoid colon and rectovaginal septum represent key areas of involvement. Magnetic resonance imaging has demonstrated high diagnostic performance in detecting rectal and rectosigmoid disease, with a reported sensitivity of 86% and specificity of 96% [24]. A detailed evaluation includes the identification of the number of nodules, their longitudinal extent, and their distance from the anal verge, all of which are critical parameters for planning colorectal surgical interventions [16]. Similarly, the rectovaginal septum is a frequent site of disease involvement, where magnetic resonance imaging enables the detection of nodular lesions and supports decision-making regarding the need for surgical resection [18].

In the middle compartment, magnetic resonance imaging provides a comprehensive assessment of the uterus, ovaries, and supporting ligaments, which is fundamental for understanding disease distribution and guiding surgical management. Evaluation of the uterus and its associated ligaments allows for the identification of infiltrative lesions that may contribute to pain and anatomical distortion [17]. Ovarian involvement is also common, with magnetic resonance imaging playing a key role in detecting endometriomas and assessing their

relationship with adjacent pelvic structures. This information is particularly important in the context of fertility-preserving surgical strategies [23]. In addition, the torus uterinus, although less frequently emphasized, can be accurately evaluated through magnetic resonance imaging to ensure comprehensive lesion detection and avoid underestimation of disease extent [18].

The anterior compartment, which includes the bladder and vesicouterine space, is another critical region in the evaluation of deep infiltrating endometriosis. Magnetic resonance imaging is particularly effective in identifying bladder nodules, providing detailed information regarding their size, location, and proximity to the ureteric orifice. These features are essential for preoperative planning, especially in cases requiring urological surgical involvement [16]. Furthermore, assessment of the vesicouterine space allows for the identification of subtle disease involvement that may otherwise be overlooked, thereby ensuring a more complete evaluation of pelvic pathology [18].

The importance of systematic mapping using a compartment-based approach extends beyond lesion detection, as it enhances communication among multidisciplinary teams and supports comprehensive patient management. The use of standardized magnetic resonance imaging protocols and reporting terminology improves diagnostic consistency and facilitates the integration of imaging findings into clinical decision-making [16]. This structured approach provides a detailed preoperative roadmap, aiding in patient counseling and in anticipating the need for additional surgical expertise, such as colorectal or urological intervention [17]. Moreover, the compartment-based analysis aligns with classification systems such as the #Enzian classification, which integrates imaging and surgical findings to improve diagnostic accuracy and optimize treatment planning in patients with deep infiltrating endometriosis [7].

Surgical Correlation and Intraoperative Findings

The surgical management of deep infiltrating endometriosis has evolved toward minimally invasive approaches, with laparoscopy being widely preferred over open surgery due to its reduced invasiveness, lower postoperative pain, and shorter recovery time. Laparoscopic techniques allow for precise excision of endometriotic lesions while preserving surrounding structures, thereby improving functional outcomes and facilitating faster patient recovery [25]. In parallel, robotic-assisted laparoscopy has emerged as a potential alternative, offering enhanced dexterity through articulating instruments and improved visualization with high-definition three-dimensional imaging. However, despite these technical advantages, its superiority over conventional laparoscopy has not yet been conclusively demonstrated in randomized controlled trials [26].

In this context, magnetic resonance imaging plays a fundamental role in bridging preoperative assessment and intraoperative findings. It provides a detailed mapping of disease distribution across pelvic compartments, which is essential for surgical planning and intraoperative orientation. The correlation between magnetic resonance imaging findings and intraoperative anatomy is generally strong, allowing imaging to function as a reliable pre-surgical roadmap that contributes to improved surgical outcomes and more targeted interventions [16, 17].

A key strength of magnetic resonance imaging lies in its ability to predict critical surgical parameters, particularly the depth of infiltration of endometriotic lesions. Accurate assessment of infiltration depth is essential for determining the extent of surgical resection required and for selecting the most appropriate operative strategy. Similarly, magnetic resonance imaging demonstrates high sensitivity and specificity in identifying bowel involvement, making it a valuable tool in preoperative planning for

colorectal surgery. Imaging findings help guide the choice between different surgical techniques, including bowel shaving, disc excision, and segmental resection, depending on the extent and depth of intestinal infiltration [26, 27].

Magnetic resonance imaging is also instrumental in detecting ureteral involvement, which is critical for preventing complications such as hydronephrosis. Preoperative identification of ureteral encasement allows for appropriate surgical planning, including the use of laparoscopic ureterolysis and, when necessary, ureteral stenting to preserve renal function and ensure safe dissection [28].

Despite its high diagnostic performance, discrepancies between magnetic resonance imaging findings and intraoperative observations may occur. These differences can be attributed to several factors, including operator experience, variability in imaging techniques, and the inherent complexity of deep infiltrating endometriosis, which often presents with multifocal and heterogeneous lesions. In some cases, magnetic resonance imaging may underestimate disease extent, particularly in retroperitoneal structures such as the ureters and neural pathways, leading to potential false-negative findings [5]. Conversely, overestimation may occur when imaging findings are misinterpreted or when lesions identified on imaging do not correspond to clinically significant disease, highlighting the importance of expertise in image interpretation and multidisciplinary correlation [7].

Role of MRI in Preoperative Planning and Outcomes

Magnetic resonance imaging has become a cornerstone in surgical decision-making for deep infiltrating endometriosis, offering a non-invasive alternative to diagnostic laparoscopy while providing a detailed and comprehensive evaluation of pelvic anatomy and disease extent. Unlike direct visualization techniques that may be limited by anatomical distortion caused by adhesions or fibrosis, magnetic resonance imaging allows for a global assessment of both pelvic and extrapelvic involvement, thereby facilitating a more accurate preoperative understanding of disease distribution [6, 17]. In this context, structured scoring systems such as the Deep Pelvic Endometriosis Index magnetic resonance imaging score have been validated as useful tools for predicting key surgical parameters, including operative time, length of hospital stay, and the risk of postoperative complications, thus contributing to more informed surgical planning [16].

The comprehensive nature of magnetic resonance imaging also plays a pivotal role in multidisciplinary planning, which is essential in complex cases involving multiple organ systems. By providing a clear and detailed pre-surgical roadmap, imaging facilitates effective communication among gynecologists, colorectal surgeons, and urologists, ensuring coordinated management strategies tailored to the individual patient [17]. The implementation of standardized imaging protocols and reporting terminology, as recommended by the European Society of Urogenital Radiology, further enhances consistency and clarity in communication across specialties, thereby improving clinical decision-making and surgical outcomes [16].

In addition to guiding surgical strategy, magnetic resonance imaging contributes to the prediction of surgical complexity and potential complications. The Deep Pelvic Endometriosis Index magnetic resonance imaging score enables stratification of disease severity, which has been shown to correlate with longer operative times and an increased likelihood of intraoperative and postoperative complications [16]. Furthermore, the compartment-based analysis inherent to magnetic resonance imaging allows for precise localization of lesions, which is critical for anticipating technical challenges and planning nerve-sparing approaches aimed at minimizing functional morbidity [18, 29].

Finally, magnetic resonance imaging has a significant impact on patient counseling and prognostic assessment. The detailed anatomical and pathological information obtained through imaging can be used to inform patients about the extent of their disease, the complexity of the planned surgical procedure, and the potential risks and expected outcomes. This facilitates shared decision-making and helps establish realistic expectations regarding symptom relief, recovery, and long-term prognosis. By accurately mapping disease burden and guiding tailored surgical strategies, magnetic resonance imaging ultimately contributes to improved clinical outcomes and more personalized care in patients with deep infiltrating endometriosis [7, 17].

Limitations, Challenges, and Future Directions

Despite its significant diagnostic value, magnetic resonance imaging has several limitations in the evaluation of deep infiltrating endometriosis that must be considered in clinical practice. One of the principal challenges is its reduced sensitivity in detecting small, superficial, and highly vascularized lesions. These lesions may not exhibit the typical fibrotic characteristics that facilitate identification on magnetic resonance imaging, which can lead to underdiagnosis in certain cases. This limitation is particularly relevant in the context of emerging therapies, such as Quinagolide Vaginal Ring treatment, where accurate detection of subtle lesions may influence therapeutic decision-making [20]. In addition, the diagnostic accuracy of magnetic resonance imaging is highly dependent on operator expertise and the quality of imaging protocols, resulting in variability in interpretation and potential inconsistencies in reported findings [5].

When compared with advanced ultrasound techniques, magnetic resonance imaging demonstrates both complementary strengths and relative limitations. Transvaginal ultrasound remains a valuable first-line imaging modality due to its accessibility, cost-effectiveness, and ability to perform dynamic maneuvers that facilitate the assessment of adhesions and organ mobility. It may also provide higher spatial resolution for evaluating specific structures, such as the depth of bowel wall invasion [6]. However, magnetic resonance imaging offers a more comprehensive evaluation of the pelvis, enabling assessment of all pelvic compartments and detection of extrapelvic disease, which may not be readily visualized with ultrasound alone. Although magnetic resonance imaging generally exhibits superior sensitivity for deep infiltrating endometriosis, ultrasound continues to play a critical role in the initial diagnostic approach [1].

Advances in imaging technologies are expected to address some of these limitations and further enhance diagnostic capabilities. Artificial intelligence has shown promise in improving image interpretation by identifying complex patterns and potentially reducing diagnostic delays. Nevertheless, its effectiveness is closely linked to the availability of high-quality datasets and the expertise involved in algorithm development and implementation [30]. Similarly, functional magnetic resonance imaging techniques have emerged as potential tools for providing non-invasive biomarkers of treatment response. For example, studies such as the QLARITY trial have demonstrated the ability of these techniques to detect changes in lesion characteristics following targeted therapies, offering new perspectives in disease monitoring [20].

In this context, the need for standardized reporting systems becomes increasingly important. Consensus guidelines, such as those proposed by the European Society of Urogenital Radiology, emphasize the implementation of standardized magnetic resonance imaging protocols and a structured lexicon based on compartmental analysis. This approach improves diagnostic consistency and facilitates effective communication among healthcare providers involved in patient management [16]. Furthermore, structured reporting templates

contribute to the creation of a clear preoperative roadmap, enhancing multidisciplinary collaboration, optimizing surgical planning, and supporting more accurate patient counseling [17].

Conclusions

Deep infiltrating endometriosis is a complex, multifactorial disease characterized by ectopic endometrial implantation, progressive fibrosis, and a sustained hormonal and inflammatory microenvironment. Its tendency toward multifocal and compartmental distribution, particularly involving the uterosacral ligaments, rectosigmoid colon, and urinary tract, underscores the need for a comprehensive anatomical understanding to guide diagnosis and management.

The clinical presentation is often non-specific and insufficient for definitive diagnosis, making imaging essential. Magnetic resonance imaging, supported by optimized protocols and compartment-based analysis, provides high diagnostic accuracy by identifying characteristic signal patterns, mapping disease extent, and detecting organ-specific involvement, thereby serving as a cornerstone in the evaluation of deep infiltrating endometriosis.

Magnetic resonance imaging demonstrates strong correlation with intraoperative findings and plays a critical role in preoperative planning, prediction of surgical complexity, and multidisciplinary coordination. Despite its limitations in detecting small lesions and its operator dependency, advances such as standardized reporting systems and emerging technologies continueto enhance its clinical utility, ultimately improving surgical outcomes and patient care.

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