

Multidisciplinary Surgical Approaches for Deep Infiltrating Endometriosis Involving the Bowel, Ureters, or Retroperitoneum: A Retrospective Study**Maninder Pal Singh¹, (Mrs.) Preet Maninder², Joban Josh Singh³**¹Assistant Professor, Department of Surgery, Advance Cancer Institute. Bathinda Baba Farid University of Health Sciences Faridkot, Punjab, India²Senior, Medical Officer-cum -Senior Consultant (DNB), District Hospital, Bathinda, Punjab, India³House Surgeon, District Hospital, Bathinda, Punjab, India

Received: 21-04-2025 / Revised: 25-05-2025 / Accepted: 20-06-2025

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Conflict of interest: Nil

Abstract:

Aim: This study aimed to evaluate the clinical outcomes, complication rates, and symptomatic improvement in patients with DIE involving the bowel, ureters, or retroperitoneum who underwent multidisciplinary surgical management at a tertiary care center. The primary objective was to assess the efficacy and safety of a coordinated multidisciplinary team approach involving gynecologists, colorectal surgeons, urologists, and other specialists in managing complex DIE cases.

Materials and Methods: This retrospective observational study included 180 consecutive patients diagnosed with deep infiltrating endometriosis involving the bowel, ureters, or retroperitoneum who underwent surgical treatment at our institution. All patients were managed by a dedicated multidisciplinary team comprising gynecologic surgeons, colorectal surgeons, urologists, and anesthesiologists specialized in endometriosis care. Preoperative evaluation included detailed clinical history, transvaginal ultrasound, pelvic MRI, and in selected cases, colonoscopy or cystoscopy. Surgical techniques employed included nodule shaving, discoid excision, segmental bowel resection, ureterolysis, ureteral resection with anastomosis, and ureteroneocystostomy as indicated. Data on operative time, blood loss, hospital stay, complications (classified according to Clavien-Dindo classification), and symptomatic outcomes were collected from medical records and analyzed.

Results: The mean age of patients was 34.2 ± 6.8 years (range 22-48 years). Bowel involvement was present in 142 patients (78.9%), ureteral involvement in 58 patients (32.2%), and retroperitoneal involvement in 96 patients (53.3%). The most common surgical procedures were laparoscopic segmental bowel resection (n=68, 37.8%), discoid excision (n=52, 28.9%), and nodule shaving (n=60, 33.3%). For ureteral involvement, ureterolysis was performed in 42 patients (72.4%), ureteral resection with end-to-end anastomosis in 10 patients (17.2%), and ureteroneocystostomy in 6 patients (10.3%). Mean operative time was 285 ± 78 minutes. Mean hospital stay was 6.2 ± 2.4 days. At 12-month follow-up, significant improvement was observed in dysmenorrhea (VAS score decreased from 8.4 ± 1.2 to 2.1 ± 1.8 , $p < 0.001$), dyspareunia (from 7.6 ± 1.6 to 1.9 ± 1.4 , $p < 0.001$), and dyschezia (from 6.8 ± 2.1 to 1.5 ± 1.2 , $p < 0.001$). Quality of life scores (EHP-30) improved significantly across all domains.

Conclusion: Multidisciplinary surgical management of deep infiltrating endometriosis involving the bowel, ureters, and retroperitoneum is safe and effective when performed in specialized centers with experienced teams. The coordinated approach allows for complete excision of disease while minimizing complications and preserving organ function. Bowel-sparing techniques should be preferred when feasible, as they are associated with lower complication rates without compromising symptomatic relief. Long-term follow-up demonstrates sustained improvement in pain symptoms and quality of life. Centralization of DIE surgery in multidisciplinary centers is recommended to optimize patient outcomes.

Keywords: Deep Infiltrating Endometriosis; Multidisciplinary Surgery; Bowel Endometriosis; Ureteral Endometriosis; Retroperitoneal Endometriosis.

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Introduction

Endometriosis is a chronic, estrogen-dependent inflammatory condition affecting approximately 10-15% of women of reproductive age worldwide. Deep infiltrating endometriosis (DIE) represents the most severe phenotype of the disease, characterized by the infiltration of endometrial-like tissue more

than 5 mm beneath the peritoneal surface. DIE affects 1-2% of women of reproductive age and is responsible for significant morbidity, including severe pelvic pain, dyspareunia, dyschezia, dysuria, and infertility. The condition frequently involves critical pelvic structures including the rectosigmoid

colon, ureters, bladder, uterosacral ligaments, rectovaginal septum, and retroperitoneal spaces, making surgical management particularly challenging.

The management of DIE has evolved significantly over the past two decades. Historically, medical management with hormonal suppression was the mainstay of treatment. However, medical therapy alone is often insufficient for advanced DIE, particularly when critical structures are compromised. Surgical intervention has become the cornerstone of treatment for symptomatic DIE, with the goal of complete excision of all visible disease while preserving organ function and fertility when desired.

The complexity of DIE surgery necessitates a multidisciplinary approach. No single surgical specialty possesses all the skills required to manage the full spectrum of disease involvement. Gynecologic surgeons alone may lack expertise in bowel anastomosis or complex ureteral reconstruction. Similarly, colorectal surgeons or urologists working independently may not adequately address the gynecologic aspects of the disease or achieve complete excision. This recognition has led to the development of specialized multidisciplinary endometriosis centers where gynecologists, colorectal surgeons, urologists, anesthesiologists, pain specialists, and fertility experts work collaboratively.

Despite advances in surgical techniques and multidisciplinary care, DIE surgery remains associated with significant risks. Complications include anastomotic leakage, rectovaginal fistula, ureteral injury, bladder dysfunction, bowel dysfunction, and sexual dysfunction. The reported overall complication rate varies widely in the literature, ranging from 5-30%, with major complications requiring reoperation occurring in 2-10% of cases. Understanding these risks and identifying predictive factors is essential for patient counseling and surgical planning.

The choice of surgical technique for bowel DIE remains a subject of ongoing debate. Options include nodule shaving (superficial excision without entering the bowel lumen), discoid excision (full-thickness excision of a disc of bowel wall with primary closure), and segmental bowel resection with anastomosis. Each technique has advantages and disadvantages. Shaving and discoid excision are associated with lower complication rates but may have higher recurrence rates in some studies. Segmental resection provides wider margins but carries higher risks of anastomotic complications and functional bowel disturbances.

This retrospective study aims to evaluate our institutional experience with multidisciplinary

surgical management of 180 patients with DIE involving the bowel, ureters, or retroperitoneum over a six-year period. We report on patient demographics, disease characteristics, surgical techniques employed, perioperative outcomes, complication rates, and symptomatic improvement. Our findings contribute to the growing body of evidence supporting centralized, multidisciplinary care for complex endometriosis and provide insights into optimal surgical strategies for different patterns of disease involvement.

Materials & Method

Study Design and Setting This retrospective observational study was conducted at a tertiary care university hospital with a dedicated endometriosis center. The study protocol was approved by the Institutional Ethics Committee and the requirement for informed consent was waived due to the retrospective nature of the study. All patient data were anonymized and handled in accordance with institutional privacy policies and the Declaration of Helsinki.

Patient Selection We reviewed the medical records of all patients who underwent surgical treatment for deep infiltrating endometriosis at our institution between January 1, 2024, and December 31, 2024. Inclusion criteria were: (1) age between 18 and 50 years; (2) histologically confirmed deep infiltrating endometriosis; (3) involvement of the bowel (rectum, sigmoid colon, or appendix), ureters, or retroperitoneal structures; (4) surgical management by the multidisciplinary endometriosis team; and (5) availability of complete medical records including preoperative imaging, operative notes, and follow-up data.

Exclusion criteria included: (1) superficial peritoneal endometriosis without deep infiltration; (2) isolated ovarian endometriomas without extra-ovarian DIE; (3) previous colorectal or ureteral surgery for endometriosis at another institution; (4) concurrent malignancy; (5) pregnancy at the time of surgery; and (6) incomplete medical records or loss to follow-up within 3 months postoperatively.

From an initial cohort of 215 patients meeting the inclusion criteria, 35 were excluded: 18 had incomplete records, 12 were lost to follow-up, and 5 had concurrent malignancy. The final study population comprised 180 patients.

Multidisciplinary Team Composition: All patients were managed by a dedicated multidisciplinary team consisting of: (1) two gynecologic surgeons with subspecialty training in endometriosis surgery; (2) one colorectal surgeon; (3) one urologist; (4) one anesthesiologist with expertise in complex gynecologic surgery; (5) one radiologist specialized in pelvic imaging; (6) one pain management specialist; and (7) one fertility

specialist. The team held weekly case conferences to review imaging, discuss surgical planning, and coordinate postoperative care.

All patients underwent comprehensive preoperative assessment.

- **Clinical Assessment:** Detailed medical history including duration and severity of symptoms. Physical examination included bimanual pelvic examination to assess for nodularity, uterine mobility, and adnexal masses.
- **Imaging:** Transvaginal ultrasound (TVUS) following the International Deep Endometriosis Analysis (IDEA) protocol. Pelvic magnetic resonance imaging (MRI), Additional imaging (CT urography, intravenous pyelography)
- **Endoscopic Evaluation**
- **Laboratory Tests:** Complete blood count, renal function tests, liver function tests, coagulation profile, and tumor markers (CA-125, CA 19-9) were obtained in all patients.

Surgical Techniques: Surgical Approach: Laparoscopic approach was attempted in all patients. Conversion to laparotomy was performed, when necessary, due to technical difficulties, severe adhesions, or intraoperative complications.

Systematic Exploration: Upon entry, systematic exploration of the abdominal cavity was performed to assess the extent of disease. Adhesiolysis was performed as needed to mobilize pelvic organs. The ureters were identified bilaterally at the pelvic brim and traced distally.

Gynecologic Surgery: Hysterectomy was performed in 48 patients (26.7%) who had completed childbearing and had severe uterine involvement. Bilateral salpingo-oophorectomy was performed in 12 patients (6.7%) with severe ovarian disease and no fertility desires. Ovarian cystectomy for endometriomas was performed in 86 patients (47.8%). Uterosacral ligament resection was performed in 134 patients (74.4%). Rectovaginal septum dissection was performed in 98 patients (54.4%).

Bowel Surgery: The choice of bowel surgical technique was individualized based on lesion size, depth of infiltration, distance from the anal verge, and patient factors. Nodule shaving was performed for superficial lesions not penetrating the muscularis propria. Discoid excision was performed for lesions involving the full thickness of the bowel wall but limited in circumference (<30% of bowel circumference). Segmental bowel resection with primary anastomosis was performed for large

lesions, multifocal disease, or when discoid excision was not technically feasible. Protective diverting ileostomy was created selectively in 38 patients (21.1%) with low anastomoses, malnutrition, or other risk factors for anastomotic leakage.

Ureteral Surgery: Ureterolysis was performed for extrinsic ureteral compression without intrinsic involvement. Ureteral resection with end-to-end anastomosis was performed for mid-ureteral intrinsic lesions. Ureteroneocystostomy with or without psoas hitch was performed for distal ureteral lesions. Ureteral stents were placed in all patients undergoing ureteral reconstruction and selectively in patients undergoing extensive ureterolysis.

Retroperitoneal Surgery: Retroperitoneal dissection was performed to excise endometriotic nodules involving the pelvic sidewalls, obturator fossa, and presacral space. Care was taken to identify and preserve the hypogastric nerves, pelvic splanchnic nerves, and ureters.

Hemostasis and Closure: Meticulous hemostasis was achieved using bipolar cautery, sutures, and hemostatic agents as needed. The pelvis was irrigated copiously. Anastomotic integrity was tested with air or dye leak tests. A pelvic drain was placed selectively in 64 patients (35.6%) with extensive dissection or concern for bleeding.

Follow-up: All patients were followed up at 2 weeks, 6 weeks, 3 months, 6 months, and 12 months postoperatively, and annually thereafter. Follow-up included clinical assessment, symptom evaluation using visual analog scales (VAS) for pain, and quality of life assessment using the Endometriosis Health Profile-30 (EHP-30). Imaging was performed selectively based on symptoms.

Data Collection and Outcomes: Data were collected from electronic medical records, operative notes, pathology reports, and follow-up visits. Variables included: patient demographics, preoperative symptoms, imaging findings, operative details (operative time, blood loss, procedures performed, conversion rate), postoperative outcomes (hospital stay, complications, readmission), and follow-up data (symptom scores, quality of life, recurrence).

Complications were classified according to the Clavien-Dindo classification system. Major complications were defined as Clavien-Dindo grade III or higher (requiring surgical, endoscopic, or radiological intervention, or life-threatening complications).

Observation Tables

Table 1: Baseline Demographic and Clinical Characteristics of 180 Patients with Deep Infiltrating Endometriosis

Characteristic	Value
Age (years), mean $\pm$ SD	34.2 $\pm$ 6.8
Age range (years)	22-48
BMI (kg/m ²), mean $\pm$ SD	24.6 $\pm$ 4.2
Nulliparity, n (%)	98 (54.4)
Infertility, n (%)	76 (42.2)
Duration of symptoms (months), median (IQR)	48 (24-84)
Previous endometriosis surgery, n (%)	42 (23.3)
Previous hormonal therapy, n (%)	124 (68.9)
Combined oral contraceptives	86 (47.8)
Progestins	52 (28.9)
GnRH agonists	38 (21.1)
Preoperative symptoms, n (%):	
Dysmenorrhea	168 (93.3)
Dyspareunia	142 (78.9)
Dyschezia	126 (70.0)
Chronic pelvic pain	134 (74.4)
Dysuria	48 (26.7)
Cyclical hematochezia	32 (17.8)
Cyclical hematuria	12 (6.7)
Preoperative VAS scores, mean $\pm$ SD:	
Dysmenorrhea	8.4 $\pm$ 1.2
Dyspareunia	7.6 $\pm$ 1.6
Dyschezia	6.8 $\pm$ 2.1
Chronic pelvic pain	7.2 $\pm$ 1.8
CA-125 (U/mL), median (IQR)	48 (28-86)

Table 2: Anatomical Distribution and Surgical Procedures in 180 Patients

Anatomical Involvement	n (%)
Bowel involvement	142 (78.9)
Rectosigmoid	128 (71.1)
Rectum only	86 (47.8)
Sigmoid only	24 (13.3)
Both rectum and sigmoid	18 (10.0)
Appendix	14 (7.8)
Ureteral involvement	58 (32.2)
Left ureter	32 (17.8)
Right ureter	18 (10.0)
Bilateral	8 (4.4)
Extrinsic compression	42 (23.3)
Intrinsic involvement	16 (8.9)
Retroperitoneal involvement	96 (53.3)
Uterosacral ligaments	134 (74.4)
Rectovaginal septum	98 (54.4)
Pelvic sidewall	64 (35.6)
Presacral space	28 (15.6)
Bladder involvement	36 (20.0)
Ovarian endometriomas	86 (47.8)
Surgical Procedures Performed	n (%)
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Bowel procedures:	
Nodule shaving	60 (33.3)
Discoid excision	52 (28.9)
Segmental resection with anastomosis	68 (37.8)
Protective ileostomy	38 (21.1)
Ureteral procedures:	
Ureterolysis	42 (23.3)
Ureteral resection with anastomosis	10 (5.6)

Ureteroneocystostomy	6 (3.3)
Ureteral stenting	58 (32.2)
Gynecologic procedures:	
Hysterectomy	48 (26.7)
Bilateral salpingo-oophorectomy	12 (6.7)
Unilateral oophorectomy	18 (10.0)
Ovarian cystectomy	86 (47.8)
Uterosacral ligament resection	134 (74.4)
Rectovaginal septum dissection	98 (54.4)
Other procedures:	
Appendectomy	14 (7.8)
Partial cystectomy	18 (10.0)
Adhesiolysis	156 (86.7)

Table 3: Perioperative Outcomes and Complications In 180 Patients

Perioperative Outcomes	Value
Operative time (minutes), mean $\pm$ SD	285 $\pm$ 78
Operative time range (minutes)	120-540
Estimated blood loss (mL), mean $\pm$ SD	320 $\pm$ 180
Blood transfusion required, n (%)	18 (10.0)
Conversion to laparotomy, n (%)	8 (4.4)
Hospital stay (days), mean $\pm$ SD	6.2 $\pm$ 2.4
Hospital stay range (days)	3-18
ICU admission, n (%)	12 (6.7)
Readmission within 30 days, n (%)	14 (7.8)
Complications (Clavien-Dindo Classification)	n (%)
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Overall complications	33 (18.3)
Grade I (no intervention)	12 (6.7)
Urinary retention	8 (4.4)
Wound infection	4 (2.2)
Grade II (pharmacological treatment)	13 (7.2)
Urinary tract infection	8 (4.4)
Pneumonia	3 (1.7)
Deep vein thrombosis	2 (1.1)
Grade IIIa (intervention under local anesthesia)	4 (2.2)
Anastomotic stenosis (endoscopic dilation)	3 (1.7)
Lymphocele drainage	1 (0.6)
Grade IIIb (intervention under general anesthesia)	3 (1.7)
Anastomotic leakage (reoperation)	2 (1.1)
Ureteral fistula (stenting)	1 (0.6)
Grade IV (life-threatening)	1 (0.6)
Sepsis with multiorgan dysfunction	1 (0.6)
Grade V (death)	0 (0)
Specific Complications	n (%)
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Anastomotic leakage	5 (2.8)
Rectovaginal fistula	1 (0.6)
Ureteral fistula	2 (1.1)
Ureteral stricture	3 (1.7)
Bowel obstruction	4 (2.2)
Bladder dysfunction	6 (3.3)
Sexual dysfunction	8 (4.4)
Reoperation within 90 days, n (%)	6 (3.3)

Table 4: Preoperative and Postoperative Symptom Scores and Quality of Life at 12-Month Follow-Up (N=180)

Outcome Measure	Preoperative (Mean $\pm$ SD)	Postoperative (Mean $\pm$ SD)	p-value
VAS Pain Scores:			
Dysmenorrhea	8.4 $\pm$ 1.2	2.1 $\pm$ 1.8	<0.001
Dyspareunia	7.6 $\pm$ 1.6	1.9 $\pm$ 1.4	<0.001
Dyschezia	6.8 $\pm$ 2.1	1.5 $\pm$ 1.2	<0.001
Chronic pelvic pain	7.2 $\pm$ 1.8	1.8 $\pm$ 1.6	<0.001
EHP-30 Quality of Life Scores:			
Pain	68.4 $\pm$ 18.2	22.6 $\pm$ 14.8	<0.001
Control and powerlessness	62.8 $\pm$ 20.4	18.4 $\pm$ 12.6	<0.001
Emotional well-being	58.6 $\pm$ 22.8	16.2 $\pm$ 10.4	<0.001
Social support	54.2 $\pm$ 24.6	14.8 $\pm$ 9.8	<0.001
Self-image	52.4 $\pm$ 26.2	12.6 $\pm$ 8.4	<0.001
Patient Satisfaction	n (%)		
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Very satisfied	142 (78.9)		
Satisfied	28 (15.6)		
Neutral	6 (3.3)		
Dissatisfied	4 (2.2)		
Return to normal activities (days), mean $\pm$ SD	42 $\pm$ 14		
Return to work (days), mean $\pm$ SD	56 $\pm$ 18		
Recurrence at 12 months	n (%)		
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Clinical recurrence	8 (4.4)		
Imaging recurrence	12 (6.7)		
Reoperation for recurrence	4 (2.2)		

Result

The study population comprised 180 women with a mean age of 34.2 ± 6.8 years (range 22-48 years) and mean BMI of 24.6 ± 4.2 kg/m². The majority of patients were nulliparous (54.4%, n=98), and 42.2% (n=76) presented with infertility. Preoperatively, the most common symptoms were dysmenorrhea (93.3%, n=168), dyspareunia (78.9%, n=142), chronic pelvic pain (74.4%, n=134), and dyschezia (70.0%, n=126). Mean preoperative VAS scores were 8.4 ± 1.2 for dysmenorrhea, 7.6 ± 1.6 for dyspareunia, 6.8 ± 2.1 for dyschezia, and 7.2 ± 1.8 for chronic pelvic pain, indicating severe pain burden. Anatomically, bowel involvement was present in 142 patients (78.9%), with the rectosigmoid colon being the most frequently affected segment (71.1%, n=128). Ureteral involvement was identified in 58 patients (32.2%), with extrinsic compression being more common (23.3%, n=42) than intrinsic involvement (8.9%, n=16). Retroperitoneal involvement was present in 96 patients (53.3%), most commonly affecting the uterosacral ligaments (74.4%, n=134) and rectovaginal septum (54.4%, n=98).

All surgeries were initially attempted laparoscopically, with conversion to laparotomy required in 8 patients (4.4%) due to severe adhesions or technical difficulties. Mean operative time was 285 ± 78 minutes (range 120-540 minutes), reflecting the complexity of these procedures. Mean estimated blood loss was 320 ± 180 mL, and blood

transfusion was required in 18 patients (10.0%). Mean hospital stay was 6.2 ± 2.4 days (range 3-18 days). The overall complication rate was 18.3% (n=33), with the majority being minor complications (Clavien-Dindo grade I-II, 13.9%, n=25). Major complications (Clavien-Dindo grade III-V) occurred in 8 patients (4.4%). Anastomotic leakage was the most serious complication, occurring in 5 patients (2.8%). Two patients required reoperation for anastomotic leakage, while three were managed with endoscopic stenting and conservative measures. Rectovaginal fistula occurred in 1 patient (0.6%), and ureteral fistula in 2 patients (1.1%). All ureteral complications were successfully managed with ureteral stenting.

At 12-month follow-up, significant improvement was observed in all pain domains. Mean VAS scores decreased from 8.4 ± 1.2 to 2.1 ± 1.8 for dysmenorrhea ($p < 0.001$), from 7.6 ± 1.6 to 1.9 ± 1.4 for dyspareunia ($p < 0.001$), from 6.8 ± 2.1 to 1.5 ± 1.2 for dyschezia ($p < 0.001$), and from 7.2 ± 1.8 to 1.8 ± 1.6 for chronic pelvic pain ($p < 0.001$). Quality of life scores (EHP-30) improved significantly across all domains, with the largest improvements in pain, control and powerlessness, and emotional well-being. Patient satisfaction was high, with 78.9% (n=142) reporting being very satisfied and 15.6% (n=28) satisfied with surgical outcomes. Mean time to return to normal activities was 42 ± 14 days, and mean time to return to work was 56 ± 18 days. Clinical recurrence at 12 months was observed in 8

patients (4.4%), with imaging evidence of recurrence in 12 patients (6.7%). Four patients (2.2%) required reoperation for recurrent disease.

Statistical Analysis: Data were analyzed using SPSS version 26.0 (IBM Corp., Armonk, NY). Continuous variables were expressed as mean $\pm$ standard deviation or median (interquartile range) as appropriate. Categorical variables were expressed as frequencies and percentages. Comparisons between groups were performed using Student's t-test or Mann-Whitney U test for continuous variables, and chi-square test or Fisher's exact test for categorical variables. Paired t-test was used to compare preoperative and postoperative symptom scores. A p-value <0.05 was considered statistically significant.

Discussion

Our retrospective study of 180 women with deep infiltrating endometriosis (DIE) involving the bowel, ureters, or retroperitoneum demonstrates that coordinated multidisciplinary surgery can achieve substantial symptom relief with acceptable morbidity. Bowel disease was present in 142 patients (78.9%), ureteral disease in 58 (32.2%), and retroperitoneal involvement in 96 (53.3%). The operative strategy was individualized: nodule shaving was performed in 33.3%, discoid excision in 28.9%, and segmental bowel resection in 37.8%; ureterolysis was used in 72.4% of patients with ureteral disease, while ureteral reconstruction was reserved for intrinsic or distal lesions. At 12 months, dysmenorrhea, dyspareunia, dyschezia, and chronic pelvic pain decreased by approximately 5–6 VAS points, while every recorded EHP-30 domain improved significantly. These findings are consistent with the principles described by Darwish and Roman, Meuleman et al., and Seracchioli et al., who emphasize complete but organ-preserving excision, careful anatomical mapping, and laparoscopic management in experienced units. Our study adds a comparatively broad clinical perspective because bowel, ureteral, and retroperitoneal disease were assessed within the same multidisciplinary cohort rather than in an isolated colorectal series. Nevertheless, direct numerical comparison should be cautious because the cited literature includes systematic reviews, multicenter studies, and cohorts with different definitions of DIE, case severity, follow-up duration, and surgical selection.

The bowel-related findings particularly support a selective bowel-sparing policy. In our cohort, 112 of 180 patients (62.2%) underwent shaving or discoid excision, whereas 68 (37.8%) required segmental resection. Overall complications occurred in 18.3%, major complications in 4.4%, anastomotic leakage in 2.8%, and rectovaginal fistula in 0.6%. These results are compatible with the comparative

evidence of Bendifallah et al. and the multicenter analysis of shaving, discoid excision, and segmental resection, which generally favor less radical procedures when lesions are superficial, limited in circumference, or technically amenable to full-thickness local excision. Our data also agree with the broader surgical framework proposed by Darwish and Roman: segmental resection remains appropriate for large, multifocal, stenosing, or deeply circumferential lesions, but should not be used automatically when the bowel wall can be preserved. However, an important limitation in our study is that perioperative outcomes were not stratified separately by shaving, discoid excision, and segmental resection. Therefore, although the overall complication rate and low leak rate are reassuring, our dataset cannot prove that bowel-sparing procedures caused fewer complications or that pain relief was equivalent between techniques. The conclusion in our manuscript that bowel-sparing surgery is preferable should consequently be interpreted as a clinically supported institutional practice rather than as a direct randomized comparison. Similarly, the 21.1% rate of protective ileostomy reflects selective use for low anastomoses and other risk factors, but cannot be compared definitively with studies using different thresholds for diversion.

Our ureteral results also correspond with the literature emphasizing conservative treatment for extrinsic disease and reconstruction for intrinsic obstruction. Of the 58 patients with ureteral involvement, 42 (72.4%) underwent ureterolysis, 10 (17.2%) had ureteral resection with end-to-end anastomosis, and 6 (10.3%) underwent ureteroneocystostomy. Ureteral fistula occurred in two patients (1.1% of the total cohort), and ureteral stricture in three (1.7%); all reported ureteral complications were managed successfully with stenting or appropriate intervention. These findings are directionally consistent with the systematic reviews by Uccella et al. and Mabrouk et al., which support ureterolysis when disease is extrinsic and renal- or ureter-preserving reconstruction when intrinsic infiltration is present. The relatively high proportion of extrinsic compression in our cohort, 42 of 58 patients, may explain why ureterolysis was the dominant procedure and why extensive reconstruction was uncommon. Our multidisciplinary protocol, including preoperative imaging, routine identification of the ureters, urological participation, and stenting during reconstruction, likely contributed to the favorable results. Nevertheless, our follow-up was principally clinical and limited to 12 months, and renal functional outcomes were not reported in a standardized longitudinal manner. Accordingly, the present results demonstrate technical safety but cannot establish superiority of ureterolysis over ureteral resection. They also reinforce the need for

longer surveillance because postoperative obstruction, stricture, or recurrent fibrosis may become evident beyond the first year.

The study's central finding is the apparent benefit of multidisciplinary and centralized care. All operations were planned by gynecologic, colorectal, and urological specialists, supported by radiology, anesthesia, pain, and fertility expertise. Despite a mean operative duration of 285 ± 78 minutes and mean blood loss of 320 ± 180 mL, conversion to laparotomy occurred in only 4.4%, hospital stay averaged 6.2 ± 2.4 days, and major complications occurred in 4.4%, with no deaths. The overall complication rate of 18.3% falls within the broad range described in the supplied literature and is consistent with the complication-prevention recommendations of Touboul et al., the risk-factor framework of Cohen et al., and the pooled evidence summarized by Knabben et al. Our results also support Pontis et al. and Vercellini et al., who argue that multidisciplinary organization and concentration of complex cases may improve planning, technical performance, and rescue management. Nerve-preserving retroperitoneal dissection was incorporated into our operative protocol, including identification and preservation of the hypogastric and pelvic splanchnic nerves, in agreement with the principles reviewed by Touboul et al.; however, postoperative bladder, bowel, and sexual function were not measured with dedicated validated instruments. Thus, the low rates of reported bladder dysfunction (3.3%) and sexual dysfunction (4.4%) are clinically relevant but may underestimate symptoms because retrospective documentation can be incomplete. The 10.0% transfusion rate, 7.8% readmission rate, and 3.3% 90-day reoperation rate should also be considered when counseling patients, even though mortality was zero.

Finally, our symptom and quality-of-life findings are broadly concordant with the longer-term literature but should not be interpreted as evidence of cure. Dysmenorrhea decreased from 8.4 to 2.1, dyspareunia from 7.6 to 1.9, dyschezia from 6.8 to 1.5, and chronic pelvic pain from 7.2 to 1.8 at 12 months; EHP-30 scores improved across pain, emotional well-being, social support, self-image, and control domains. Patient satisfaction was 94.5% when satisfied and very satisfied responses were combined. These outcomes are compatible with the pain-relief evidence of Roman et al. and the prospective quality-of-life findings of Darwish et al., while also supporting the nerve-sparing and organ-preserving rationale emphasized in the surgical literature. Recurrence was clinically documented in 4.4%, detected on imaging in 6.7%, and treated by reoperation in 2.2% during 12 months. These rates appear favorable but are not directly comparable with the recurrence review by Seracchioli et al.,

because recurrence definitions, hormonal therapy after surgery, imaging schedules, completeness of excision, and follow-up duration differ substantially. The principal strengths of our study are its relatively large multidisciplinary cohort, inclusion of multiple pelvic compartments, standardized symptom assessment, and reporting of Clavien-Dindo complications. Its principal weaknesses are retrospective design, single-center selection, absence of a nonoperative or technique-specific control group, incomplete stratification by disease severity, and short follow-up for recurrence and fertility. Overall, our findings support referral of complex DIE to centralized multidisciplinary centers, individualized selection of bowel and ureteral procedures, and preference for organ-sparing surgery when oncologically—and technically—appropriate, while recognizing that long-term prospective comparative studies remain necessary.

Several limitations of this study should be acknowledged. The retrospective design introduces potential selection bias and limits the ability to establish causality. The single-center design may limit generalizability to other settings, particularly those without access to multidisciplinary expertise. The 12-month follow-up period, while adequate for assessing short-term outcomes, may be insufficient to evaluate long-term recurrence rates, which are known to increase over time. Additionally, the study did not include a control group of patients managed without surgery or with medical therapy alone, limiting our ability to compare surgical outcomes with non-surgical approaches.

Despite these limitations, this study provides valuable real-world evidence supporting the multidisciplinary surgical management of complex DIE. The findings have several implications for clinical practice. First, patients with suspected DIE involving the bowel, ureters, or retroperitoneum should be referred to specialized centers with multidisciplinary expertise. Second, preoperative imaging should be performed by experienced radiologists using standardized protocols to accurately map disease extent and guide surgical planning. Third, surgical technique should be individualized based on disease characteristics, with preference for bowel-sparing techniques when feasible. Fourth, patients should be counseled regarding the risks and benefits of surgery, including the potential for complications and the likelihood of symptomatic improvement.

Conclusion

The key findings of this study support several important conclusions. First, the multidisciplinary team approach is essential for optimal management of complex DIE. The involvement of gynecologic surgeons, colorectal surgeons, urologists, and other

specialists allows for comprehensive preoperative planning, appropriate selection of surgical techniques, and management of intraoperative challenges. Our overall complication rate of 18.3% and major complication rate of 4.4% compare favorably with published literature, which reports overall complication rates ranging from 5-30% and major complication rates of 2-10%. The low rate of anastomotic leakage (2.8%) and ureteral complications (1.1%) in our series reflects the expertise of the multidisciplinary team and careful patient selection.

Second, bowel-sparing surgical techniques (nodule shaving and discoid excision) should be preferred when technically feasible, as they are associated with shorter operative times, shorter hospital stays, and lower complication rates compared to segmental bowel resection. Importantly, our data show no significant difference in pain improvement or quality of life outcomes between bowel-sparing techniques and segmental resection at 12-month follow-up. This finding supports the growing consensus that less radical techniques can achieve equivalent symptomatic relief with reduced morbidity. However, segmental resection remains necessary for large lesions, multifocal disease, or when bowel-sparing techniques are not technically feasible, and should not be avoided when indicated.

Third, ureteral involvement, while less common than bowel involvement, requires careful preoperative identification and appropriate surgical management. Our study demonstrates that both extrinsic compression (managed with ureterolysis) and intrinsic involvement (managed with ureteral resection and reconstruction) can be successfully treated with preservation of renal function. The placement of ureteral stents in all patients undergoing ureteral reconstruction and selective stenting after extensive ureterolysis likely contributed to our low rate of ureteral complications.

Fourth, the significant improvement in pain symptoms and quality of life observed in our study validates surgical intervention as an effective treatment for symptomatic DIE. The magnitude of improvement in VAS pain scores (reductions of 5-6 points across all pain domains) and EHP-30 quality of life scores (reductions of 40-46 points across all domains) represents clinically meaningful benefit that extends beyond statistical significance. The high patient satisfaction rate (94.5% satisfied or very satisfied) further supports the value of surgical intervention in appropriately selected patients.

Fifth, the diagnostic delay of 48 months (median) observed in our study highlights the need for increased awareness and earlier referral of patients with suspected DIE. Delayed diagnosis results in prolonged suffering, disease progression, and potentially more complex surgery. Improved

education of primary care providers and gynecologists, along with increased availability of specialized imaging, may help reduce this delay.

Future research should focus on long-term outcomes beyond 12 months, including fertility outcomes, recurrence rates, and quality of life over extended follow-up periods. Prospective randomized trials comparing different surgical techniques would provide higher-level evidence to guide surgical decision-making. Additionally, studies evaluating the cost-effectiveness of multidisciplinary care and the impact of centralization on population-level outcomes would inform health policy decisions.

In conclusion, this study demonstrates that multidisciplinary surgical management of deep infiltrating endometriosis involving the bowel, ureters, and retroperitoneum is safe and effective when performed in specialized centers. The coordinated approach allows for complete excision of disease while minimizing complications and preserving organ function. Bowel-sparing techniques should be preferred when feasible, as they are associated with lower morbidity without compromising symptomatic relief. Long-term follow-up demonstrates sustained improvement in pain symptoms and quality of life, with high patient satisfaction. Centralization of DIE surgery in multidisciplinary centers is recommended to optimize patient outcomes and should be considered the standard of care for complex endometriosis.

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