

ORIGINAL RESEARCH

Comparative outcomes of MPPE and segmental rectosigmoid resection in cytoreductive surgery for advanced ovarian cancer

Sahana Somasegar^{1,*}, Jiaqi Zhang¹, Talayeh Ghezelayagh¹, Simge Bagci Turkmen¹, Amer Karam¹

¹Department of Obstetrics & Gynecology, Stanford University, Palo Alto, CA 94305, USA

***Correspondence**

sahana.somasegar@endeavorhealth.org
(Sahana Somasegar)

Abstract

Background: To compare outcomes between modified posterior pelvic exenteration (MPPE) and segmental rectosigmoid resection performed separately from reproductive organ removal during primary cytoreductive surgery for advanced ovarian cancer. **Methods:** We conducted a retrospective cohort study of 113 patients who underwent cytoreductive surgery for advanced epithelial ovarian cancer with rectosigmoid resection at a single tertiary care center from 2010 to 2024. Clinical, surgical, and oncologic outcomes were compared using univariate tests, Kaplan-Meier analysis, and multivariable regression models. **Results:** Complete gross resection was achieved in 99% of MPPE cases and 93% of non-MPPE cases ($p = 0.13$). MPPE was associated with higher rates of diverting loop ileostomy ($p < 0.001$) but similar operative time, blood loss, hospital stay, and postoperative complication rates. Rectovaginal fistulas and anastomotic strictures were numerically less frequent in the MPPE group, and pelvic recurrence rates were similar ($p = 0.84$). Time from surgery to adjuvant chemotherapy was not delayed in the MPPE group ($p = 0.64$). Complete response to upfront treatment was higher in the MPPE group ($p = 0.05$). Recurrence-free survival and overall survival did not differ significantly between groups (median recurrence-free survival: $p = 0.39$; median overall survival: $p = 0.69$). **Conclusions:** MPPE is an effective approach for advanced ovarian cancer, achieving high rates of complete resection without increased perioperative morbidity or inferior survival. MPPE did not delay adjuvant therapy and may reduce the risk of rectovaginal fistula and stricture while maintaining similar pelvic recurrence rates. MPPE is a valuable option when *en bloc* resection is required to achieve optimal cytoreduction.

Keywords

Advanced ovarian cancer; Cytoreductive surgery; MPPE; Rectosigmoid resection; Colorectal anastomosis; Surgical outcomes; Recurrence-free survival; Pelvic morbidity

1. Introduction

Modified posterior pelvic exenteration (MPPE) is a radical technique used in cytoreductive surgery for advanced ovarian cancer, particularly in cases with direct tumor invasion of the rectosigmoid colon and adjacent pelvic structures. The procedure involves *en bloc* resection of the uterus, adnexa, upper vagina, rectosigmoid colon, and associated peritoneum, with primary colorectal anastomosis [1–3]. Eisenkop *et al.* [2] first described this procedure in ovarian cancer cytoreduction in 1991, reporting high rates of optimal cytoreduction and acceptable morbidity and mortality in patients with stage IIIC–IV disease. Bristow *et al.* [4] (2003) noted that the terminology surrounding this operation has varied considerably in the literature. Still, they highlighted the role of radical pelvic surgery, including MPPE, as a key strategy to achieve no gross residual disease, which is the most important prognostic factor

for survival in advanced ovarian cancer [4, 5].

The objective of cytoreductive surgery in advanced ovarian cancer is complete gross resection (R0), which has consistently been shown to be the strongest predictor of survival [6]. In a single-institution series of patients undergoing MPPE for advanced ovarian cancer, R0 resection was associated with a mean disease-free survival of 33.6 months, compared to 19.6 and 14.3 months for R1 and R2 resections, respectively [1]. Despite these benefits, MPPE has been associated with substantial morbidity, most commonly anastomotic leak, pelvic abscess, and wound infection [1, 2, 7]. However, MPPE did not appear to delay the initiation of adjuvant chemotherapy, which is critical for optimal outcomes [1, 2].

Studies comparing different rectal dissection techniques during rectosigmoid resection have reported equivalent residual disease rates and survival outcomes, but lower morbidity with less radical dissection [8, 9]. However,

no direct comparative data exist evaluating MPPE versus segmental hysterectomy with rectosigmoid resection and primary reanastomosis in the context of cytoreductive surgery for advanced ovarian cancer. When both MPPE and a segmental approach are technically feasible, understanding their relative risks and benefits is critical for informed surgical planning.

In this retrospective cohort study, we aim to evaluate and compare surgical and oncologic outcomes in patients with advanced ovarian cancer undergoing cytoreductive surgery with rectosigmoid resection, performed via either MPPE or a segmented resection approach. By analyzing a large institutional cohort, we aim to provide evidence to guide operative decision-making and optimize treatment strategies for this complex, high-risk population.

2. Materials & methods

We conducted a retrospective, single-institution cohort study evaluating surgical and oncologic outcomes in patients with advanced ovarian cancer undergoing cytoreductive surgery that included rectosigmoid resection. This study represents a retrospective cohort of patients who underwent cytoreductive surgery with rectosigmoid resection, rather than a study of preoperative selection criteria for surgical candidacy. This study was approved by the Stanford University Institutional Review Board (IRB Protocol #77171). Patients were grouped by surgical technique:

(1) MPPE, or (2) separate resection and reanastomosis of the rectosigmoid from the removal of reproductive organs. The surgical objective in all cases was complete gross resection (R0), defined as no visible residual disease after cytoreductive surgery. The study was approved by the Stanford University Institutional Review Board. It was granted a waiver of informed consent and HIPAA (Health Insurance Portability and Accountability Act) authorization due to the minimal risk and the retrospective nature of the study. Eligible patients were female, aged >18 , had histologically confirmed primary epithelial ovarian cancer, and underwent cytoreductive surgery for ovarian cancer between 01 January 2010 and 31 December 2024. Patients were excluded if they had low malignant potential tumors, missing operative details, or incomplete cancer history, or if postoperative treatment information was not available. All cytoreductive surgeries in this cohort were performed by 13 board-certified gynecologic oncologists at Stanford Health Care. Surgical candidacy was determined clinically by the treating team based on standard oncologic and institutional practices, incorporating disease extent, performance status, and overall medical fitness for surgery. The number of cases per surgeon was small and not suitable for surgeon-level statistical analysis, and no surgeon performed exclusively a surgical technique.

Clinical data were extracted from the electronic medical record and managed using REDCap. Variables included demographic data, clinical characteristics, surgical details, and postoperative outcomes. Oncologic outcomes included recurrence status, recurrence-free survival, and overall survival. Recurrence-free survival was defined as the time from diagnosis to recurrence or death, whichever occurred first. Overall

survival was defined as the time from diagnosis to death from any cause, with patients censored at the date of last follow-up if alive.

Descriptive statistics were reported as medians with interquartile ranges (IQRs) for continuous variables and frequencies with percentages for categorical variables. Differences between surgical groups were assessed using the Wilcoxon rank-sum test for continuous variables and the chi-square test or Fisher's exact test for categorical variables. Recurrence-free survival and overall survival were visualized using Kaplan-Meier curves, with differences between groups analyzed using the log-rank test. Cox proportional hazards regression models were used to estimate crude and adjusted hazard ratios (HRs) with 95% confidence intervals (CIs) for recurrence-free survival and overall survival (packages *survival* and *survminer*). The multivariable Cox models were adjusted for age at diagnosis, BMI (Body Mass Index) group (normal, overweight, underweight), FIGO (International Federation of Gynecology and Obstetrics) stage group (I or II, III, IV), and cytoreduction type (primary, interval), given their known association with disease burden and surgical complexity. The multivariable Cox models did not adjust for ECOG (Eastern Cooperative Oncology Group) performance status due to a high percentage of missing data. The proportional hazards assumption was evaluated using Schoenfeld residual tests and figures, confirming that the assumption was satisfied. Logistic regression models were fitted to examine the association between surgery type and binary outcomes, such as cytoreduction outcome (RD (residual disease) 0 vs. RD 1–10) and diverting loop ileostomy creation. Given the low event rate and small number of patients with suboptimal cytoreduction, estimation of the corresponding logistic regression models was performed using the Firth penalized maximum likelihood method (package: *logistf*) [10]. Multivariable logistic regression models were adjusted for the same covariates used in the Cox model.

The trend of MPPE and diverting loop ileostomy rates over time was evaluated by linear regression. Due to small annual case numbers, surgery dates were grouped into multi-year periods for percentage calculations. All statistical tests were two-sided with a significance threshold of $p < 0.05$. Analyses were performed using R version 4.5.0 (R Foundation for Statistical Computing, Vienna, Austria) (<https://CRAN.R-project.org/package=survival>). In accordance with the journal's guidelines, we will provide our data for independent analysis by a selected team designated by the Editorial Team for additional data analysis or assessment of the reproducibility of this study in other centers, if requested.

Surgical technique was not standardized across all cases, as procedures were performed by multiple gynecologic oncologists over the study period. However, the general principles of each approach were consistent. MPPE was defined as an *en bloc* resection of the uterus, adnexa, upper vagina, and rectosigmoid colon, typically performed when there was contiguous tumor involvement of the posterior pelvis requiring removal of these structures as a single specimen to achieve complete cytoreduction. In contrast, segmental rectosigmoid resection with separate removal of the reproductive organs involved hysterectomy and bilateral salpingo-oophorectomy performed independently from rectosigmoid resection, with

subsequent colorectal reanastomosis. This approach was generally utilized when disease distribution allowed for separation of gynecologic and colorectal components without compromising cytoreductive goals. The choice between MPPE and segmental rectosigmoid resection was made intraoperatively at the discretion of the attending surgeon, based on disease extent, involvement of adjacent pelvic structures, and the feasibility of achieving complete gross resection. Colorectal anastomoses were performed according to surgeon preference, most commonly using a stapled end-to-end or end-to-side technique, with selective use of diverting loop ileostomy based on intraoperative assessment of anastomotic integrity and patient risk factors.

In general, rectosigmoid resection was performed when disease involvement of the bowel precluded complete cytoreduction without resection. This included cases with extensive serosal disease, bulky peritoneal implants involving the rectosigmoid colon, suspected or confirmed bowel wall invasion, mesenteric involvement, or bowel wall thickening concerning for deeper infiltration. The threshold for resection was guided by the ability to achieve complete gross resection rather than by a single predefined criterion. Pelvic peritonectomy without bowel resection was not included in this study, as the cohort was limited to patients undergoing rectosigmoid resection as part of cytoreductive surgery.

From an anatomic perspective, MPPE involves *en bloc* dissection within the posterior pelvic compartment, incorporating the rectosigmoid colon, posterior vaginal wall, and surrounding peritoneum, often requiring mobilization along retroperitoneal planes and division of the mesorectum to achieve complete resection. In contrast, segmental rectosigmoid resection with separate removal of reproductive organs involves dissection along distinct gynecologic and colorectal planes, allowing separation of the rectum from the posterior vagina when feasible. In both approaches, dissection is guided by tumor distribution and the principle of achieving complete cytoreduction while preserving critical structures when oncologically appropriate.

3. Results

A total of 113 patients met inclusion criteria and were included in the study. Of these, 73 patients (65%) underwent MPPE, while 40 (35%) underwent resection and reanastomosis of the rectosigmoid separate from removal of the reproductive organs. Baseline demographics and disease characteristics were similar between the groups, with no significant differences in age, BMI, race, ethnicity, FIGO stage, or ECOG performance status (Table 1). Notably, a higher proportion of patients in the MPPE group had an ECOG performance status of 0 compared to the non-MPPE group (MPPE 42% (n = 31) vs. non-MPPE 23% (n = 9), $p = 0.07$). Histologic subtypes were similar between groups (Table 1). High-grade serous carcinoma comprised the majority of cases, with clear cell and endometrioid cancers representing only a small proportion of cases. Rates of MPPE versus non-MPPE resection did not differ by histologic subtype.

Rates of primary versus interval cytoreductive surgery were comparable between groups (MPPE: 51% primary, 49% in-

terval; non-MPPE: 53% primary, 48% interval; $p = 0.85$), suggesting a similar distribution of disease burden and treatment approach across cohorts (Table 2). All patients achieved optimal cytoreduction, defined as residual disease <1 cm. Complete gross resection (R0), the intended surgical endpoint, was achieved in 72/73 (99%) MPPE cases and 37/40 (93%) non-MPPE cases ($p = 0.13$). Although there was no statistically significant difference in cytoreductive outcomes between the MPPE and non-MPPE groups, there was a trend toward more residual disease in the non-MPPE group. MPPE was less likely to have residual disease compared to non-MPPE, though this was not statistically significant (adjusted OR (odds ratio) 0.31, 95% CI: 0.03–2.12, $p = 0.23$).

Rates of prior hysterectomy were similar (MPPE 15% (n = 11) vs. non-MPPE 13% (n = 5), $p = 0.71$). Duration of surgery was comparable in both groups with a median operative time of 7.7 hours (IQR: 6.3–8.4) in the MPPE group compared to 7.6 hours (IQR: 5.3–8.7) in the non-MPPE group ($p = 0.39$). Estimated blood loss was similar between groups, with a median estimated blood loss of 650 mL (IQR: 400–1100 mL) in both the MPPE and non-MPPE groups ($p = 0.53$). Median hospital stay was eight nights in both groups ($p = 0.98$), and the majority of patients were discharged home (MPPE 92% vs. non-MPPE 93%, $p > 0.99$).

When surgical approaches were evaluated over time, both MPPE and diverting loop ileostomy rates demonstrated significant upward trends. Crude linear regression showed that the proportion of MPPE among all surgeries increased significantly over time ($p < 0.001$; Fig. 1). Patients in the MPPE group were significantly more likely to undergo diverting loop ileostomy creation compared to those in the non-MPPE group (86% (n = 63) vs. 55% (n = 22), $p < 0.001$) (Table 2). This association remained statistically significant after adjusting for age at diagnosis, primary versus interval cytoreduction, BMI, and FIGO stage (adjusted OR 6.68, 95% CI: 2.43–20.2, $p < 0.001$). No postoperative ED visit in either group was attributable to dehydration or gastrointestinal symptoms consistent with ileostomy management challenges. All stoma reversals occurred after completion of adjuvant chemotherapy, consistent with institutional practice.

Table 3 displays later postoperative outcomes after MPPE and non-MPPE surgeries. There were no significant differences between groups in rates of 30-day blood transfusion (MPPE 58% (n = 42) vs. non-MPPE 58% (n = 23); $p > 0.99$), ED visits (MPPE 26% (n = 19) vs. non-MPPE 18% (n = 7); $p = 0.30$), or hospital readmission (MPPE 19% (n = 14) vs. non-MPPE 18% (n = 7); $p = 0.83$). Rates of intraoperative bladder cystotomy (MPPE 4.1% (n = 3) vs. non-MPPE 0.0% (n = 0); $p = 0.55$), bowel injury/anastomotic leak (MPPE 8.2% (n = 6) vs. non-MPPE 10% (n = 4), $p = 0.74$), and reoperation (MPPE 5.5% (n = 4) vs. non-MPPE 10% (n = 4), $p = 0.45$) were also comparable. Of the four patients in the MPPE group who experienced intraoperative bladder cystotomies, one underwent intentional cystotomy to allow complete resection of tumor invading the bladder, while the other three were incidental and repaired immediately. Among the six MPPE patients with an anastomotic leak or bowel injury, four required reoperations; similarly, all four non-MPPE patients with an anastomotic leak or bowel injury required reoperation.

TABLE 1. Baseline demographic and clinical characteristics by surgical group.

Characteristic	MPPE		<i>p</i> -value
	Yes (N = 73) ¹	No (N = 40) ¹	
Age at diagnosis	66 (60, 74)	65 (56, 71)	0.27
BMI	23.3 (20.2, 27.7)	24.6 (21.4, 28.4)	0.32
Unknown	0 (0.0%)	1 (2.5%)	
BMI Group			
Normal	40 (55%)	20 (50%)	
Overweight	28 (38%)	18 (45%)	
Underweight	5 (6.8%)	1 (2.5%)	0.55
Unknown	0 (0.0%)	1 (2.5%)	
Race			
White	56 (77%)	33 (83%)	
Asian	11 (15%)	6 (15%)	0.84
Other	6 (8.2%)	1 (2.5%)	
Ethnicity			
Hispanic or Latino	17 (23%)	7 (18%)	
Not Hispanic or Latino	56 (77%)	33 (83%)	0.47
ECOG PS			
0	31 (42%)	9 (23%)	
1	12 (16%)	5 (13%)	
2	2 (2.7%)	1 (2.5%)	0.07
3	0 (0.0%)	1 (2.5%)	
Unknown	28 (38%)	24 (60%)	
FIGO Stage			
I	1 (1.4%)	0 (0.0%)	
II	6 (8.2%)	3 (7.5%)	
III	37 (51%)	23 (58%)	0.94
IV	29 (40%)	14 (35%)	
Tumor Histology			
High-grade serous	66 (90.4%)	37 (92.5%)	
Endometrioid	2 (2.7%)	0 (0.0%)	0.89
Clear cell	5 (6.8%)	3 (7.5%)	

¹Median (Q1, Q3) for continuous variables; count (percentage) for categorical variables. Percentages might not sum to 100% due to approximation.

MPPE: modified posterior pelvic exenteration; BMI: Body Mass Index; ECOG PS: Eastern Cooperative Oncology Group Performance Status; FIGO: International Federation of Gynecology and Obstetrics.

Although not statistically significant, rectovaginal fistulas (5.5% (n = 4) vs. 13% (n = 5)) and anastomotic strictures (5.5% (n = 4) vs. 10% (n = 4)) were less frequent in the MPPE group. Rates of early postoperative large bowel obstruction and long-term LAR syndrome were low and similar between groups (1 patient each, *p* > 0.99) (Table 3).

Rates of neoadjuvant chemotherapy (MPPE 49% (n = 36) vs. non-MPPE 48% (n = 19), *p* = 0.85) and adjuvant chemotherapy (MPPE 97% (n = 71) vs. non-MPPE 95% (n = 38), *p* = 0.61) were similar between groups. Maintenance therapy use was also not significantly different (49% (n = 36) vs. 40% (n =

16), *p* = 0.34). The rate of complete response at completion of upfront treatment was higher in the MPPE group compared to the non-MPPE group (93% (n = 68) vs. 80% (n = 32), *p* = 0.05) (Table 3).

There was no significant difference in time from surgery to initiation of postoperative adjuvant treatment, with a median of 38 days (IQR: 31–48) in the MPPE group compared to 36 days (IQR: 28–51) in the non-MPPE group (*p* = 0.64). Among patients without a postoperative bowel leak, the median (IQR) time to chemotherapy was similar between groups at 37 (31–47) days for the MPPE group and 36 (26–53) days for the

TABLE 2. Surgical and immediate postoperative characteristics by surgical group.

Characteristic	MPPE		<i>p</i> -value
	Yes (N = 73) ¹	No (N = 40) ¹	
Primary vs. Interval Cytoreductive Surgery			
Primary cytoreduction	37 (51%)	21 (53%)	0.85
Interval cytoreduction	36 (49%)	19 (48%)	
Prior hysterectomy	11 (15%)	5 (13%)	0.71
Cytoreduction Outcome			
RD 0	72 (99%)	37 (93%)	0.13
RD 1–10	1 (1.4%)	3 (7.5%)	
RD >10	0 (0.0%)	0 (0.0%)	
Duration of Surgery (min)	461 (378, 506)	455 (321, 525)	0.39
Estimated Blood Loss			
0–250 mL	1 (1.4%)	2 (5.0%)	0.53
251–500 mL	29 (40%)	14 (35%)	
501–1000 mL	20 (27%)	10 (25%)	
>1000 mL	23 (32%)	14 (35%)	
Estimated Blood Loss Group			
≤500 mL	30 (41%)	16 (40%)	0.91
>500 mL	43 (59%)	24 (60%)	
Diverting loop ileostomy	63 (86%)	22 (55%)	<0.001
Hospital Stay (#nights)	8.0 (6.0, 10.0)	8.0 (6.0, 9.5)	0.98
Discharge Location			
Home	67 (92%)	37 (93%)	>0.999
SNF	6 (8%)	3 (7%)	

¹Median (Q1, Q3) for continuous variables; count (percentage) for categorical variables. Percentages might not sum to 100% due to approximation.

MPPE: modified posterior pelvic exenteration; RD: residual disease; SNF: skilled nursing facility.

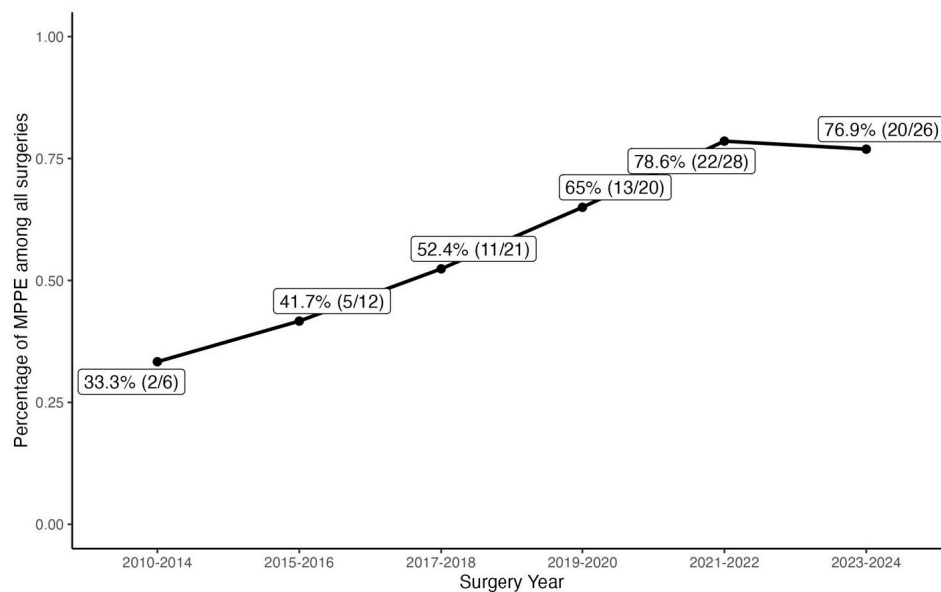


FIGURE 1. Linear trend in percentage of MPPE among all surgeries over time. MPPE: modified posterior pelvic exenteration.

TABLE 3. Perioperative events, adjuvant therapy, and disease outcomes by surgical group.

Characteristic	MPPE		<i>p</i> -value
	Yes (N = 73) ¹	No (N = 40) ¹	
Postoperative Complications within 30 days from hospital discharge			
ED presentation	19 (26%)	7 (18%)	0.30
Hospital readmission	14 (19%)	7 (18%)	0.83
Intraoperative Bladder Cystotomy	3 (4.1%)	0 (0.0%)	0.55
Bowel injury/leak	6 (8.2%)	4 (10%)	0.74
Blood transfusion	42 (58%)	23 (58%)	>0.999
Reoperation	4 (5.5%)	4 (10%)	0.45
CT imaging	29 (40%)	11 (28%)	0.19
Large bowel obstruction	1 (1.4%)	1 (2.5%)	>0.999
Long-term postoperative complications			
Rectovaginal fistula	4 (5.5%)	5 (13%)	0.28
Anastomotic stricture	4 (5.5%)	4 (10%)	0.45
Large bowel obstruction	3 (4.1%)	2 (5.0%)	>0.999
LAR syndrome	1 (1.4%)	1 (2.5%)	>0.999
Adjuvant treatment	71 (97%)	38 (95%)	0.61
Time between surgery and starting adjuvant treatment (d)	38 (31, 48)	36 (28, 51)	0.64
Disease status at completion of upfront treatment			
Complete response	68 (93%)	32 (80%)	0.05
Partial response	0 (0.0%)	2 (5.0%)	
Stable disease	0 (0.0%)	1 (2.5%)	
Progressive disease	5 (6.8%)	5 (13%)	0.34
Maintenance therapy	36 (49%)	16 (40%)	
Recurrence	45 (64%)	26 (70%)	
Unknown	3 (4.1%)	3 (7.5%)	0.53
Recurrent pelvic carcinomatosis	38 (52%)	20 (54%)	0.84
Unknown	0 (0.0%)	3 (7.5%)	

¹Median (Q1, Q3) for continuous variables; count (percentage) for categorical variables. Percentages might not sum to 100% due to approximation.

MPPE: modified posterior pelvic exenteration; ED: emergency department; CT: computed tomography; LAR: low anterior resection.

non-MPPE group. Among patients who experienced a postoperative bowel leak (MPPE *n* = 6, non-MPPE *n* = 4), the median (IQR) time to initiation of adjuvant chemotherapy was 41 (5, 65) days in the MPPE group and 37 (34, 45) days in the non-MPPE group. Notably, two non-MPPE patients-initiated chemotherapy substantially later, at 65 and 69 days postoperatively, both due to prolonged recovery from anastomotic leak-related complications, including the need for reoperation, ICU (intensive care unit) admission, sepsis, extended hospital stays, and delayed return of bowel function. Given the small number of patients with a bowel leak, no formal statistical comparison was performed.

There was no difference in recurrence rates between the groups (MPPE 64% vs. non-MPPE 70%; *p* = 0.53). Median recurrence-free survival was 21.0 months (95% CI, 16.4–30.3) in the non-MPPE group and 17.2 months (95% CI, 15.2–23.1)

in the MPPE group (*p* = 0.39) (Fig. 2). Median overall survival (OS) was 51.0 months (95% CI: 34.4–88) for the non-MPPE vs. 55.0 months (95% CI: 40.5–128) for the MPPE (*p* = 0.69), with mortality rates of 37% and 43%, respectively (*p* = 0.57). The Kaplan-Meier curves were overlapping for overall survival between groups (Fig. 2).

In terms of recurrence patterns, rates of recurrent pelvic carcinomatosis were comparable between groups (52% MPPE vs. 54% non-MPPE, *p* = 0.84) (Table 3). Additionally, long-term large bowel obstruction was infrequent and occurred at similar rates in both cohorts (1.4% (*n* = 1) MPPE vs. 2.5% (*n* = 1) non-MPPE), with no significant difference observed (*p* > 0.99) (Table 3).

In unadjusted Cox regression models, MPPE was not significantly associated with recurrence-free survival (HR 0.76, 95% CI: 0.40–1.44, *p* = 0.40) or overall survival (HR 1.13, 95% CI:

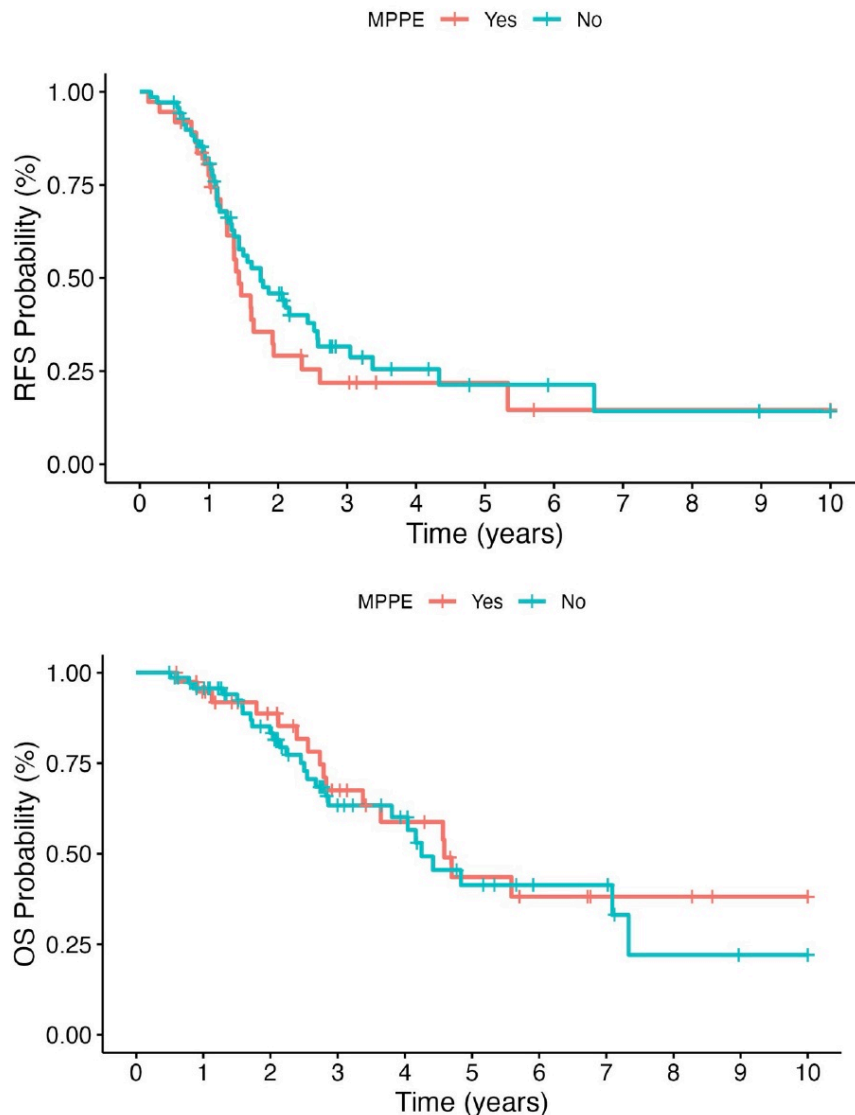


FIGURE 2. Recurrence-free and overall survival. MPPE: modified posterior pelvic exenteration; OS: overall survival; RFS: recurrence-free survival.

0.61–2.09, $p = 0.69$). After adjusting for age at diagnosis, BMI, FIGO stage, and primary versus interval cytoreduction, MPPE was not statistically associated with recurrence-free survival (adjusted HR 0.75, 95% CI: 0.38–1.48, $p = 0.41$) or overall survival (adjusted HR 0.94, 95% CI: 0.50–1.78, $p = 0.85$).

4. Discussion

In this retrospective cohort study of patients undergoing cytoreductive surgery for advanced ovarian cancer, MPPE achieved high rates of complete gross resection without increased perioperative morbidity or inferior survival compared to segmental resection of the rectosigmoid colon with separate reanastomosis. To our knowledge, this is the first direct comparison of these two techniques in this setting, addressing a gap in the literature where prior studies have largely been single-arm series or have grouped pelvic resections without distinguishing between surgical approaches.

MPPE resulted in cytoreductive outcomes comparable to

those achieved with segmental rectosigmoid resection, with complete gross resection rates of 99% and 93%, respectively. Operative time, blood loss, and length of stay were similar between groups, reflecting the magnitude of high-complexity cytoreduction, with median operative duration exceeding seven hours in both cohorts. Short-term complication rates—including transfusion, postoperative emergency department visits, and hospital readmissions—were comparable, and use of hyperthermic intraperitoneal chemotherapy increased over the study period but remained infrequent. Rectovaginal fistulas (5.5% versus 13%) and anastomotic strictures (5.5% versus 10%) were numerically fewer after MPPE, although these differences were not statistically significant.

MPPE was associated with a higher complete response rate following upfront treatment (93% versus 80%, $p = 0.05$), and the median time to initiation of adjuvant chemotherapy (38 days) was consistent with expectations after radical pelvic surgery. Rates of recurrent pelvic carcinomatosis and overall survival were similar between groups.

Subgroup analysis suggested that anastomotic leak con-

tributed to chemotherapy delays, particularly in the group undergoing segmental rectosigmoid resection. Greater variability in postoperative recovery—including delayed return of bowel function, prolonged hospitalization, reoperation, and admission to the intensive care unit—contributed to a wider range of chemotherapy start times in this cohort. Differences in use of diverting ileostomy, which was more common in the MPPE group, may have mitigated the clinical consequences of leaks, although the small number of leaks prevented meaningful statistical comparison.

The higher rate of diverting loop ileostomy in the MPPE cohort is an important consideration, particularly in the context of patient quality of life. While diverting ileostomy may reduce the clinical consequences of anastomotic complications, it is associated with its own morbidity, including dehydration, electrolyte abnormalities, need for additional surgery for reversal, and potential impact on patient well-being.

In this study, no postoperative emergency department visits were attributed to ileostomy-related complications, and all stomas were reversed following completion of adjuvant therapy, consistent with institutional practice. These findings suggest that, in this cohort, ileostomy creation was generally well tolerated. However, the potential quality-of-life implications remain important in surgical decision-making, particularly when both MPPE and segmental resection are technically feasible.

The higher rate of ileostomy in the MPPE group likely reflects surgeon preference and intraoperative risk assessment in the setting of more extensive *en bloc* pelvic resection, rather than an inherent requirement of the technique itself.

The timing of cytoreductive surgery (primary versus interval) is an important consideration in advanced ovarian cancer, as it may reflect underlying disease burden and influence surgical complexity and perioperative outcomes. In this cohort, the distribution of primary and interval cytoreductive surgery was similar between the MPPE and non-MPPE groups, and this variable was included in multivariable analyses. These findings suggest that differences in surgical timing were unlikely to have significantly influenced the observed comparisons in perioperative or oncologic outcomes. However, we acknowledge that residual confounding related to disease biology and treatment response cannot be fully excluded in a retrospective study.

The trend toward higher complete gross resection rates with MPPE aligns with prior studies showing improved outcomes when complete cytoreduction is achieved through either MPPE or segmental resection [11–15]. Rates of recurrent pelvic carcinomatosis were similar, suggesting that neither surgical approach altered long-term oncologic risk. Operative time, blood loss, and length of stay were comparable between groups, consistent with literature demonstrating that radical pelvic surgery does not necessarily increase morbidity [1, 11–15].

Short-term complication rates, including transfusion, emergency department visits, and readmissions, were consistent with previously published data supporting the perioperative safety of radical pelvic surgery and MPPE specifically [1, 14]. Bladder cystotomy was rare across both groups; the single intentional cystotomy in the MPPE cohort reflected disease-related involvement, while incidental cystotomies were re-

paired without sequelae.

Prior work has highlighted the substantial morbidity and negative quality-of-life consequences associated with rectovaginal fistulas and anastomotic strictures. The numerically lower rates of these complications after MPPE may relate to the surgical principle of separating the rectum and vagina to increase the distance between the colorectal anastomosis and the vaginal cuff, thereby potentially reducing fistula risk. Although these differences were not statistically significant, they may represent clinically meaningful trends.

Similar survival outcomes between groups mirror findings from prior studies showing no significant survival differences between pelvic peritonectomy and segmental resection of the rectosigmoid colon [15–17]. Comparable timing of postoperative chemotherapy initiation is also consistent with evidence that radical pelvic surgery can be integrated safely into cytoreductive surgery pathways without compromising systemic therapy timelines [1, 14].

Strengths of this study include a well-defined patient population, detailed perioperative and survival data, and a direct comparison of two anatomically and technically distinct pelvic cytoreductive approaches within a high-volume tertiary center. These data provide clinically meaningful information to inform operative planning, wherein the choice between MPPE and segmental rectosigmoid resection is often driven by the surgeon's intraoperative assessment of feasibility and resectability.

Several limitations warrant consideration. The retrospective design introduces the possibility of selection bias, although baseline characteristics were largely balanced between groups. Missing Eastern Cooperative Oncology Group performance status data (45.6%) limited inclusion of this variable in adjusted analyses, and estimates derived from multiple imputation may have high variance. While the overall sample size is robust for a single-institution study, it remains insufficiently powered to detect rare complications, and the small number of anastomotic leaks limits interpretation of subgroup findings. Functional outcomes and quality-of-life measures were not collected and represent important areas for future investigation. Additionally, detailed preoperative variables such as laboratory parameters, tumor markers, and radiologic response assessments were not consistently available across the study period and therefore were not included in this analysis. As a result, this study does not address factors influencing initial patient selection for surgery.

No institutional changes in perioperative or surgical practice occurred during the study period, and all cytoreductive surgeries were performed through laparotomy. The increasing adoption of MPPE likely reflects an evolution in surgical philosophy and individual surgeon preference rather than changes in patient characteristics. Small numbers of cases per surgeon prevented meaningful evaluation of surgeon-level effects.

The findings of this study support MPPE as a safe and effective technique for achieving complete cytoreduction in appropriately selected patients with advanced ovarian cancer. Perioperative and oncologic outcomes were comparable to those achieved through segmental resection of the rectosigmoid colon, and the potential for reduced rates of rectovaginal fistula and anastomotic stricture, as well as consistent systemic

therapy timelines, may offer practical advantages when both operations are technically feasible.

Higher rates of ileostomy creation in the MPPE cohort reflect surgeon judgment in the context of more extensive *en bloc* pelvic dissections and should not be interpreted as an inherent disadvantage of the technique. Given the low frequency of complications such as fistula and stricture, larger multicenter studies are needed to determine whether diverting ileostomy meaningfully modifies these risks.

These results should be viewed as exploratory given the modest sample size, but they provide important insight into institutional patterns and outcomes and into the evolving role of MPPE within cytoreductive strategies. Future research should prioritize multicenter collaborations, evaluation of functional and quality-of-life outcomes, and development of refined patient selection criteria for MPPE versus segmental rectosigmoid resection.

5. Conclusions

This first comparison of MPPE and segmental rectosigmoid resection shows that both techniques achieve high rates of complete resection with similar morbidity and survival. MPPE demonstrated numerically fewer pelvic complications without delaying recovery or chemotherapy. These results support MPPE as a safe option for *en bloc* cytoreduction and highlight the need for prospective studies addressing patient selection and long-term functional outcomes.

AVAILABILITY OF DATA AND MATERIALS

The datasets generated and/or analyzed during the current study are not publicly available due to institutional data privacy regulations but are available from the corresponding author on reasonable request and with appropriate institutional approvals.

AUTHOR CONTRIBUTIONS

SS—performed the research and analyzed the data. JQZ—provided assistance and guidance on data management and statistical analysis. AK—supervised the study and contributed to the conceptualization, study design, and interpretation of results. TG and SBT—contributed to the interpretation of results. SS, JZ, TG, SBT and AK—wrote and critically revised the manuscript. All authors contributed to editorial changes in the manuscript. All authors read and approved the final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study was approved by the Stanford University Institutional Review Board (IRB Protocol #77171). Given the retrospective nature of the study, the requirement for informed consent was waived by the Institutional Review Board.

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CONFLICT OF INTEREST

The authors declare no conflicts of interest related to this study. No financial support, commercial affiliations, or other relationships that could be perceived to influence the work reported in this manuscript were disclosed by any of the authors.

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