

ORIGINAL RESEARCH ARTICLE

Clinical study of concurrent chemoradiotherapy for remedial treatment of occult invasive cervical cancer: A long-term retrospective study

Zhiru Li¹, Dong Yang^{2,3}, Junmei Song^{2,3}, and Chao Li^{4*}¹Department of Oncology, Sichuan Provincial People's Hospital and Qionglai Medical Center Hospital, Chengdu, Sichuan, China²Department of Radiation Oncology, The First Affiliated Hospital of Guangxi Medical University, Nanning, Guangxi, China³Guangxi Tumor Radiation Therapy Clinical Medical Research Center, Nanning, Guangxi, China⁴Department of Obstetrics and Gynecology, Sichuan Provincial People's Hospital and Wenjiang District People's Hospital, Chengdu, Sichuan, China

Abstract

Introduction: Occult invasive cervical cancer (OICC) is occasionally detected after simple extrafascial hysterectomy, lacking unified optimal salvage management guidelines. Radical reoperation and remedial concurrent chemoradiotherapy are two mainstream strategies, while their long-term survival and toxicity differences remain insufficiently clarified.

Objective: To compare the efficacy and side effects of concurrent chemoradiotherapy with radical reoperation for OICC salvage treatment.

Methods: Seventy-four patients with OICC who underwent extrafascial hysterectomy between 2013 and 2024 at three hospitals were enrolled. Forty patients received radical concurrent chemoradiotherapy plus 3D intracavitary brachytherapy (radiotherapy group); 34 underwent abdominal/laparoscopic radical hysterectomy plus pelvic $\pm$ para-aortic lymphadenectomy, among whom 10 received adjuvant chemoradiotherapy for high-risk factors (surgery group). Recurrence, survival, surgical and radiochemotherapy-related toxicities were analyzed.

Results: Median follow-up was 48 (15–106) months (surgery group) and 56 (21–112) months (radiotherapy group), with four recurrent patients in each cohort. No significant intergroup differences were found in 5-year overall survival (94.5% vs. 93.5%, $p = 0.728$) and disease-free survival (88.1% vs. 86.7%, $p = 0.789$). Distinct mild-to-moderate treatment-related complications were observed in both groups, with only rare grade 3 toxicities in the radiotherapy group and no severe long-term adverse events.

Conclusion: Radical reoperation and salvage concurrent chemoradiotherapy yield equivalent curative outcomes for post-hysterectomy OICC with tolerable complications. Adjuvant chemoradiotherapy after reoperation increases complication risks, which may be alleviated via precise radiotherapy techniques.

Keywords: Chemoradiotherapy; Surgery; Occult; Cervical cancer

***Corresponding author:**Chao Li
(lichao@ql-med.fun)

Citation: Li Z, Yang D, Song J, Li C. Clinical study of concurrent chemoradiotherapy for remedial treatment of occult invasive cervical cancer: A long-term retrospective study. *Eurasian J Med Oncol*. doi: 10.36922/EJMO025390409

Received: September 22, 2025**Revised:** June 4, 2026**Accepted:** June 18, 2026**Published online:** July 10, 2026

Copyright: © 2026 Author(s). This is an Open-Access article distributed under the terms of the Creative Commons Attribution License, permitting distribution, and reproduction in any medium, provided the original work is properly cited.

Publisher's Note: AccScience Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

1. Introduction

Occult invasive cervical cancer (OICC) refers to invasive cervical carcinoma that is incidentally diagnosed after a hysterectomy performed for benign gynecological conditions. Inadequate preoperative evaluation, including incomplete screening, lack of Pap smear testing, diagnostic errors, and false-negative Pap smear results, leads to the diagnosis of Stage IA1 or more advanced OICC in 3.5% of invasive cervical cancer cases following simple hysterectomy.^{1,2} Recent studies have further confirmed that up to 31.7% of patients diagnosed with cervical adenocarcinoma *in situ* by routine punch biopsy have occult invasive lesions, which is a major cause of OICC occurrence after simple hysterectomy. Cervical cancer ranks fourth in terms of morbidity and mortality among female malignancies worldwide, posing a severe threat to women's reproductive health.³⁻⁵ In recent decades, the incidence of OICC has declined from 12.9% to 2.7% due to advances in preoperative screening technologies and increased patient health awareness. However, inadequate preoperative examinations in primary medical institutions remain the primary cause of OICC,⁶ especially the high false-negative rate of conventional screening for specific human papillomavirus subtypes and endocervical lesions.⁷

The 2023 National Comprehensive Cancer Network Clinical Practice Guidelines for Cervical Cancer specify that an extrafascial or simple hysterectomy is only indicated for Stage IA1 cervical cancer. Radical hysterectomy or radiotherapy is recommended for Stage IA2 to IIA disease, and concurrent chemoradiotherapy (CCRT) is the standard treatment for tumors larger than Stage IB (e.g., lymph node-positive tumors and those at Stage IIB or higher).^{3,8} The American Cancer Society cervical cancer screening guidelines further identify OICC high-risk populations and recommend enhanced combined screening protocols,⁹ but current guidelines still do not define an optimal remedial treatment strategy for OICC diagnosed post-simple hysterectomy.⁸ Radical reoperation for OICC is associated with elevated surgical risks, including scarring, adhesion, and intraoperative complications, as well as increased economic burden for patients. Radiotherapy, on the other hand, may cause ovarian dysfunction, sexual impairment, and complications of the intestinal and urinary systems.¹⁰⁻¹²

Routine preoperative screening for cervical cancer, including magnetic resonance imaging, pelvic ultrasound, and Pap smear testing, is performed in approximately 85% of clinical cases. However, false-negative results of cervical cytology cannot be completely avoided, and even intensive preoperative examinations fail to eliminate the occurrence of OICC.¹³ A large global cohort study confirmed that human papillomavirus 45/52/58 subtypes are high-risk

factors for occult cervical neoplasia, with a false-negative rate of 41.2% for the conventional ThinPrep cytology test.⁷ Adjuvant therapy is therefore essential for OICC patients: those with Stage IA1 disease without lymphovascular invasion do not require further treatment, whereas the 2-year recurrence rate after surgery ranges from 10% to 20% in patients with Stage IB to IIA disease. Recurrent cases carry a poor prognosis, with a 2-year survival rate of only 18.5% to 35.0%.¹³ Patients with pathological high-risk factors, such as lymph node metastasis, positive incisional margin, parametrial invasion, deep cervical stromal infiltration, vascular emboli, and large local tumors, have a higher recurrence risk, and postoperative adjuvant therapy can reduce this risk. However, there is no clinical consensus on the optimal adjuvant regimen.^{6,14} Current optional treatment strategies include radical panhysterectomy with pelvic lymph node dissection, partial vaginal resection, and adjuvant radiotherapy with or without CCRT.² A recent multicenter retrospective study on OICC salvage treatment also confirmed the clinical dilemma of selecting between reoperation and CCRT,^{15,16} which further supports the necessity of this study. This study compared the survival outcomes and complications of OICC patients treated with CCRT or radical reoperation, aiming to explore a more optimal remedial treatment strategy based on the latest clinical evidence and technical standards.

2. Methods

2.1. General information

The medical records of patients with OICC, accidentally discovered during simple hysterectomy, at the Zigong First People's Hospital, Qionglai Medical Center Hospital, and Chengdu Fifth People's Hospital between 2013 and 2023 were retrospectively analyzed. Patients with an interstitial infiltration depth < 3 mm, no vascular invasion, and locally advanced stages were excluded. Histopathological records revealed that most patients were referred and admitted to other hospitals. The details of the preoperative diagnosis and surgical scope were unclear, and the preoperative disease stage could not be determined. However, patients were classified into a radical reoperation group (the operation group) and a salvage chemoradiotherapy group (the radiotherapy group) based on different treatment methods. The following parameters were included in the analyses: age, body mass index, International Federation of Gynecology and Obstetrics stage, histopathological reports (including tumor size, marginal positivity, risk factors such as lymphatic vessel invasion), treatment outcomes, and complications.

2.2. Ethics statement

The study was approved by the Ethics Committee of

Qionglai Medical Center Hospital, and written informed consent was obtained from patients, in accordance with the 2013 revision of the Declaration of Helsinki.

2.3. Treatment strategy

All patients in the radiotherapy group received radical CCRT and three-dimensional intracavitary brachytherapy. The pelvic irradiation volume of intensity-modulated radiation therapy (IMRT) external irradiation refers to the 2011 consensus on the delineation of target areas of radical cervical cancer by the American Association for Radiation Therapy.^{17,18} The gross tumor volume is the lymph node in the positive region, and the clinical target volume (CTV) is the subclinical area, including 2 mm below the cervix (1/3 above the vagina) and the stump, paruterine soft tissue, and pelvic lymphatic drainage area. All patients received the prescribed dose of IMRT external pelvic irradiation, 45 Gy/25f (1.8 Gy/f). If pelvic and/or para-aortic lymph nodes were positive, the dose was escalated to 55–60 Gy. We used the Varian Eclipse planning system for planning, design, and optimization. Additionally, 6MV-X-ray (Varian Medical Systems, United States) was used with seven equal-center coplane radiography fields, and the radiation dose for key organs at risk was as follows: rectal, $V_{40} < 40\%$ (i.e. less than 40% of the volume of radiation is more than 40 Gy); bladder, $V_{40} < 50\%$; small intestine, $V_{30} < 40\%$; femoral head, $V_{40} < 10\%$; and spinal cord, D_{max} (maximum point dose) < 45 Gy. Three-dimensional brachytherapy was performed with a Dutch Heitong 192Ir high-dose-rate post-loading apparatus (Nucletron B.V., Netherlands). After three-dimensional optimization guided by computed tomography (CT) images, tumor target areas and organs at risk were delineated according to the Gynecologic Groupe Européen de Curiethérapie recommended standards. A single prescription dose of high-risk CTV 6–6.5 Gy was administered 4–5 times, twice a week: external irradiation and brachytherapy of high-risk CTV $D_{90} > 80$ Gy and intermediate-risk CTV $D_{90} > 75$ Gy (equivalent dose in 2Gy, EQD2). During radiotherapy, cisplatin was administered weekly at 40 mg/m² for 4–6 weeks.

In the surgery group, patients underwent extensive hysterectomy+pelvic lymphadenectomy $\pm$ abdominal para-aortic lymphadenectomy. Intermediate- and high-risk factors were evaluated after the surgical operation. The intermediate-risk factors included large tumor size (maximum diameter of surgical specimen of 4 cm), deep interstitial infiltration (cervical infiltration ≥ 0.5 cm), and lymphovascular lumen invasion. The high-risk factors included positive incisional margin, paracentral invasion, and positive pelvic or para-aortic lymph nodes. All postoperative patients with two intermediate or one

high-risk factor recovered bladder function 2–3 weeks after urinary tube removal and were treated with IMRT external pelvic irradiation and concurrent chemotherapy; the external irradiation and chemotherapy regimens were the same as those administered in the radiotherapy group (Figure 1).

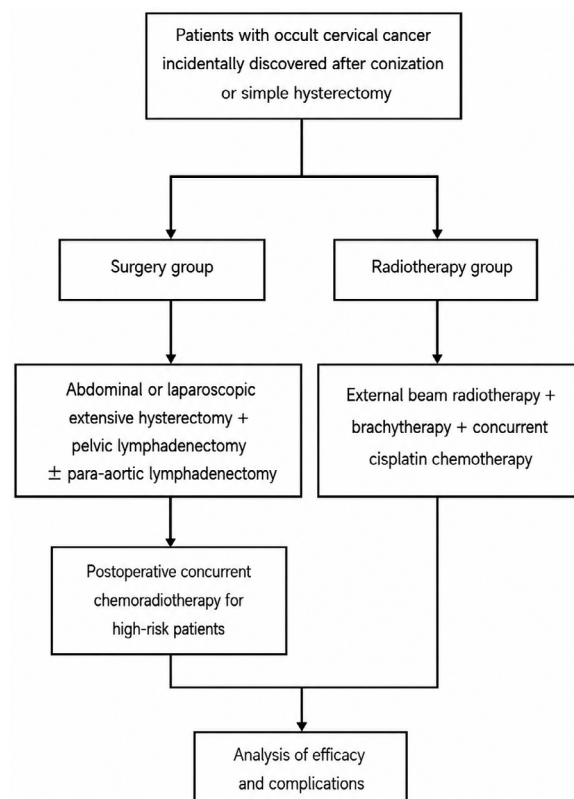


Figure 1. Research process and treatment strategy

2.4. Evaluation of efficacy, toxicity, and side effects

Treatment efficacy was uniformly evaluated according to the Response Evaluation Criteria in Solid Tumors¹¹ and classified as complete response, partial response, stable disease, or progressive disease. Complete and partial responses were valid responses. The Clavien–Dindo complication scale was used to assess postoperative complications, whereas acute radiation reactions were evaluated according to the American Association for Radiation Therapy/European Organization for Research in Cancer Therapy acute radiation injury scale.

2.5. Follow-up procedure

Follow-up was conducted every three months for two years, every six months for 2–5 years after treatment, and once a year if there was no recurrence. Follow-up included medical history-taking, physical examination, imaging,

and Pap smear. The follow-up was primarily conducted through outpatient and telephone follow-ups. Overall survival began on day 1 of radiotherapy or on the date of completion of surgery and continued until death or the end of the follow-up period. Progression-free survival was calculated from the first day of radiotherapy or the date of completion of surgery until the first discovery of tumor recurrence. The follow-up period was till June 30, 2024.

2.6. Statistical analysis

The Statistical Package for Social Sciences version 26.0 was used for statistical analysis, and GraphPad Prism 8.3.0 was used to prepare the graphs. Data with normal distribution were expressed as mean $\pm$ standard deviation ($\bar{x} \pm s$) and counting data as a composition ratio. A *t*-test was used to compare the groups, and data with non-normal distributions were reported as medians (maximum and minimum values). The Mann–Whitney U test was used to compare the groups. χ^2 test and Kaplan–Meier method were used for disease-free survival (DFS) and overall survival (OS) analyses. The log-rank test was used to compare the survival rate between the two groups. $p < 0.05$ was considered statistically significant.

3. Results

3.1. Patient characteristics

A total of 74 patients with stage IA2–IIA2 OICC were included in this study, all of whom had pathological types of squamous cell carcinoma, including 34 and 40 patients in the surgery and radiotherapy groups, respectively. The mean age of patients in the surgery and radiotherapy groups was 51 ± 11 years and 52 ± 12 years, respectively ($p = 0.519$), while the mean body mass index was 22.79 ± 3.4 kg/m² and 21.96 ± 3.5 kg/m², respectively ($p = 0.47$). Federation of Gynecology and Obstetrics staging in the radiotherapy and surgery groups was 20% and 17.6% for IA, 55% and 58.8% for IB, and 25% and 23.5% for IIA, respectively ($p = 0.971$). The maximum tumor size in the surgery and radiotherapy groups was 20 ± 7 mm and 22 ± 9 mm, respectively ($p = 0.55$). Interstitial infiltration depth > 5 mm was found in 23.5% of patients in the surgery group and 25% ($p = 0.612$) of those in the radiotherapy group, whereas lymphatic vascular spatial involvement was found in 29.4% of patients in the surgery group and 30% ($p = 0.62$) of those in the radiotherapy group (Table 1).

3.2. Comparison of complications

In the surgery group, 22 patients (64.7%) underwent laparoscopic surgery, and 12 (35.3%) underwent open surgery. Of the 34 patients in the surgery group, 10 (29.4%) received postoperative adjuvant radiotherapy

and synchronous chemotherapy due to postoperative high-risk factors, with no intraoperative complications. A total of 16 patients had postoperative complications. Six patients had lymphedema (Clavien–Dindo grade I), four of whom underwent postoperative radiotherapy; four had bladder dysfunction (Clavien–Dindo grade I and III, two cases each); and four had hydronephrosis (Clavien–Dindo grade I). There were four cases of partial intestinal obstruction (Clavien–Dindo grade I) and four cases of pelvic lymphocysts (Clavien–Dindo grade I and III, two cases each).

In the radiotherapy group, all patients underwent pelvic IMRT, external irradiation, or three-dimensional brachytherapy. Six patients developed bone marrow suppression, and two developed radiation enteritis, requiring treatment that prolonged the overall radiotherapy duration. Twenty patients had acute complications, including 14 patients with grade I–II acute rectal reaction, 14 patients with grade I–II acute bladder reaction, and six patients with lymphedema. There were two cases each of grade 3 urinary tract and digestive tract adverse reactions, which were characterized by pain during urination accompanied by gross hematuria and intestinal obstruction, respectively; however, no long-term complications occurred (Figure 2, Table 2).

3.3. Comparison of therapeutic effect

The median follow-up time of the surgery group was 48 months (15–106 months), and four patients had recurrence and metastasis: one patient developed lung metastasis at 18 months and died of multiple metastases throughout the body after radiotherapy and chemotherapy; one patient developed pelvic recurrence at 35 months and died of renal failure after refusing further treatment; one patient developed lumbar metastasis and received radiotherapy; and one patient developed abdominal lymph node metastasis. In the radiotherapy group, the median follow-up time was 56 months (21–112 months), and metastasis was found in four patients, at 12–44 months. Of these patients, the overall survival times after treatment were 21, 33, and 68 months; the remaining patient with abdominal and lung metastases was alive throughout the follow-up period. No pelvic recurrence was found in the radiotherapy group. The 5-year OS and DFS rates were 94.5% and 93.5% ($p = 0.728$), respectively, in the surgery group and 88.1% and 86.7% ($p = 0.789$), respectively, in the radiotherapy group (Figure 3).

4. Discussion

Cervical cancer poses a major threat to the health of women worldwide and ranks fourth in terms of morbidity and mortality among female malignancies.^{3–5,19} OICC

Table 1. Comparison of clinical data between the two groups

Variables	Radiotherapy group (<i>n</i> = 40)	Surgery group (<i>n</i> = 34)	<i>p</i> -value
Age (years)			
≤45	16 (40.0)	12 (35.3)	0.519
>45	24 (60.0)	22 (64.7)	
Body mass index, kg/m ² (mean± standard deviation)	21.96 ± 3.52	22.79 ± 3.40	0.47
Follow-up (mean± standard deviation, range)	57 ± 25 (21–112)	52 ± 23 (15–106)	
Concomitant disease			
Hypertension	10 (25.0)	8 (23.5)	0.622
Diabetes	6 (15.0)	6 (17.6)	
Stage (Federation of Gynecology and Obstetrics)			
IA	8 (20.0)	6 (17.6)	0.971
IB	22 (55.0)	20 (58.8)	
IIA	10 (25.0)	8 (23.5)	
Pathological grading			
1	12 (30.0)	10 (29.4)	0.952
2	10 (25.0)	10 (29.4)	
3	18 (45.0)	14 (41.2)	
Tumor diameter			
≤20 mm	28 (70.0)	22 (64.7)	0.502
>20 mm	12 (30.0)	12 (35.3)	
Interstitial infiltration depth			
≤5 mm	30 (75.0)	26 (76.5)	0.612
>5 mm	10 (25.0)	8 (23.5)	
Lymphatic vessel invasion			
Positive	12 (30.0)	10 (29.4)	0.627
Negative	28 (70.0)	24 (70.6)	
Positive incisal margin (vaginal invasion)	2 (5.0)	1 (2.9)	
Positive lymph node			
Pelvic cavity	3 (7.5)	2 (5.9)	0.667
Para-aortic	1 (2.5)	0 (0)	
Recurrence	4 (10.0)	4 (11.8)	0.827
Five-year disease-free survival (%)	86.7	88.1	0.728
Five-year overall survival (%)	93.5	94.5	0.789

Note: Data presented as *n* (%), unless stated otherwise.

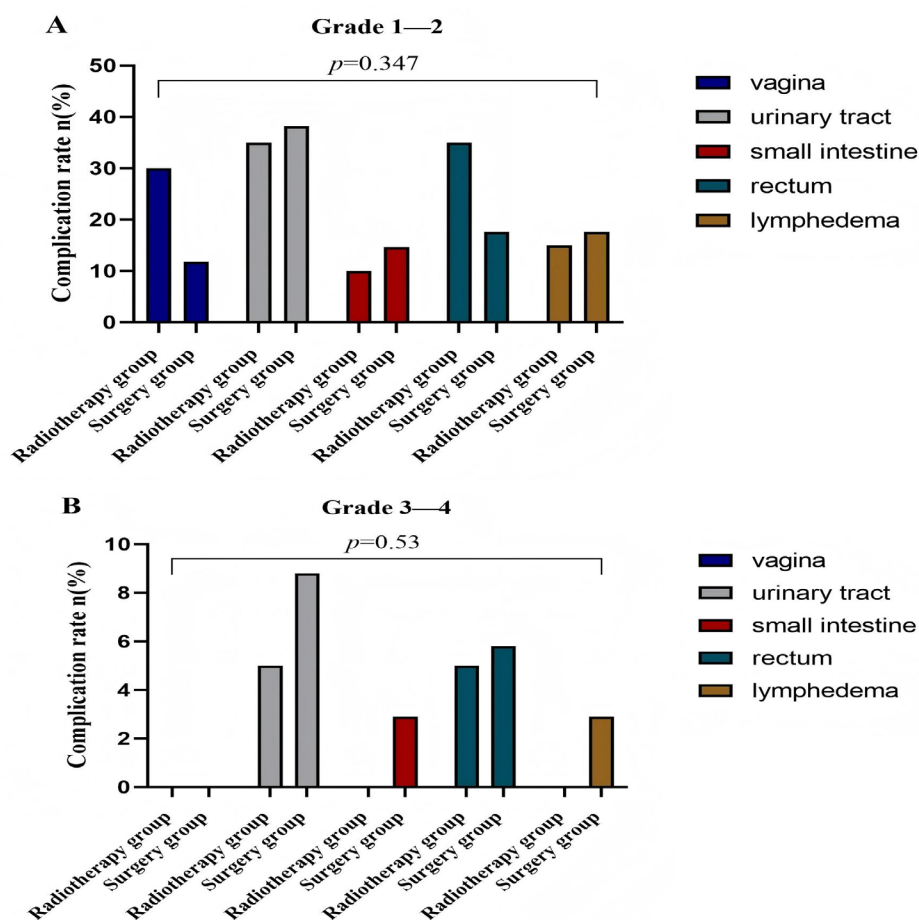


Figure 2. Comparison of complications between the radiotherapy group and the surgery group

Table 2. Related complications in the radiotherapy and surgery subgroups

Complications	Grade 1–2			Grade 3–4		
	Radiotherapy group	Surgery group		Radiotherapy group	Surgery group	
		Simple surgery group (n = 24)	Surgery + radiotherapy group (n = 10)		Simple surgery group (n = 24)	Surgery + radiotherapy group (n = 10)
Vagina	12 (30.0)	0 (0)	4 (40.0)	0 (0)	0 (0)	0 (0)
Urinary tract	14 (35.0)	7 (29.2)	6 (60.0)	2 (5.0)	0 (0)	3 (20.0)
Small intestine	4 (10.0)	3 (12.5)	2 (20.0)	0 (0)	0 (0)	1 (10.0)
Rectum	14 (35.0)	2 (8.3)	4 (40.0)	2 (5.0)	0 (0)	2 (20.0)
Lymphedema	6 (15.0)	2 (8.3)	4 (40.0)	0 (0)	0 (0)	1 (10.0)

Note: Data presented as n (%).

is common and often occurs after a hysterectomy due to leiomyoma or abnormal uterine bleeding.^{13,20-22} In recent decades, the incidence of occult cervical cancer has gradually decreased from 12.9% to 2.7%, owing to the progress in preoperative screening technology and improvement in patients' awareness of the disease. Most studies believe that inadequate preoperative examination, that is, the treatment of benign gynecological diseases in lower-level hospitals, is the most common cause of OICC.⁶

Routine cervical cancer screening procedures, including preoperative magnetic resonance imaging, pelvic ultrasound, and Pap staining, are performed in approximately 85% of the patients in the clinic. Cervical cytology itself may yield false-negative results, and intensive preoperative examinations cannot completely prevent the occurrence of occult cervical cancer.¹³ In the face of this dilemma, adjuvant therapy is necessary. Studies have shown that there is no need for further treatment in patients with non-lymphoid vascular invasion in stage IA1, and the recurrence rate of patients with stage IB–IIA cervical cancer is 10–20% two years after surgery. The prognosis of patients with tumor recurrence is poor, with a 2-year survival rate of only 18.5–35.0%.¹⁵ For patients with risk factors, such as lymph node metastasis, positive incisional margin, paracentral invasion, deep cervical muscle infiltration, vascular embolus, and large local tumor indicated by postoperative pathology, the recurrence rate is high, and postoperative adjuvant treatment could reduce the recurrence risk; however, no guidelines have recommended optimal treatment for OICC. Radical panhysterectomy, partial vaginal resection with pelvic lymph node dissection, or adjuvant radiotherapy with or without concurrent chemotherapy may be considered.

The incidence of surgical complications of radical panhysterectomy after extrafascial hysterectomy has been reported to range from 8.7–30% and mainly includes a need for blood transfusion, ureterovaginal fistula, misincision of the bladder, urinary tract infection, and intestinal obstruction.²³ The relatively high complication rate is associated with the difficulty of the surgery due to the small amount of tissue that can be removed during the operation.²⁴ Leath *et al.*¹⁴ studied 23 patients with OICC, and seven (30%) developed surgical complications after radical panhysterectomy surgery, four of which were intraoperative needs for blood transfusions. The median follow-up time was 61 months (range: 9–103), and the 5-year OS rate was 96%. Kinney *et al.*²⁵ studied 27 patients with OICC who underwent radical reoperation and reported a 5-year OS of 82%, among whom 24 underwent blood transfusion, and two underwent reoperation for ureterovaginal fistula.

Salvage radiotherapy is a feasible treatment option for OICC. Hsu *et al.*²⁶ studied 90 patients with OICC; the conventional external irradiation dose of the four-field box technique was 4,500–5,000 cGy, and 44 patients received routine A-point Ir-192 brachytherapy (median: 2,100 cGy/7 f). The 5- and 10-year OS rates were 85.5% and 74.1%, respectively, and the 5- and 10-year progression-free survival rates were 85.5% and 80.5%, respectively. There were six cases of radioproctitis, four cases of intestinal obstruction, and three cases of hemorrhagic cystitis. Only one patient (1%) had terminal ileal stenosis and severe intestinal obstruction requiring surgical treatment. Koh *et al.*¹ studied 117 patients with occult cervical cancer who received salvage radiotherapy; 32 (33%) received two-dimensional intracavity radiotherapy. The 5-year local

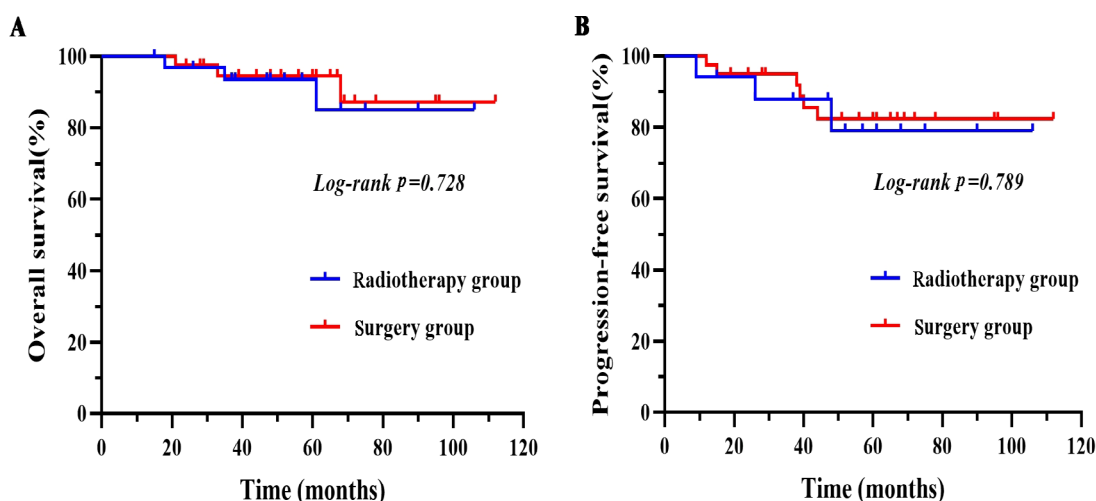


Figure 3. Comparison of progression-free survival and overall survival between the two groups

control rate and OS rate were 95% and 85%, respectively, and 5% of grade 3 or higher late toxic reactions manifested as small bowel obstruction, rectovaginal fistula, severe hematuria, and hip necrosis. Park *et al.*²⁷ reported 99 patients with stage IA2–IIA OICC. There were 26 patients in the observation/chemotherapy group, 44 patients in the radiotherapy (or CCRT) group, and 29 patients in the surgery group. No recurrence was observed in the surgery group during the 116-month follow-up period, compared with 6.8% in the radiotherapy group and 34.6% in the observation group. The 10-year OS rate and DFS rate were 100% and 93%, 63% and 100%, and 94% and 84% in the aforementioned groups, respectively. In the radiotherapy group, toxicities above grade 3 occurred in 4.5%. Narducci *et al.*² retrospectively analyzed 29 patients with OICC, including 13 in the surgery group and 16 in the radiotherapy or CCRT group. The 5-year OS and DFS rates were 100% and 77%, respectively; no grade 3 or higher side effects were observed in the radiotherapy group; one case of lymphocyst in the surgery group required drainage, and 30% of patients required auxiliary external irradiation.

According to relevant studies (Table 3), the 5-year OS rates of radical reoperation and salvage radiotherapy in patients with OICC are approximately 78–86% and 53–93.9%, respectively. The 5-year OS and DFS rates of the surgery and radiotherapy groups in our study were 94.5% and 93.5%, respectively, which were close to

those reported in relevant literature, and there was no significant difference in efficacy between the two groups. Some patients still needed adjuvant chemoradiotherapy after surgery, accounting for 29.4% in the study. However, complications associated with radiotherapy in such patients were significantly higher than those in patients undergoing radical radiotherapy. Considering the increased difficulty of surgery, scar formation, and adhesion formation, the advantage of a second surgery is the potential cure for early-stage cancer in young patients, the lack of need for adjuvant radiotherapy, and the preservation of ovarian and vaginal functions. Hence, if a patient presents with a high need for radiotherapy after a second operation, they should be carefully operated on again. Dual treatment not only increases the financial burden but also requires a larger tumor size for the clinical benefit of such patients. The toxicity and side effects in our study radiotherapy group were lower than those reported in similar studies. In summary, these advantages may be due to advancements in radiotherapy technology. IMRT and three-dimensional brachytherapy technology are increasingly becoming the standard modes of cervical cancer radiotherapy and can achieve good tumor coverage while preserving normal tissue, with good treatment tolerance and fewer complications than conventional radiotherapy. IMRT and three-dimensional brachytherapy may play an important role in achieving better tumor control and lower toxicity in patients with OICC.

Table 3. Results of previous studies

Author	Research period	n	Treatment options (n)	DFS (%)		OS (%)		Complications (grade 3–4)
				5 years	10 years	5 years	10 years	
Koh <i>et al.</i> ¹	1979–2010	117	Radiotherapy	87	84	87	83	Digestive tract: 4.4%; urinary tract: 2.2%
Narducci <i>et al.</i> ²	2000–2010	29	Surgery (13)	86	-	100	-	7.7%
			Radiotherapy (16)	37	-	77	-	-
Bai <i>et al.</i> ⁶	2003–2012	89	Radiotherapy	93.9	-	94.7	-	-
Leath <i>et al.</i> ¹⁴	1994–2000	25	Surgery	-	-	96	-	8%
Hsu <i>et al.</i> ²⁶	1975–1994	90	Radiotherapy	85.5	80.5	85.5	74.1	Digestive tract: 4.4%; urinary tract: 3.3%

(cont'd...)

Table 3. (Continued)

Author	Research period	n	Treatment options (n)	DFS (%)		OS (%)		Complications (grade 3–4)
				5 years	10 years	5 years	10 years	
Kinney <i>et al.</i> ²⁵	1956–1988	27	Surgery	78	-	82	-	7.4%
Park <i>et al.</i> ²⁷	1989–2009	99	Observation (26)	63	63	-	84	-
			Surgery (44)	100	100	-	100	-
			Radiotherapy (29)	93	93	-	94	4.5%
			Radiotherapy (564)	-	-	73.2	-	-
Wang <i>et al.</i> ²⁸	SEER data	2036	Surgery (1,472)	-	-	77.9	-	-
Crane <i>et al.</i> ²⁹	1979–1997	18	Radiotherapy	88	93	88	93	-
Saibishkumar <i>et al.</i> ³⁰	1996–2001	105	Radiotherapy	53.3	-	55.2	-	4.7%
Smith <i>et al.</i> ³¹	1961–2004	25	Radiotherapy	100	100	100	95	2%
			Radiotherapy (44)	-	93.2	100	-	-
Ruengkachorn <i>et al.</i> ³²	2004–2014	57	Surgery (1)	-	-	-	-	-
			Observation (12)	-	-	-	-	-

Abbreviations: DFS: Disease-free survival; OS: Overall survival; SEER: Surveillance, Epidemiology, and End Results.

5. Conclusion

The risk of OICC should not be ignored, and more careful preoperative evaluation and screening are necessary. Patients with OICC can choose either radical reoperation or concurrent chemoradiation, while patients who need chemoradiation after reoperation may develop increased complications. Radical reoperation is recommended for young patients to preserve ovarian function, and remedial chemoradiation is preferred for patients with lymphatic vessel invasion, high-grade tumors, or positive lymph nodes confirmed after a simple hysterectomy.

Acknowledgments

We express our deepest gratitude to the participants of this study.

Funding

This work was supported by the Chengdu Medical Research project in 2023 by the Chengdu Health Commission (No. 2023406) and the 2023 Sichuan Medical Association Youth Innovation Research Project (No. Q23075).

Conflict of interest

The authors declare no competing interests.

Author contributions

Conceptualization: Zhiru Li, Chao Li

Formal analysis: Dong Yang

Funding acquisition: Zhiru Li, Chao Li

Investigation: Dong Yang, Junmei Song

Methodology: Zhiru Li, Dong Yang

Writing–original draft: Zhiru Li, Junmei Song

Writing–review & editing: Zhiru Li, Chao Li

Ethics approval and consent to participate

This study was approved by the Ethics Committee of Qionglai Medical Center Hospital (20240305), and written informed consent was obtained from patients in accordance with the 2013 revision of the Declaration of Helsinki.

Consent for publication

Written consent for the publication of anonymized clinical

data was obtained from each participant. All patient identifiers were removed, and no identifiable images are included in this work.

Availability of data

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

References

- Koh HK, Jeon W, Kim HJ, *et al.* Outcome analysis of salvage radiotherapy for occult cervical cancer found after simple hysterectomy. *Jpn J Clin Oncol.* 2013;43(12):1226-1232.
doi: 10.1093/jjco/hyt137
- Narducci F, Merlot B, Bresson L, *et al.* Occult invasive cervical cancer found after inadvertent simple hysterectomy: is the ideal management: systematic parametrectomy with or without radiotherapy or radiotherapy only? *Ann Surg Oncol.* 2015;22(4):1349-1352.
doi: 10.1245/s10434-014-4140-5
- Cibula D, Rosaria Raspollini M, Planchamp F, *et al.* ESGO/ESTRO/ESP Guidelines for the management of patients with cervical cancer - Update 2023. *Radiother Oncol.* 2023;184:109682.
doi: 10.1016/j.radonc.2023.109682
- Siegel RL, Giaquinto AN, Jemal A. Cancer statistics, 2024. *CA Cancer J Clin.* 2024;74(1):12-49.
doi: 10.3322/caac.21820
- Sung H, Ferlay J, Siegel RL, *et al.* Global Cancer Statistics 2020: GLOBOCAN Estimates of Incidence and Mortality Worldwide for 36 Cancers in 185 Countries. *CA Cancer J Clin.* 2021;71(3):209-249.
doi: 10.3322/caac.21660
- Bai H, Cao D, Yuan F, *et al.* Occult invasive cervical cancer after simple hysterectomy: a multi-center retrospective study of 89 cases. *BMC Cancer.* 2016;16(1):507.
doi: 10.1186/s12885-016-2480-1
- Utkowska W, Tucka B, Szyszkowski J, Krasuski K, Ludwin A, Suchonska B. Histopathological Verification of Abnormal Cytology Results Suggesting High-Grade Intraepithelial Lesions in Women over 50 Years of Age-Evaluation of the Clinical Utility of Conventional Gynecological Cytology. *J Clin Med.* 2025;14(23):8305.
doi: 10.3390/jcm14238305
- Mayadev JS, Ke G, Mahantshetty U, Pereira MD, Tarnawski R, Toita T. Global challenges of radiotherapy for the treatment of locally advanced cervical cancer. *Int J Gynecol Cancer.* 2022;32(3):436-445.
doi: 10.1136/ijgc-2021-003001
- Perkins RB, Wolf AMD, Church TR, *et al.* Self-collected vaginal specimens for human papillomavirus testing and guidance on screening exit: An update to the American Cancer Society cervical cancer screening guideline. *CA Cancer J Clin.* 2026;76(1):e70041.
doi: 10.3322/caac.70041
- Perrucci E, Cerrotta A, Macchia G, *et al.* Postoperative treatment of intermediate-risk early stage cervical cancer: results of a survey from the Gynecology Study Group in the AIRO Gyn and MITO Groups. *Crit Rev Oncol Hematol.* 2022;174:103704.
doi: 10.1016/j.critrevonc.2022.103704
- Chargari C, Peignaux K, Escande A, *et al.* Radiotherapy of cervical cancer. *Cancer Radiother.* 2022;26(1-2):298-308.
doi: 10.1016/j.canrad.2021.11.009
- Hafiz A, Abbasi AN, Ali N, Khan KA, Qureshi BM. Frequency and Severity of Acute Toxicity of Pelvic Radiotherapy for Gynecological Cancer. *J Coll Physicians Surg Pak.* 2015;25(11):802.
- Topdagi Yilmaz EP, Cimilli Senocak GN, Topdagi YE, Aynaoglu Yildiz G, Kumtepe Y. Incidence of occult malignancies identified during hysterectomies performed for benign indications. *J Gynecol Obstet Hum Reprod.* 2020;49(3):101620.
doi: 10.1016/j.jogoh.2019.08.003
- Leath CA 3rd, Straughn JM, Bhoola SM, Partridge EE, Kilgore LC, Alvarez RD. The role of radical parametrectomy in the treatment of occult cervical carcinoma after extrafascial hysterectomy. *Gynecol Oncol.* 2004;92(1):215-219.
doi: 10.1016/j.ygyno.2003.10.018
- Lu HW, Li J, Liu YY, *et al.* Can radical parametrectomy be omitted in occult cervical cancer after extrafascial hysterectomy? *Chin J Cancer.* 2015;34(3):413-419.
doi: 10.1186/s40880-015-0041-7
- Kim H, Cho WK, Kim YJ, Kim YS, Park W. Significance of the number of high-risk factors in patients with cervical cancer treated with radical hysterectomy and concurrent chemoradiotherapy. *Gynecol Oncol.* 2020;157(2):423-428.
doi: 10.1016/j.ygyno.2020.02.031
- Luo HC, Lin GS, Liao SG, *et al.* Cervical cancer treated with reduced-volume intensity-modulated radiation therapy base on Sedlis criteria (NCCN VS RTOG). *Br J Radiol.* 2018;91(1081):20170398.
doi: 10.1259/bjr.20170398
- Konski A, Deshmukh S, Klopp AH, *et al.* Quality-adjusted survival in women with gynecologic malignancies receiving IMRT after surgery: A Patient Reported Outcome study of NRG oncology's RTOG 1203. *Gynecol Oncol.* 2023;175:176-

181.
doi: 10.1016/j.ygyno.2023.05.074
19. Ma X, Fang J, Zhang L, *et al.* Efficacy and safety of adjuvant chemotherapy for locally advanced cervical cancer: A systematic review and meta-analysis. *Crit Rev Oncol Hematol.* 2023;184:103953.
doi: 10.1016/j.critrevonc.2023.103953
20. Tchartchian G, Bojahr B, Becker S, *et al.* Occult Malignancy Rate of 1498 Hysterectomies or Myomectomies with Morcellation: A Retrospective Single-Arm Study. *J Obstet Gynaecol India.* 2019;69(S2):188-193.
doi: 10.1007/s13224-018-1190-9
21. Lei L, Zhang L, Zheng Y, *et al.* Clinical analysis of 314 patients with high-grade squamous intraepithelial lesion who underwent total hysterectomy directly: a multi-center, retrospective cohort study. *BMC Cancer.* 2024;24(1):575.
doi: 10.1186/s12885-024-12342-2
22. Pan G, Wang W, Sun Z, Chu R, Xue J, Li N. High-Risk Clinical Characteristics and Risk Model for Unexpected Cervical Cancer Diagnosed After Surgery in Patients with LSIL/HSIL Biopsy. *Int J Womens Health.* 2026;18:584455.
doi: 10.2147/IJWH.S584455
23. Chen SW, Liang JA, Yang SN, Lin FJ. Postoperative radiotherapy for patients with invasive cervical cancer following treatment with simple hysterectomy. *Jpn J Clin Oncol.* 2003;33(9):477-481.
doi: 10.1093/jjco/hyg086
24. Takahashi M, Sakai K, Iwasa N, *et al.* Validation of the FIGO 2018 staging system of cervical cancer: Retrospective analysis of FIGO 2009 stage IB1 cervical cancer with tumor under 2 cm. *J Obstet Gynaecol Res.* 2021;47(5):1871-1877.
doi: 10.1111/jog.14713
25. Kinney WK, Egorshin EV, Ballard DJ, Podratz KC. Long-term survival and sequelae after surgical management of invasive cervical carcinoma diagnosed at the time of simple hysterectomy. *Gynecol Oncol.* 1992;44(1):24-27.
doi: 10.1016/0090-8258(92)90006-5
26. Hsu WL, Shueng PW, Jen YM, *et al.* Long-term treatment results of invasive cervical cancer patients undergoing inadvertent hysterectomy followed by salvage radiotherapy. *Int J Radiat Oncol Biol Phys.* 2004;59(2):521-527.
doi: 10.1016/j.ijrobp.2003.11.023
27. Park JY, Kim DY, Kim JH, Kim YM, Kim YT, Nam JH. Management of occult invasive cervical cancer found after simple hysterectomy. *Ann Oncol.* 2010;21(5):994-1000.
doi: 10.1093/annonc/mdp426
28. Wang Y, Ouyang Y, Su J, *et al.* Is salvage radiotherapy optimal to patients with occult cervical cancer undergoing inadvertent simple hysterectomy? A propensity score-matched analysis of a nationwide clinical oncology database. *Jpn J Clin Oncol.* 2021;51(4):630-638.
doi: 10.1093/jjco/hyaa251
29. Crane CH, Schneider BF. Occult carcinoma discovered after simple hysterectomy treated with postoperative radiotherapy. *Int J Radiat Oncol Biol Phys.* 1999;43(5):1049-1053.
doi: 10.1016/s0360-3016(98)00523-9
30. Saibishkumar EP, Patel FD, Ghoshal S, Kumar V, Karunanidhi G, Sharma SC. Results of salvage radiotherapy after inadequate surgery in invasive cervical carcinoma patients: a retrospective analysis. *Int J Radiat Oncol Biol Phys.* 2005;63(3):828-833.
doi: 10.1016/j.ijrobp.2005.04.002
31. Smith KB, Amdur RJ, Yeung AR, Morris CG, Kirwan J, Morgan LS. Postoperative radiotherapy for cervix cancer incidentally discovered after a simple hysterectomy for either benign conditions or noninvasive pathology. *Am J Clin Oncol.* 2010;33(3):229-232.
doi: 10.1097/COC.0b013e3181a6500d
32. Ruengkachorn I, Phithakwatchara N, Viriyapak B, Sangkarat S, Hanamornroongruang S, Petsuksiri J. Comparison of oncologic outcomes of unanticipated cervical carcinoma in women undergoing inadvertent simple hysterectomy and those undergoing surgical treatment after preoperative diagnosis. *Gynecol Oncol.* 2019;153(2):248-254.
doi: 10.1016/j.ygyno.2019.02.025