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Original Research

Efficacy Analysis of Cervical Cerclage in the Treatment of Cervical Insufficiencies

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Abstract

Background: This study aimed to assess the efficacy and safety of laparoscopic and transvaginal cervical cerclage treatments in patients with cervical insufficiency before and during pregnancy. **Methods**: A total of 70 patients diagnosed with cervical insufficiency and undergoing cervical cerclage at the Second Affiliated Hospital of Xinjiang Medical University between January 2020 and December 2022 were included. The patients were divided into three groups based on different surgical methods: transvaginal loop during pregnancy (Group 1, n = 30), transabdominal loop before pregnancy (Group 2, n = 20), and transabdominal loop during pregnancy (Group 3, n = 20). The groups were compared in terms of general clinical data, operation time, intraoperative bleeding, hospital stay, delivery gestational weeks, preterm delivery rate, prolonged gestational weeks, and neonatal births. **Results**: (1) There were no statistically significant differences in age, pregnancy, delivery, number of miscarriages, cervical length, and history of midterm pregnancy loss among the three groups ($p > 0.05$). (2) Prolonged gestational week, delivery gestational week, term delivery, and neonatal birth weight were higher in Groups 2 and 3 compared to Group 1, with statistically significant differences ($p < 0.05$). There was no statistically significant difference ($p > 0.05$) when comparing Group 2 and Group 3. Premature rupture of membranes and preterm delivery were higher in Group 1 compared to Groups 2 and 3, with statistically significant differences ($p < 0.05$). There was no statistically significant difference when comparing Group 2 and Group 3 ($p > 0.05$). (3) The amount of surgical bleeding and surgical time showed statistically significant differences ($p < 0.05$) among the three groups. Group 1 had more surgical bleeding than Groups 2 and 3, with statistically significant differences ($p < 0.05$). When comparing Group 2 and Group 3, Group 3 had more surgical bleeding than Group 2, with a statistically significant difference ($p < 0.05$). Group 2 had a shorter surgical time than Group 1 and Group 3, with statistically significant differences ($p < 0.05$). When comparing Group 1 and Group 3, Group 3 had a longer surgical time than Group 1, with a statistically significant difference ($p < 0.05$). There was no statistically significant difference in hospital stay when comparing three groups ($p > 0.05$). **Conclusions**: Laparoscopic cervical cerclage is a safe and effective treatment option, yielding better pregnancy outcomes than transvaginal cervical cerclage, particularly for patients with previous failed transvaginal cerclage. Preconception laparoscopic cervical cerclage carries lower surgical risks and should be considered for clinical application.

Keywords: cervical cerclage; cervical insufficiency; laparoscopy

1. Introduction

Cervical insufficiency is characterized by a deficiency of fibrous tissue, elastic fibers, and smooth muscle in the cervix, leading to an inability to sustain a pregnancy until full term due to anatomical or functional defects. These defects may include fracture of the fibrous tissue in the endocervix or reduced sphincter function of the isthmus. The exact causes of cervical insufficiency are not fully understood, but potential factors include birth injury, forceps use, improper dilation during abortion, previous cervical surgery, cervical dysplasia [1], as well as race-related differences [2] and genetic mutations [3,4]. The prevalence of cervical insufficiency in pregnant women ranges from 0.1% to 1.0%, with 20%–25% of mid-pregnancy miscarriages attributed to this condition. Recurrent miscarriage rates among patients with cervical insufficiency are approximately 8%–15% [5]. Clinical manifestations primarily include recurrent miscarriages and preterm births in the second and third trimesters, significantly impacting the physical and mental well-being of patients and their families. In recent years, cervical insufficiency has garnered increased attention.

The treatment of cervical insufficiency encompasses non-surgical and surgical approaches [6]. Non-surgical treatments involve bed rest, vaginal administration of progestin therapy, and uterine support [7]. However, the Canadian Obstetrical and Gynaecological Society highlighted the limited clinical evidence supporting non-surgical treatments [8]. Among surgical interventions, cervical cerclage is currently the only effective procedure for cervical insufficiency. Cervical cerclage aims to restore the cervix's structure, maintain its length, increase cervical tolerance, prolong gestational weeks, enhance pregnancy

success rates, and promote full-term births. Cervical cerclage techniques include transvaginal and transabdominal approaches. Transvaginal cervical cerclage, initially employed in clinical practice, involves two named techniques by Shirodkar and McDonald. Shirodkar's method involves freeing the bladder-cervical and rectovaginal spaces and suturing near the endocervical opening. The McDonald approach entails suturing at the cervico-vaginal junction without displacing the bladder and rectum. Evidence does not favor one approach over the transvaginal loop technique [9]. Transabdominal cervical cerclage, although more invasive, offers a higher success rate in restoring cervical integrity and effectively reducing miscarriages and preterm labor. Laparoscopic cervical cerclage, a minimally invasive alternative, reduces surgical trauma, complications, and intraoperative bleeding. It is increasingly utilized in clinical practice and can be performed before or during pregnancy. In this study, we compared laparoscopic cervical cerclage performed outside of pregnancy and during pregnancy with transvaginal cervical cerclage during pregnancy. We analyzed pregnancy outcomes, surgical complications, and neonatal births to assess the clinical efficacy of different surgical procedures in treating cervical insufficiency.

2. Materials and Methods

2.1 Study Design

A total of 70 patients diagnosed with cervical insufficiency and treated at the Second Affiliated Hospital of Xinjiang Medical University between January 2020 and December 2022 were included in this study. The patients were divided into three groups based on the timing and method of surgery. Group 1 consisted of 30 patients who underwent transvaginal cervical cerclage during pregnancy. Group 2 comprised 20 patients who received transabdominal laparoscopic cervical cerclage before pregnancy, and Group 3 consisted of 20 patients who underwent transabdominal laparoscopic cervical cerclage during pregnancy. All participants provided informed consent.

2.2 Methods

2.2.1 Diagnostic Criteria for Cervical Insufficiency (Inclusion Criteria)

The diagnosis of cervical insufficiency was based on the following criteria: (1) previous history of painless cervical dilation leading to miscarriage or preterm delivery in the middle of pregnancy; (2) ultrasound examination showing cervical length shortening to less than 25 mm by 24 weeks of gestation in singleton pregnancies; (3) ability to accommodate a No. 8 dilation rod without resistance; and (4) hysterosalpingogram confirming cervical dilation or enlargement of the funnel area in the isthmus during mid-pregnancy.

2.2.2 Exclusion Criteria

Patients with the following conditions were excluded from the study: (1) other causes of recurrent miscarriage (e.g., chromosomal abnormalities, endocrine diseases); (2) acute infectious phase of the disease; (3) fetal malformation or multiple pregnancies and genital malformations; and (4) other contraindications to surgery.

2.2.3 Surgical Method

(1) For preconception laparoscopic cervical cerclage, the patient was placed in a lithotomy position under general anesthesia. Routine procedures including disinfection, towel placement, catheterization, and placement of the lifting cup were performed. After successful puncture, a pneumoperitoneum was established, and laparoscopic instruments were inserted. The pelvis was explored, and the uterine isthmus and bilateral uterine vascular zone were exposed. A needle was inserted from posterior to anterior at the uterine isthmus above the sacral ligament, on both sides of the uterine vessels. A knot was tied, and the suture was tightened at the anterior wall of the uterus near the endocervix. A second loop was created at approximately 0.5 cm intervals from the initial entry point, both above and below. Simultaneous hysteroscopy was performed to ensure proper positioning of the annuloplasty band within the cervical canal.

(2) Laparoscopic cervical cerclage during pregnancy: The preoperative preparation and placement of laparoscopic instruments were performed as described above, but no uterine cup was placed intraoperatively. The pelvic cavity was explored, and the bilateral uterine arteries were exposed. The loop was inserted through a needle at the medial side of the uterine arteries on both sides, above the isthmus of the sacral ligament. The loop was tied and tightened at the anterior wall of the uterus near the endocervical opening. A second loop was tied at an interval of 0.5 cm above and below the initial entry point.

(3) Transvaginal cervical cerclage during pregnancy: the patient was positioned in a lithotomy position, and general anesthesia was administered. Routine disinfection, towel placement, and catheterization were performed. The cervix was exposed by applying traction on the anterior and posterior vaginal walls using hooks, and Allis forceps were used to clamp and expose the transverse bladder sulcus. Saline was injected under the vaginal mucosa to create a water pad. The vaginal mucosa over the transverse bladder sulcus was incised, and a blunt sharp separation was made in the bladder-cervical space. The bladder was pushed upward, and a needle was inserted and exited from above at the interstitial part of the cervix on both sides. The knot was tied at the posterior vaginal fornix, and adjustments were made until the uterine orifice could accommodate a fingertip. Absorbable sutures were used to close the vaginal mucosa.

Table 1. Comparison of general clinical data of patients in the 3 groups.

Subgroup	N	Age (years)	Number of pregnancies	Number of deliveries	Number of miscarriages	Cervical length (cm)	History of midterm pregnancy loss
Group 1	30	31 ± 2.29	2.6 ± 0.93	1.07 ± 0.25	1.43 ± 0.94	2.48 ± 0.2	1.1 ± 0.4
Group 2	20	31.35 ± 2.58	2.55 ± 0.69	1 ± 0	1.55 ± 0.69	2.5 ± 0.22	1 ± 0.32
Group 3	20	31.45 ± 2.21	2.5 ± 0.69	1 ± 0	1.5 ± 0.69	2.51 ± 0.22	1.15 ± 0.37
Total	70	31.23 ± 2.33	2.56 ± 0.79	1.03 ± 0.17	1.49 ± 0.79	2.49 ± 0.21	1.09 ± 0.37
F		0.256	0.094	1.367	0.131	0.073	0.854
p		0.775	0.910	0.262	0.878	0.929	0.430

2.2.4 Postoperative Follow-Up

Patients were followed up through outpatient reviews and telephone follow-ups until successful delivery.

2.3 Evaluation Indicators

The objectives of this study were as follows: (1) To compare the general clinical information among the three groups, including age, number of pregnancies and births, number of midterm pregnancy losses, and number of miscarriages. (2) To compare the pregnancy outcomes among the three groups, including full-term delivery, preterm delivery, miscarriage, extended gestational weeks, and neonatal weight. (3) To compare the surgical conditions among the three groups, including intraoperative bleeding, operation time, and hospital stay.

2.4 Statistical Analysis

Statistical analysis was performed using SPSS 19.0 (IBM Corp., Armonk, NY, USA). Quantitative data conforming to a normal distribution were expressed as mean ± standard deviation. Differences between groups and among multiple groups were analyzed using one-way analysis of variance (ANOVA), and differences between two groups were compared using the Least—Significant Difference (LSD) method test. Qualitative data were expressed as n (%) and were compared between groups using cross-tabulation chi-square test. Statistical significance was set at $p < 0.05$ for all test results.

3. Results

3.1 Comparison of Patients' General Clinical Data

There were no statistically significant differences ($p > 0.05$) when comparing age, pregnancy, delivery, number of miscarriages, cervical length, and history of midterm pregnancy loss among the three groups (Table 1).

3.2 Comparison of Patient Pregnancy Outcomes

Statistically significant differences ($p < 0.05$) were observed when comparing prolonged gestational weeks, delivery gestational weeks, term delivery, preterm delivery, premature rupture of membranes, and neonatal birth weight among all three groups. Specifically, Group 2 and Group 3 showed statistically significant differences ($p < 0.05$) compared to Group 1 in terms of prolonged gestational weeks, delivery gestational weeks, term delivery, and neonatal birth weight. No statistically significant differences ($p > 0.05$) were found between Group 2 and Group 3. Group 1 had higher rates of premature rupture of membranes and preterm delivery compared to Groups 2 and 3, and this difference was statistically significant ($p < 0.05$). However, there was no statistically significant difference between Group 2 and Group 3 in terms of premature rupture of membranes and preterm delivery ($p > 0.05$) (Table 2).

3.3 Comparison of Intraoperative Conditions

Significant differences ($p < 0.05$) were observed in the amount of surgical bleeding and surgical time among the three groups. Group 1 had higher surgical bleeding compared to Groups 2 and 3, and this difference was statistically significant ($p < 0.05$). Group 3 had more surgical bleeding than Group 2, and the difference was statistically significant ($p < 0.05$). Group 2 had shorter surgical time compared to Group 1 and Group 3, and this difference was statistically significant ($p < 0.05$). Comparing Group 1 and Group 3, Group 3 had longer surgical time than Group 1, and the difference was statistically significant ($p < 0.05$). There was no statistically significant difference ($p > 0.05$) in hospital stay between three groups (Table 3).

4. Discussion

Cervical insufficiency is a significant contributing factor to late pregnancy miscarriage and preterm delivery [10]. The treatment of cervical insufficiency has gained increasing attention, with cervical cerclage being the primary treatment method. Cervical cerclage strengthens the tension and weight-bearing capacity of the cervical canal, prolongs the gestational cycle, and helps prevent adverse pregnancy outcome [11–13].

Laparoscopic cervical cerclage involves suturing a cervical band laparoscopically to the medial aspect of the uterine artery at the isthmus. The band is looped at the isthmus level and positioned higher to effectively encircle the inner cervical opening. In contrast, transvaginal cervical cerclage is positioned slightly lower than laparoscopic cerclage, limiting its reach to a higher level of the endocervix and increasing the risk of failed cerclage and miscarriage [14]. Transvaginal cervical cerclage carries a rela-

Table 2. Comparison of pregnancy outcomes among the 3 groups.

Subgroup	N	Prolonged gestational weeks	Gestational weeks of delivery	Full-term delivery (n)	Preterm delivery (n)	Premature rupture of membranes (n)	Newborn birth weight (g)
Group 1	30	9.03 ± 2.43①②	36.21 ± 1.76①②	11 (36.67)	19 (63.33)	16 (53.33)①②	2961.17 ± 529.99①②
Group 2	20	12.85 ± 2.11	38.23 ± 0.41	20 (100)	0 (0)	0 (0)	3738.5 ± 132.83
Group 3	20	12.85 ± 1.42	38.15 ± 0.47	20 (100)	0 (0)	0 (0)	3746.5 ± 94.77
Total	70	11.21 ± 2.81	37.34 ± 1.54	51 (72.86)	19 (27.14)	16 (22.86)	3407.64 ± 526.37
F		28.448	22.988	34.771	34.771	33.801	40.525
p		0.000	0.000	0.000	0.000	0.000	0.000

①There were statistically significant differences between Group 1 and Group 2. ②There were statistically significant differences between Group 1 and Group 3.

Table 3. Comparison of intraoperative and postoperative conditions of patients in the 3 groups.

Subgroup	N	Surgical bleeding (mL)	Surgical time (minute)	Length of hospital stay (days)
Group 1	30	70.33 ± 25.39	50.2 ± 8.26	6.17 ± 0.75
Group 2	20	6.5 ± 2.35	43.25 ± 4.94	6.25 ± 0.64
Group 3	20	40 ± 21.28	73 ± 12.07	6.55 ± 0.51
Total	70	43.43 ± 33.32	54.73 ± 14.81	6.3 ± 0.67
F		60.181	63.801	2.128
p		0.000	0.000	0.127

tively high risk of postoperative infection, followed by premature rupture of membranes, unavoidable miscarriage, or preterm delivery [15]. A meta-analysis supports the use of laparoscopic cervical cerclage in patients who have previously experienced failed transvaginal cerclage [14]. The advantages of laparoscopic cervical cerclage are attributed to its minimally invasive nature, resulting in less intraoperative bleeding, fewer incisional complications, lower chance of infection, shorter hospital stay, earlier recovery, and the ability to simultaneously detect and manage other pregnancy-related conditions, such as tubal adhesions and ovarian cysts, thereby improving pregnancy outcomes for patients [16]. Laparoscopic cervical cerclage can be performed either before or during pregnancy. Preconception laparoscopic cervical cerclage is relatively straightforward due to the normal size of the uterus and the possibility of intraoperative placement of the lifting cup, which facilitates the surgical procedure, provides a clear surgical field, and presents lower surgical complexity compared to cervical cerclage during pregnancy. This approach is associated with fewer intraoperative and postoperative complications. Additionally, postoperative hysteroscopy can be performed to assess whether the cerclage tape has penetrated, without affecting the fetus [17]. Ades *et al*. [18] analyzed patients who underwent preconception laparoscopic cervical cerclage and reported a perinatal survival rate of 98.5%, with a mean gestational age of 35.2 weeks. Saridogan *et al*. [19] studied patients who underwent laparoscopic cervical cerclage during pregnancy and reported a neonatal survival rate of 97%. The rate of midtrimester loss was 8%, and the rate of full-term delivery was 75%. Studies have consistently demonstrated the safety, effectiveness, and feasibility of preconception laparoscopic cervical cerclage. However, performing laparoscopic cervical cerclage during pregnancy is more challenging due to the significantly larger uterus and increased pelvic blood flow, resulting in higher intraoperative bleeding. Intraoperative placement of uterine lifting instruments and postoperative hysteroscopy are not feasible in this situation. Huang *et al*. [20] selected 100 patients with a history of failed vaginal cervical cerclage, and the timing of surgery was 14–18 weeks. Pregnancy is lost at 22–28 weeks. Laparoscopic cervical cerclage was performed in the above patients, and 82 patients had successful postoperative pregnancy and delivery, with a mean gestational age of (37.5 ± 1.8) weeks, suggesting that preconception laparoscopic cervical cerclage can effectively prolong gestational age. In this study, the laparoscopic preconception and gestational cervical cerclage groups exhibited longer prolonged gestational weeks, delivery gestational weeks, higher term delivery rates, and greater newborn birth weights compared to the transvaginal cervical cerclage group. Furthermore, the risk of premature rupture of membranes and preterm delivery was lower in the laparoscopic cervical cerclage groups compared to the transvaginal cervical cerclage group. The transvaginal cervical cerclage group experienced more surgical bleeding than both the preconception laparoscopic cervical cerclage group and the gestational laparoscopic cervical cerclage group. Additionally, the preconception laparoscopic cervical cerclage group had a shorter operative time and less intraoperative bleeding compared to the gestational laparoscopic cervical cerclage group and the pregnancy transvagi-

nal cervical cerclage group. These findings can be attributed to the increased procedural difficulty during pregnancy and the higher amount of bleeding. Preconception laparoscopic cervical cerclage offers greater safety, lower surgical risks, and improved outcomes.

5. Conclusions

In conclusion, laparoscopic cervical cerclage yields superior pregnancy outcomes compared to transvaginal cervical cerclage, especially in cases of failed transvaginal cerclage. Among the approaches, preconception laparoscopic cervical cerclage offers several advantages, including reduced intraoperative complications, greater convenience, safer and more definitive surgery, and holds significant clinical significance.

Availability of Data and Materials

In accordance with the journal's guidelines, we will provide our data for the reproducibility of this study if our institution approved the request.

Author Contributions

QHZ: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Writing - original draft, Writing - review & editing. YSL: Participate in the completion of Writing - original draft, interpretation of data. CSX: Conception, Funding acquisition, Resources. All authors contributed to editorial changes in the manuscript. All authors have participated sufficiently in the work and agreed to be accountable for all aspects of the work. All authors read and approved the final manuscript.

Ethics Approval and Consent to Participate

All subjects gave their informed consent for inclusion before they participated in the study. This study was approved by the Ethics Committee of the Second Affiliated Hospital of Xinjiang Medical University (Ethics Approval Number: 2022H024).

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Conflict of Interest

The authors declare no conflict of interest.

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