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Comparative Outcomes of Pre-Conceptional and Post-Conceptional Laparoscopic Cervical Cerclage: A Retrospective Cohort Study

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Abstract

Objective: To compare the surgical, pregnancy, and neonatal outcomes of pre-conceptional versus post-conceptional laparoscopic cervical cerclage in women diagnosed with cervical insufficiency. **Methods:** This retrospective cohort study included 143 women who underwent laparoscopic cervical cerclage between January 2021 and December 2023 at the Second Affiliated Hospital of Nanjing Medical University. Patients were grouped into pre-conceptional (n = 39) and post-conceptional (n = 104) cohorts. Baseline characteristics, surgical metrics, and obstetric outcomes were compared using t-tests and chi-square or Fisher's exact tests. **Results:** Neonates in the pre-conceptional group had significantly higher birth weights (3101.6 ± 605.7 g vs. 2756.4 ± 465.4 g; p = 0.0005). The pre-conceptional group also showed greater cervical length gain post-cerclage (7.9 ± 5.7 mm vs. 5.2 ± 5.8 mm; p = 0.012). Surgical time was longer in the pre-conceptional group (90.0 ± 24.2 minutes vs. 80.0 ± 18.3 minutes; p = 0.004), but no differences were observed in blood loss, complications, or fetal survival (97.4% vs. 94.4%, p = 0.674). **Conclusion:** Pre-conceptional laparoscopic cervical cerclage may offer neonatal benefits without increasing surgical or obstetric risks. These findings support its consideration in high-risk patients. Further prospective studies are warranted.

Keywords

Cervical Insufficiency, Pre-Conceptional Cerclage, Post-Conceptional Cerclage, Pregnancy Outcomes, Laparoscopic Cervical Cerclage

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1. Introduction

Cervical insufficiency is an imprecise clinical diagnosis frequently applied to women with such a history, where it is assumed that the cervix is weak and unable to remain closed during pregnancy [1] [2], which is a significant contributor to second-trimester pregnancy loss and preterm birth, posing substantial risks to fetal viability and long-term neonatal outcomes. It is estimated to affect 1% of all pregnancies and accounts for 8% of mid-trimester losses [3] [4]. This condition is a significant contributor to an estimated 15 million premature births globally, with an average premature birth rate of around 10% [5]. The pathophysiology of cervical insufficiency is still not well understood. However, it is often associated with a history of cervical trauma, which is usually caused by previous surgeries or gynaecological procedures (such as conization, dilatation, curettage, etc.) [6] [7].

The management of cervical insufficiency has evolved significantly; cervical cerclage is a widely accepted procedure aimed at reinforcing the cervix to prevent premature birth and second-trimester loss [8]. Cervical cerclage can be performed either pre- or post-conceptionally, and via laparoscopic or open abdominal approach, but the laparoscopic approach is associated with fewer complications [1]. [9]. Pre-conceptional cerclage is usually performed in women with a history of cervical insufficiency or cervical anomalies, allowing for more uterine manipulation and greater accessibility in performing the procedure without adding complexities to the pregnancy [10]. Therefore, identifying women at risk is crucial for performing pre-conceptional cerclage.

In contrast, post-conceptional cerclage is more commonly practiced, especially when cervical insufficiency is diagnosed during early pregnancy or when a woman has a history of 3 or more second-trimester pregnancy losses or extreme premature deliveries, as recommended by the Society of Obstetricians and Gynaecologists of Canada (SOGC) [11]. Emergency cerclage is performed when there are signs of progressive cervical shortening, cervical dilation, and fetal membrane protrusion [11] [12].

Despite the wide use of cervical cerclage, the optimal timing for placement remains debatable. Few studies have directly compared the maternal and neonatal outcomes between pre-conceptional and post-conceptional cervical cerclage placements. For example, Abdulrahman N *et al.* concluded in their study on favourable surgical and obstetrical outcomes in both groups that both approaches are safe, with a high fetal survival rate [13]. Similar findings were reported by Tulandi *et al.* [14] Based on the evaluation of 16 studies of abdominal cerclage. Conversely, some studies reported that pre-conceptional cerclage provides more benefits than post-conceptional cerclage [15] [16].

This retrospective study aims to address this gap by directly evaluating the surgical, pregnancy, and neonatal outcomes between pre-conceptional and post-conceptional cervical cerclage. We aim to investigate whether any of the approaches offer superior outcomes. Through this analysis, we hope to contribute to the ongoing debate and provide clinicians and patients with valuable insights to guide decision-making.

2. Materials and Methods

Between January 2021 and December 2023, a retrospective study included all women who had laparoscopic abdominal cerclage placement both pre-conception and post-conception. The hospital review board (Ethics Committee of the Second Affiliated Hospital of Nanjing Medical University) obtained ethical approval for the current study (2024-KY-282-01).

2.1. Inclusion/Exclusion Criteria

The study included participants with a history of pregnancy loss during the second or third trimester, those diagnosed with cervical insufficiency through obstetric history or ultrasound, and post-conceptional women with a cervical length under 25 mm confirmed via transvaginal ultrasound. Only singleton pregnancies were considered. Exclusion criteria included multiple gestations, major fetal anomalies, or unrelated significant maternal comorbidities.

2.2. Data Collection

Patient data were retrieved from medical records based on demographic and obstetric details such as age, BMI, gravidity, parity, history of pregnancy loss, uterine anomalies, and previous cervical procedures like conization and Loop Electrosurgical Excision Procedure (LEEP). Cervical length was measured before and after surgery using transvaginal ultrasound, and the difference in cervical length (DCL) was noted. Surgical data included operation time, blood loss, the need for transfusion, and any complications during or after the cervical cerclage procedure. Pregnancy outcomes were tracked by gestational age at delivery, neonatal birth weight, fetal survival, NICU admissions, and Apgar scores.

2.3. Surgical Techniques

Laparoscopic cervical cerclage was performed on all patients in both groups: the pre-conceptional and post-conceptional cervical cerclage. This minimally invasive approach was selected due to its effectiveness in minimizing complications and improving surgical outcomes [17] [18]. In the pre-conceptional group, the procedure was performed before pregnancy for women with a history of cervical insufficiency or recurrent pregnancy loss. Under general anesthesia, a Mersilene tape was laparoscopically positioned at the cervico-isthmic junction, carefully avoiding the uterine vessels. After surgery, all patients were monitored for any surgical complications, with discharge typically occurring within 24 to 48 hours. Patients were advised to wait 6 - 8 weeks before conception to allow for adequate healing.

For the post-conceptional group, laparoscopic cerclage was performed between 9 and 20 weeks of gestation in cases where cervical insufficiency was diagnosed. The technique is similar to that of the pre-conceptional procedure, with Mersilene tape applied around the cervix without manipulating the uterus to minimize the complications of the ongoing pregnancy. Postoperative monitoring included

checking for signs of infection, premature labour, or any complication alongside routine ultrasounds to track cervical length and fetal health. Most patients were discharged within 48 hours and given specific activity restrictions based on their risk factors. Ongoing follow-up with serial ultrasounds was provided, and in cases of preterm labour, appropriate medical interventions, such as tocolysis and steroid treatment, were administered. The cerclage remained in place until delivery unless earlier removal was necessary due to complications.

2.4. Cervical Length Measurement

Cervical length was measured using transvaginal ultrasound by trained sonographers.

In the pre-conception cerclage group, Cervical length before surgery (CLB) was measured in the non-pregnant state prior to surgery, and Cervical length after surgery (CLA) was assessed postoperatively or during early pregnancy follow-up.

In the post-conception cerclage group, CLB and CLA were measured during pregnancy at standardized gestational ages surrounding the cerclage procedure.

The difference in cervical length (DCL) was calculated as the difference between CLA and CLB. Given the differing physiological contexts (non-pregnant versus pregnant), cervical-length comparisons between groups were interpreted with caution.

2.5. Outcomes

The primary outcome of the study was neonatal birthweight.

Secondary outcomes included gestational age at delivery, fetal survival, cervical length change (ΔCL), operative time, and maternal and neonatal complications.

Subgroup analyses based on the timing of cerclage placement and the placental coverage of the cervix were conducted as exploratory analyses.

2.6. Statistical Analysis

Statistical analysis was conducted using STATA version 15.1. Continuous data were presented as mean values with corresponding standard deviations (SD), while categorical data were reported as percentages. The independent t-test was utilized to compare mean values between the pre-conceptional and post-conceptional groups for continuous variables. Depending on the data distribution, categorical data were assessed using either the Chi-squared test or Fisher's exact test. A p-value of less than 0.05 was set as the threshold for statistical significance.

3. Results

3.1. Baseline Characteristics

A total of 143 women were included in this analysis; 39 underwent pre-conceptional cervical cerclage, and 104 underwent the procedure post-conceptionally (**Figure 1**). **Table 1** presents the demographic and obstetric baseline characteristics of both groups. The mean age of women in the pre-conceptional group was

30.2 ± 4.2 years, and 30.7 ± 3.8 years in the post-conceptional group, which did not show a statistically significant difference (p = 0.565). Similarly, there was no significant difference in BMI between the groups (24.4 ± 3.8 vs. 24.4 ± 3.6, p = 0.940). Gravidity and parity were comparable between the groups, with the mean gravidity at 2.6 ± 1.1 in the pre-conceptional group and 2.5 ± 1.7 in the post-conceptional group (p = 0.383), and the mean parity at 0.1 ± 0.3 and 0.2 ± 0.5, respectively (p = 0.677).

Table 1. Baseline characteristics.

Variable	Pre-Conceptional (n = 39)	Post-Conceptional (n = 104)	p-value
Demographic data			
Age (mean ± SD)	30.2 ± 4.2	30.7 ± 3.8	0.565
BMI (mean ± SD)	24.4 ± 3.8	24.4 ± 3.6	0.0940
Gravididity (mean ± SD)	2.6 ± 1.1	2.5 ± 1.7	0.383
Parity (mean ± SD)	0.1 ± 0.3	0.2 ± 0.5	0.677
Obstetric History			
History of pregnancy loss during second/third trimester, %(n)	89.7% (35)	70.2% (73)	0.015[c]
History of uterine anomaly, %(n)	12.8% (5)	3.9% (4)	0.062[f]
Cervical conization, %(n)	0% (0)	4.8% (5)	0.323[f]
Cervical LEEP, %(n)	0% (0)	6.7% (7)	0.190[f]
Mechanical cervical dilatation, %(n)	46.2% (18)	35.6% (37)	0.247[c]
PCOS, %(n)	20.5% (8)	20.3% (21)	0.966[c]
Cervical Length			
Cervical length before surgery (CLB), mm (mean ± SD)	26.4 ± 5.3	28.8 ± 6.7	0.007
Cervical length after surgery (CLA), mm (mean ± SD)	34.4 ± 5.8	35.0 ± 7.0	0.663
Difference in cervical length (DCL), (CLA-CLB). (mean ± SD)	7.9 ± 5.7	5.2 ± 5.8	0.012
Gestational age at intervention, weeks (mean ± SD)	*NA*	13.3±2.5	*NA*

This table shows the baseline characteristics of women undergoing cervical cerclage, categorized into pre-conceptional (n = 39) and post-conceptional (n = 104) groups. Continuous data are presented as mean ± SD, while categorical data are shown as percentages (n). Statistical significance is evaluated using the t-test for continuous variables, Chi-squared Test ([c]), and Fisher's Exact Test ([f]). Abbreviations: SD, standard deviation; BMI, Body Mass Index; PCOS, Polycystic Ovary Syndrome.

However, significant differences were seen in obstetric history between the two groups. The pre-conceptional group had a notably higher incidence of previous pregnancy loss during the second or third trimester (89.7% vs. 70.2%, p = 0.015).

There was also a trend of a higher rate of uterine anomalies in the pre-conceptional group (12.8% vs. 3.9%, p = 0.062), although this did not show statistical significance. Other variables, such as cervical conization, LEEP procedures, mechanical cervical dilatation, and the presence of polycystic ovarian syndrome (PCOS), showed no significant differences between the groups (p > 0.05 for all).

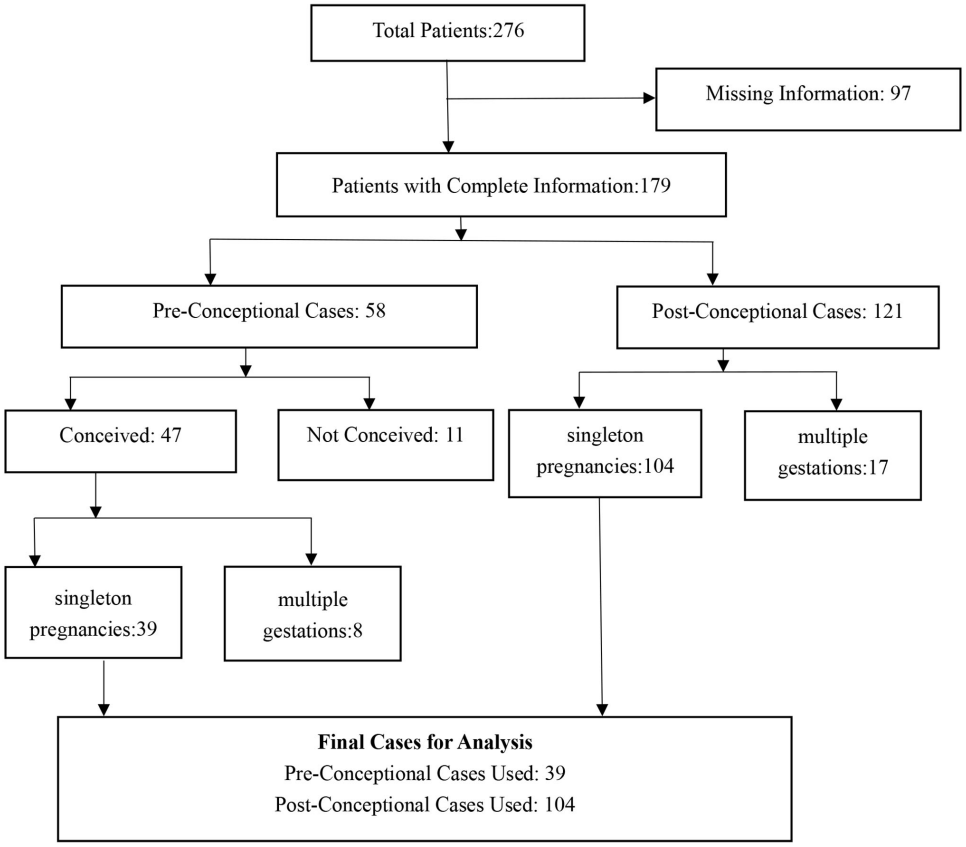

Figure 1. This flowchart presents the selection process of patients for comparing pre-conceptional and post-conceptional cerclage outcomes. A total of 276 patients were initially assessed, with 97 excluded due to missing information, leaving 179 with complete data. Among these, 58 patients underwent pre-conceptional cerclage, and 121 underwent post-conceptional cerclage. In the pre-conceptional group, 11 patients did not conceive, while 47 conceived, comprising 8 multiple gestations and 39 singleton pregnancies, leading to 39 pre-conceptional cases in the final analysis. In the post-conceptional group, 104 cases, after accounting for multiple and singleton pregnancies, were included in the final analysis.

Cervical length measurements also revealed notable differences. Before surgery, the pre-conceptional group had a significantly shorter cervical length (CLB) than the post-conceptional group (26.4 mm ± 5.3 vs. 28.8 mm ± 6.7, p = 0.007). Post-surgical cervical length (CLA) was comparable between the two groups (34.4 mm ± 5.8 vs. 35.0 mm ± 7.0, p = 0.663). However, the difference in cervical length before and after surgery (DCL) was significantly greater in the pre-conceptional group (mean difference: 2.7 mm; 95% CI: 0.5 - 4.9 mm; p = 0.012) (**Figure 2**), suggesting a more significant effect of cerclage in this cohort.

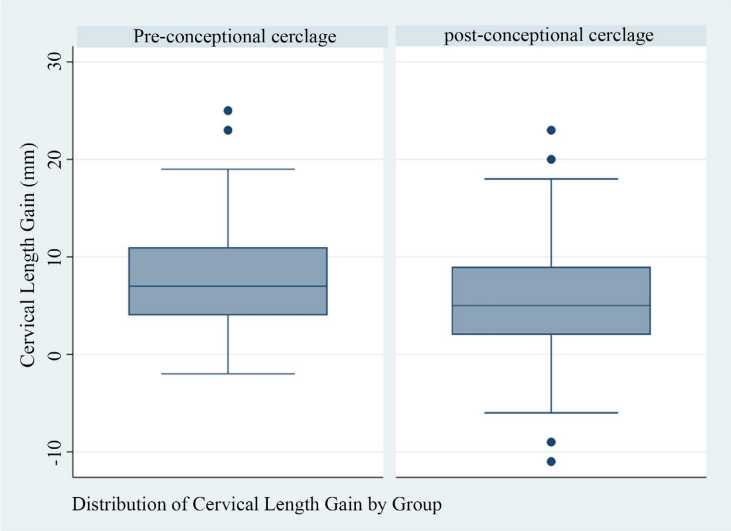

Figure 2. Cervical length gain in millimetres, comparing pre-conceptional and post-conceptional cerclage groups. The pre-conceptional group showed a higher median gain with greater variability, suggesting potential benefits in maintaining cervical length before conception.

3.2. Pregnancy Outcomes

Table 2 summarizes the pregnancy outcomes and complications in both groups. Fetal survival was comparable between groups (absolute difference: 3.0%; 95% CI: −4.1% to 10.1%; p = 0.674). Gestational age at delivery was slightly higher in the pre-conceptional group (mean difference: 1.1 weeks; 95% CI: 0.06 - 2.14 weeks; p = 0.155). The birth weight of surviving neonates was higher in the pre-conceptional group (mean difference: 345 g; 95% CI: 130 - 561 g; p = 0.0005) (**Figure 3**). This finding suggests a potential benefit of pre-conceptional cerclage in improving neonatal outcomes.

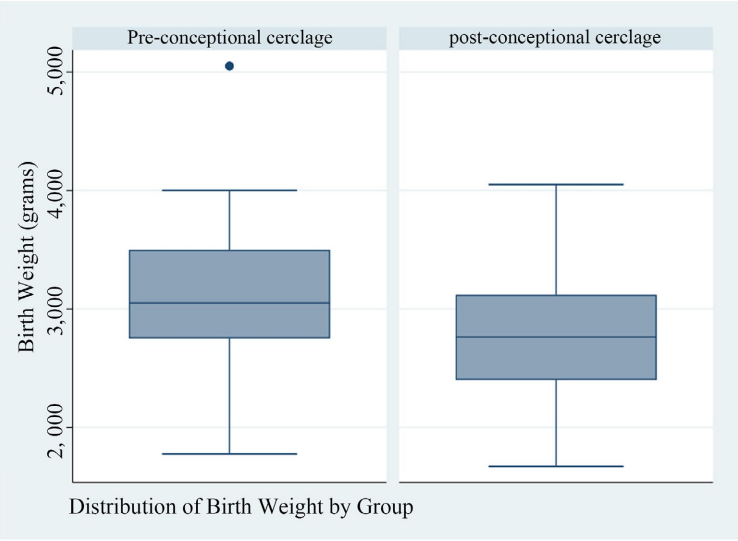

Figure 3. Birth weight distribution (in grams) for neonates born to mothers with pre-conceptional versus post-conceptional cerclage. The pre-conceptional group had a higher median birth weight, indicating potential advantages of earlier cerclage placement.

Table 2. Pregnancy outcomes.

Variable	Pre-Conceptional (n = 39)	Post-Conceptional (n = 104)	p-value
Complications during pregnancy			
Total fetal loss, % (n)	2.6% (1)	5.8% (6)	0.674[f]
Premature preterm rupture of membranes, % (n)	2.6% (1)	4.8% (5)	1.000[f]
Infection, % (n)	5.1% (2)	2.9% (3)	0.614[f]
Premature contractions at 37 wk of gestation, % (n)	41.0% (16)	30.8% (32)	0.247[c]
Vaginal Bleeding, %(n)	2.6% (1)	2.9% (3)	1.000[f]
Pregnancy outcomes			
GA at delivery (weeks) (mean ± SD)	36.9 ± 1.9	35.8 ± 4.8	0.155
Fetal survival rate %(n)	97.4% (38)	94.44% (98)	0.674[f]
Birth weight of survival neonates (mean ± SD)	3101.6 ± 605.7	2756.4 ± 465.4	0.0005
Gestational age <24 wk %(n)	0% (0)	4.8% (5)	
Gestational age >=24<28 wk %(n)	2.6% (1)	1.0% (1)	
Gestational age >=28<34 wk %(n)	2.6% (1)	4.8% (5)	0.581[c]
Gestational age >=34<37 wk% (n)	23.1% (9)	23.3% (24)	
Gestational age >=37 wk % (n)	71.8% (28)	66.4% (99)	
Admitted to NICU % (n)	23.7% (9)	31.6% (31)	0.361[c]
Apgar score			
1 min	9.6 ± 1.0	9.2 ± 1.1	0.116
5 min	9.8 ± 0.6	9.6 ± 0.8	0.140
Maternal complication			
Postpartum haemorrhage (PPH)	2.6% (1)	6.7% (7)	0.447[f]
Placenta previa	0% (0)	2.9% (3)	0.562[f]
lower limb venous thrombosis	2.6% (1)	0% (0)	0.273[f]

This table compares pregnancy complications and outcomes, categorized into pre-conceptional (n = 39) and post-conceptional (n = 104) groups. Continuous data are presented as mean ± SD, while categorical data are shown as percentages (n). Statistical significance is evaluated using the t-test for continuous variables, Chi-squared Test ([c]), and Fisher's Exact Test ([f]). Abbreviations: SD, standard deviation.

A Kaplan-Meier survival analysis to compare gestational age at delivery between patients who received pre- and post-conceptional cerclage was conducted (**Figure 4**). The survival curves for both groups were nearly identical, strongly suggesting similar outcomes. A log-rank test confirmed no statistically significant difference in survival functions between the groups ($\chi^2(1) = 0.21$, p = 0.6467).

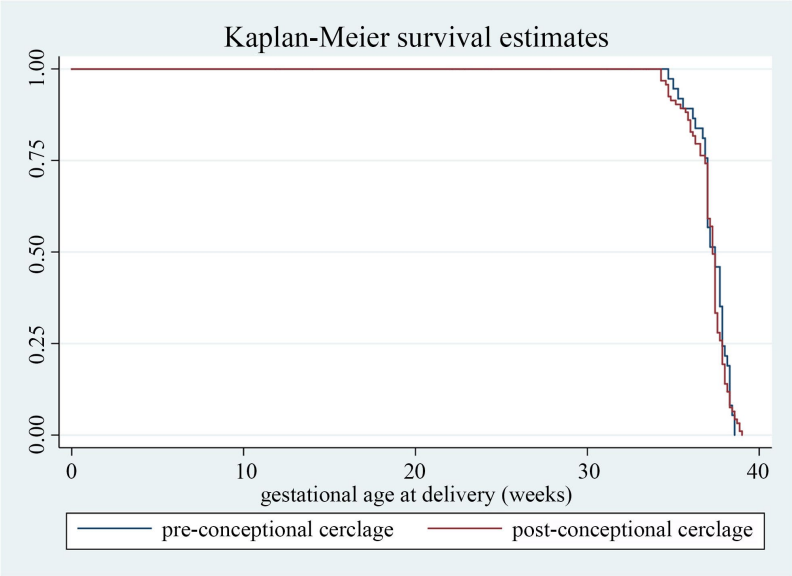

Figure 4. Kaplan-Meier survival curves showing the probability of remaining undelivered over gestational age for pre-conceptional (blue) and post-conceptional (red) cerclage groups. The x-axis represents gestational age at delivery (in weeks), and the y-axis represents the cumulative survival probability.

Pregnancy-related complications were comparable between groups. Total fetal loss occurred in 2.6% of women in the pre-conceptional group and 5.8% in the post-conceptional group ($p = 0.674$). Premature rupture of membranes occurred in 2.6% and 4.8% of cases, respectively ($p = 1.000$). Other complications, including infection and vaginal bleeding, did not differ significantly between groups (all $p > 0.05$). Premature uterine contractions at 37 weeks were more frequent in the pre-conceptional group (41.0% vs 30.8%), although this difference was not statistically significant ($p = 0.247$).

Gestational age at delivery was similar between groups, with most women delivering at or beyond 37 weeks of gestation (71.8% in the pre-conceptional group vs 66.4% in the post-conceptional group). Neonatal intensive care unit admission occurred more frequently in the post-conceptional group (31.6% vs 23.7%), but this difference did not reach statistical significance ($p = 0.361$). Apgar scores at 1 and 5 minutes were comparable between groups (all $p > 0.05$).

Maternal complications were infrequent in both cohorts. Postpartum haemorrhage occurred in 2.6% of women in the pre-conceptional group and 6.7% in the post-conceptional group ($p = 0.447$). Lower-limb venous thrombosis was observed in one woman in the pre-conceptional group and in none of the women in the post-conceptional group ($p = 0.273$).

3.3. Surgical Outcomes

Surgical outcomes are summarized in Table 3. Total skin-to-skin operation time was significantly longer in the pre-conceptional group than in the post-conceptional group (mean difference: 10.0 minutes; 95% CI: 1.6 - 18.4 minutes; p =

0.004). Despite the longer operative duration, intraoperative blood loss did not differ significantly between groups (mean difference: −24.6 mL; 95% CI: −67.5 to 18.3 mL; p = 0.213). Only one case of intraoperative hemorrhage exceeding 500 mL occurred, which was observed in the post-conceptional group, and only one patient required blood transfusion.

Table 3. Surgical outcomes.

Variable	Pre-Conceptional (n = 39)	Post-Conceptional (n = 104)	p-value
Total skin-to-skin operation time (min), (mean ± SD)	90.0 ± 24.2	80.0 ± 18.3	0.004
Blood loss during surgery (mL), (mean ± SD)	34.9 ± 22.6	59.5 ± 121.7	0.213
Hemorrhage > 500 mL (n)	0	1	*NA*
Blood transfusion (n)	0	1	*NA*
Additional complications % (n)	0	0	*NA*

This table compares pregnancy complications and outcomes, categorized into pre-conceptional (n = 39) and post-conceptional (n = 104) groups. Continuous data are presented as mean ± SD, while categorical data are shown as percentages (n). Statistical significance is evaluated using the t-test, Abbreviations: SD, standard deviation.

The absence of additional intraoperative complications in both groups strongly testifies to the safety and feasibility of cervical cerclage in pre-conceptional and post-conceptional settings.

3.4. Subgroup Analysis by Trimester of Cerclage Placement

To further evaluate the impact of timing during pregnancy, we performed a subgroup analysis comparing surgical and neonatal outcomes between women who underwent laparoscopic cerclage in the first versus the second trimester (Table 4). As expected, the mean gestational age at cerclage placement was significantly earlier in the first trimester group (11.9 ± 1.0 vs. 15.4 ± 2.5 weeks, p < 0.001). Surgical metrics, including operation time and intraoperative blood loss, were similar between groups. Intraoperative complications were rare, with only one complication reported in the second-trimester group.

Table 4. Subgroup analysis of clinical and perinatal outcomes following laparoscopic cerclage performed in the first or second trimester.

Outcome	1st Trimester (N = 61)	2nd Trimester (N = 42)	p-value
Gestational age at cerclage placement (weeks) (mean ± SD)	11.87 ± 0.98	15.43 ± 2.48	<0.001
Surgery duration (minutes) (mean ± SD)	79 ± 18	82 ± 18	0.50
Intraoperative blood loss (mL) (median, IQR)	50 (20 - 50)	50 (20 - 50)	0.073
Intraoperative complications n(%)	0 (0%)	1 (2.4%)	0.40
Gestational age at delivery (weeks) (mean ± SD)	35.4 ± 5.9	36.4 ± 2.7	0.20

Continued

Birthweight (g) (mean ± SD)	2797 ± 450	2690 ± 484	0.30
Apgar score at 1 min (median, IQR)	10.00 (9.00 - 10.00)	10.00 (9.00 - 10.00)	0.50
Apgar score at 5 min (median, IQR)	10.00 (9.00 - 10.00)	10.00 (10.00 - 10.00)	0.90
NICU admissionn (%)	14 (25%)	16 (39%)	0.20
Fetal survival n(%)	56 (92%)	41 (98%)	0.40

Footnote: Continuous variables are reported as mean ± SD or median (Q1 - Q3), depending on distribution; categorical variables are reported as n (%). Statistical tests applied were Welch's t-test for normally distributed continuous variables, Wilcoxon rank-sum test for skewed continuous variables, and Fisher's exact test for categorical variables.

Pregnancy outcomes showed no significant differences in gestational age at delivery, neonatal birthweight, or Apgar scores. Although not statistically significant, NICU admissions occurred more frequently in the second trimester group (39% vs. 25%, p = 0.2). Fetal survival rates were high and comparable (92% vs. 98%, p = 0.4).

3.5. Subgroup Analysis by Placental Coverage

Among 103 patients, 91 underwent cerclage without placental coverage and 12 with placenta covering the cervix. Baseline demographics, including age, BMI, gravidity, prior miscarriage, IVF conception, and prior cervical interventions, were comparable between groups (p > 0.2). Gestational age at cerclage placement was also similar (median 12.9 weeks for both groups) (Table 5).

Table 5. Subgroup analysis of patients with and without placenta covering the cervix at the time of cerclage.

Characteristic	Not Covering (n = 91)	Covering (n = 12)	p-value
Baseline			
Age, years (mean ± SD)	30.9 ± 3.8	29.1 ± 3.8	0.2
BMI (median, IQR)	24.2 (22.4 - 25.7)	23.4 (22.8 - 25.7)	>0.9
Gravidity (median, IQR)	2 (2 - 3)	2 (2 - 4)	0.5
Prior miscarriage, n (%)	63 (69%)	9 (75%)	>0.9
IVF conception, n (%)	35 (38%)	2 (17%)	0.2
Prior cervical intervention, n (%)	41 (45%)	3 (25%)	0.2
Gestational age at cerclage, weeks (median, IQR)	12.9 (11.9 - 13.7)	12.9 (11.6 - 14.2)	0.9
Surgical outcomes			
Surgery duration, min (median, IQR)	75 (70 - 90)	78 (65 - 85)	>0.9
Blood loss, ml (median, IQR)	50 (20 - 50)	35 (15 - 100)	>0.9
Intraoperative complications, n (%)	1 (1.1%)	0	>0.9
Postoperative infection, n (%)	3 (3.3%)	0	>0.9

Continued

Pregnancy & Neonatal outcomes			
Birth weight, g (mean ± SD)	2766 ± 477	2638 ± 361	0.3
Apgar score at 1 min (median, IQR)	10 (9 - 10)	9 (9 - 10)	0.4
Apgar score at 5 min (median, IQR)	10 (9 - 10)	10 (9 - 10)	>0.9
NICU admission, n (%)	25 (29%)	5 (45%)	0.3
Fetal survival, n (%)	86 (95%)	11 (92%)	0.5
Maternal complications			
Placenta previa, n (%)	0	1 (8.3%)	
Placental adhesions, n (%)	1 (1.1%)	1 (8.3%)	0.045
Postpartum hemorrhage, n (%)	7 (7.7%)	0	
Kaplan-Meier analysis			
Earlier delivery (covering vs not)	–	–	0.039

Values are presented as mean ± SD, median (IQR), or n (%). p-values derived from Wilcoxon rank-sum, Fisher's exact, or Chi-squared tests as appropriate.

Surgical outcomes did not differ significantly. Operation time and intraoperative blood loss were comparable, and no major intraoperative complications occurred in the covering group. Postoperative infection was rare in both groups.

Pregnancy outcomes showed high fetal survival (95% vs. 92%), with similar mean birthweights and Apgar scores. NICU admissions were more frequent in the covering group (45% vs. 29%), though this difference was not statistically significant ($p = 0.3$). Maternal complications differed significantly ($p = 0.045$), with placenta previa and placental adhesions occurring only in the covering group, while postpartum hemorrhage occurred only in the non-covering group. Kaplan-Meier analysis demonstrated earlier delivery among women with placental coverage ($p = 0.039$).

3.6. Multivariate Analysis of Factors Associated with Birthweight

A multivariable linear regression model was used to evaluate the association between cerclage timing (pre-conceptional vs post-conceptional), maternal age, body mass index (BMI), history of miscarriage, and gestational age at delivery with neonatal birth weight (Table 6). The overall model was statistically significant ($F(5, 137) = 5.75$, $p = 0.0001$) and explained 17.4% of the variance in birth weight ($R^2 = 0.174$). Post-conceptional cerclage was independently associated with lower neonatal birth weight compared with pre-conceptional cerclage (adjusted mean difference: −157 g; 95% CI: −312 to −2 g; $p = 0.047$). Gestational age at delivery was a strong independent predictor of birth weight, with each additional week of gestation associated with an increase of approximately 34 g (95% CI: 16 - 53 g; $p < 0.001$). Maternal age, BMI, and history of miscarriage were not significantly associated with birth weight after adjustment.

Table 6. Regression analysis of factors associated with birth weight.

Variable	Coefficient (β)	Std. Error	t	p-value	95% Confidence Interval
Pregnancy Timing (post- vs pre-conceptional)	−0.157	0.078	−2.01	0.047	−0.312 to −0.002
Age (years)	0.017	0.009	1.83	0.069	−0.001 to 0.035
BMI (kg/m^2)	0.020	0.012	1.67	0.098	−0.004 to 0.044
History of miscarriage (yes vs no)	0.159	0.103	1.55	0.124	−0.044 to 0.363
Gestational age at delivery (weeks)	−0.034	0.009	−3.72	<0.001	−0.053 to −0.016
Constant	2.082	0.624	3.34	0.001	0.848 to 3.315

This table presents regression coefficients, standard errors, t-values, p-values, and 95% confidence intervals for variables predicting birth weight. Birth weight was modeled in kilograms; coefficients are interpreted as kilogram differences and expressed in grams in the Results text for clinical interpretability. BMI, body mass index.

4. Discussion

The timing of cervical cerclage placement, whether pre-conceptional or post-conceptional, has been a focal point of research in obstetrics, particularly regarding its implications for pregnancy outcomes. This study compares pregnancy outcomes between women undergoing cervical cerclage in the pre-conceptional and post-conceptional periods, revealing several important findings.

4.1. Surgical Outcomes

In our study, we observed a significantly longer operation time in the pre-conceptional group (90.0 ± 24.2 minutes) compared to the post-conceptional group (80.0 ± 18.3 minutes, p = 0.004). This difference could be attributed to additional procedures often performed alongside pre-conceptional cerclage, such as checking for tubal patency using hysteroscopy. Hulshoff *et al.* [19] compared indirectly between laparoscopic and transabdominal methods, including pre-conceptional and post-conceptional cerclage, and reported that the mean duration was longer in laparoscopy, with an interval group (pre-conceptional group) having a shorter mean duration of 81 minutes compared to the during-pregnancy group (post-conceptional), which had a mean duration of 135 minutes. However, they did not explain the reasons for the difference. Despite this longer duration, the blood loss during the operation showed no significant difference between the groups and no major complications. We observed only one patient who needed a transfusion in the post-conceptional group. These results indicate that even though the pre-conceptional group takes longer to perform, it is not associated with a higher risk of surgical complications, reaffirming the safety of these procedures.

4.2. Pregnancy Outcomes

Our study found no significant differences in pregnancy complications between the pre- and post-conceptional groups, including the rate of total fetal loss, preterm rupture of membranes (PROM), infection, and premature contraction. These findings suggest that the timing of cerclage placement, before or after con-

ception, does not influence these complications. This aligns with the findings of Tulandi *et al.* [14], who also reported no significant difference in the failure rate of abdominal cerclage by laparoscopy or laparotomy in both the pre- and post-conceptional groups.

Our study also observed a comparable fetal survival rate, with 97.4% in the pre-conceptional group and 94.4% in the post-conceptional group ($p = 0.674$). Similarly, a systematic review conducted by Burger *et al.* [20] Although the study did not directly compare pre-conceptional and post-conception cervical cerclage, it reported a total fetal survival rate of 86.7% in the pre-conceptional group and 80.9% in the post-conceptional group.

However, in our study, we observed a notable difference in the birth weight of neonates. Babies born to women in the pre-conceptional group had a significantly higher mean birth weight (3101.6 ± 605.7 g) than the post-conceptional group (2756.4 ± 465.4 g, $p = 0.0005$). These findings suggest that pre-conceptional cerclage may contribute to better fetal growth outcomes. The mechanism is unclear, but one hypothesis is that uterine artery flow may be compromised during post-conceptional procedures, potentially affecting fetal growth. [21] In his study, he reported that the fetus was small for gestational age (SGA) at 32 weeks and believed this was due to the pulsatility index (PI) changes after the cerclage. He also reported low resistance of uterine circulation, which could be a sign of uterine congestion caused by the modified placement of the cerclage. Despite this, the gestational age at delivery and NICU admission rate were similar between the groups. We observed no significant differences between pre-conceptional and post-conceptional cerclage in the proportion of women delivering at less than 24 weeks (0% vs 4.8%) or between 28 and 34 weeks (2.6% vs 4.8%). The proportion of women delivering between 34 and 37 weeks was also comparable (23.1% vs 23.3%, p = NS). The majority of women in both groups delivered at or beyond 37 weeks of gestation (71.8% vs 66.4%), respectively. This indicates that while pre-conceptional cerclage may improve birth weight, it does not significantly extend the duration of pregnancy.

Similar findings were observed in different studies. Whittle *et al.* [22] report that even though cerclage failure occurred more often when the cerclage was placed during pregnancy, the timing of the cerclage placement did not influence the gestational age at delivery. Also, Hulshoff *et al.* conducted a systematic review and meta-analysis on the effectiveness of transabdominal cerclage. [19] The authors reported that they did not detect significant differences in delivery at or beyond 34 weeks between the laparoscopic (LC) or open laparotomy (AC) (pre-conceptional and post-conceptional) groups.

Our study's findings have significant implications for clinical practice. In contrast to our findings, Abdulrahman N *et al.* [13] reported more favorable obstetrical outcomes in the post-conceptional cohort. However, our study, which included a larger sample size, provides more robust and meaningful results.

Hulshoff *et al.* [19] reported contrasting results regarding birth weight in pre-

and post-conceptional cerclage. Although the authors did not directly compare the birth weights of neonates in the two groups, they noted that in the laparotomy cerclage group, the post-conceptional group had a higher mean birth weight of 2751.8 grams (2233.7 to 3269.9) compared to the pre-conceptional group, which had a mean birth weight of 2306.1 grams (1520.8 - 3091.4). The confidence intervals for both groups overlap, indicating that this difference may not be statistically significant. In contrast, in the laparoscopic cerclage group, the pre-conceptional group had a slightly higher mean birth weight of 2916.9 grams (2708.2 - 3125.6) compared to the post-conceptional group's mean of 2825.6 grams (2624.1 - 3027.2). These contrasting findings reveal the need for further research to engage the medical community in this topic. The potential impact of our study on clinical decision-making is significant and warrants further investigation.

4.3. Subgroup Analysis by Trimester of Cerclage Placement

In our cohort, laparoscopic cerclage performed in the first versus second trimester showed comparable surgical and neonatal outcomes, with no major intraoperative complications in either group. Although NICU admissions were more frequent in the second trimester, the difference was not statistically significant.

These findings are consistent with recent transvaginal cerclage studies. Ni *et al.* [23] reported no difference in preterm birth or neonatal survival between cerclage placed at 11 – 15 + 6 versus 16 – 19 + 6 weeks, supporting the safety of later prophylactic placement. By contrast, Zhao *et al.* [24] found higher rates of infection and late abortion when cerclage was delayed to 19 - 27 weeks or performed under emergency conditions, reinforcing that elective placement at 14 - 18 weeks remains optimal.

Biologically, earlier placement is safer because the cervix is closed and uninfected, whereas later or emergency procedures are technically more difficult and performed on compromised anatomy, increasing the risks of infection and preterm labor. Overall, our results and the available literature suggest that laparoscopic cerclage is safe in both the first and second trimesters, but 14 - 18 weeks appears to be the most favorable window.

4.4. Subgroup Analysis: Maternal and Neonatal Implications of Placental Coverage During Cerclage

This subgroup analysis indicates that laparoscopic cerclage is technically safe in women with a placenta covering the cervix. Surgical parameters such as blood loss and operative time were not adversely affected, consistent with prior studies demonstrating the feasibility and safety of laparoscopic abdominal cerclage in complex anatomical scenarios [25]-[29]. However, the higher rates of placenta previa and adhesions in the covering group reflect known associations between low-lying placenta and abnormal placentation, which have been well described in the literature [30]-[33].

The trend toward higher NICU admissions and earlier delivery in the covering group, although not statistically significant, raises the possibility of subtle placen-

tal insufficiency or more cautious obstetric management, consistent with evidence that placental location can influence maternal and neonatal outcomes [33]. One case of placenta previa was later diagnosed in this subgroup, raising the question of whether cerclage may influence placental persistence. While isolated reports have described cerclage use in women with placenta previa [34]-[36], current evidence does not support a direct causal link.

Overall, our findings suggest that placental coverage at the time of cerclage should not be considered a contraindication, but rather a marker for enhanced antenatal surveillance and individualized care.

4.5. Strengths and Limitations

This study has several strengths, including a well-defined cohort and a clear and direct comparison of surgical and pregnancy outcomes based on cerclage placement timing. However, the study is limited by its retrospective nature, which may introduce selection bias. Also, the small sample size in the pre-conceptional group may have affected the statistical power of the study. Furthermore, a high rate of missing data could introduce bias and limit the validity of the results, as the missing data could have affected the study outcomes. Future studies should aim to include larger sample sizes and prospective designs in order to increase statistical power and the ability to detect smaller differences between the groups.

5. Conclusion

In conclusion, pre-conception cerclage, even though it takes longer, is associated with increased birth weights and cervical length gains with no additional risks. This promising benefit should motivate clinicians to consider pre-conceptional cerclage a viable option. Both pre-conceptional and post-conceptional cerclage are safe and effective in preventing premature deliveries. Clinicians should consider these factors when determining the optimal timing for cervical cerclage placement, always providing individualized care based on patient risk profiles.

Ethical Approval

The hospital review board (Ethics Committee of the Second Affiliated Hospital of Nanjing Medical University) obtained ethical approval for the current study (2024-KY-282-01).

Authors' Contributions

All authors participated in the design of the study concept. Mundhir Semm Ally Basinda, Sifan Li contributed to data collection, analysis, and manuscript drafting. Ying Xiaoyan supervised the whole process. All authors read and approved the final manuscript for submission.

Conflicts of Interest

The authors declare that they have no known competing financial interests or per-

sonal relationships that could have appeared to influence the work reported in this paper.

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