Effectiveness of Different Cerclage Indications in Cervical Insufficiency and Perinatal Outcomes: A Single-Centre Retrospective Analysis

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Article

Effectiveness of Different Cerclage Indications in Cervical Insufficiency and Perinatal Outcomes: A Single-Centre Retrospective Analysis

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Abstract

Background and Objectives: Preterm birth is associated with perinatal morbidity and mortality, and cervical cerclage is an effective intervention for preventing cervical insufficiency. *Materials and Methods*: This retrospective study was conducted to evaluate the effects of maternal, obstetric, and perioperative variables on the prolongation of gestational duration and neonatal outcomes in pregnancies where cerclage was performed. To this end, the medical records of 93 singleton pregnancies in which cervical cerclage was performed were evaluated. *Results*: The findings showed that gestational age was significantly longer and delivery occurred later in the history-based cerclage, ultrasonographic short cervix, and emergency cerclage groups. Cervical funneling and early removal of the cerclage strongly influenced shorter gestational age and reduced live birth-discharge rates. While obstetric complications contributed to adverse neonatal outcomes, progesterone use and maternal comorbidities were not associated with gestational age at delivery. *Conclusions*: In conclusion, the success of cerclage is multidimensional; indications and the perioperative process play a decisive role.

Keywords: cervical cerclage; preterm birth; cervical insufficiency; pregnancy prolongation; perinatal outcomes

1. Introduction

Preterm birth (PTB) is the delivery of babies before the 37th week of pregnancy. PTB accounts for approximately 70% of perinatal deaths and 36% of all infant deaths [1,2] and negatively affects 15 million people worldwide, including babies, mothers and families [3]. One million neonatal deaths each year are attributable to PTB [3]. While obstetric, environmental, demographic, and genetic factors are cited as causes of PTB, it leads to adverse neurodevelopmental problems and cerebral palsy [4–6]. PTB is associated with neonatal mortality, and one of its causes is cervical insufficiency, characterised by cervical softening in the absence of uterine contractions, which prevents the continuation of pregnancy [7,8]. Cervical insufficiency occurs in 0.5-1% of pregnancies, and the estimated recurrence rate is 30% [9].

The most effective method currently used for the treatment of cervical insufficiency is cervical cerclage. Cervical cerclage was first used in 1955 by Shirodkar to prevent premature birth, and the modification made by McDonald in 1957 became the most important intervention tool for improving neonatal prognosis [10–12]. It has been noted that the success rate of cerclage varies significantly depending on the indication for its application [13–15]. Today, success requires a comprehensive clinical approach that considers not only the indications but also the gestational age at the time of cervical cerclage, cervical length, the presence of cervical funneling, and maternal profiles [16,17]. Despite all advanced applications, preterm births still occur, and their mechanism remains unclear.

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The gestational age at the time of cervical cerclage, cervical length (mm), the presence of cervical funneling and perioperative approaches are decisive factors in determining pregnancy prolongation and neonatal survival rates [18–21]. Furthermore, the literature shows a limited comprehensive analysis of risk factors related to delivery method, gestational age groups, and perinatal outcomes. In addition, the efficacy and safety of cerclage and which group of patients may benefit from it are also subjects of debate. Indications for cerclage procedures are often not fully reported, and results regarding efficacy may be inconsistent [22–24]. Consequently, gynaecologists may be more reluctant to recommend cerclage to women at risk of preterm birth [25]. The study aimed to determine perinatal outcomes according to cerclage indications and the frequency of cerclage-related complications in pregnant women who underwent cervical cerclage intervention and to evaluate the effects of maternal, obstetric, and perioperative factors on gestational age at delivery and prolongation of pregnancy duration.

2. Materials and Methods

The study was approved by the Local Ethics Committee of Dicle University Faculty of Medicine Hospital on 22 October 2025 (approval number: 361). The research was conducted in accordance with the principles of the 1964 Declaration of Helsinki. Informed consent was not required due to the retrospective nature of the study.

The study included 93 patients who underwent cervical cerclage for the diagnosis of cervical insufficiency at Dicle University Faculty of Medicine Hospital (a tertiary referral centre) between January 2015 and December 2024. Patient information was obtained through a retrospective review of electronic medical records. Pregnancies with membrane rupture, active preterm labour, fetal congenital anomalies, intrauterine fetal deaths, and multiple pregnancies were excluded from the study. Additionally, patients whose information could not be obtained or whose information was incomplete were excluded from the study. Pregnant women were divided into three groups: history-indicated cerclage, short cervix-indicated cerclage, and emergency cerclage based on physical examination.

History-indicated cerclages were performed prophylactically and electively. The indications for these cerclages were a history of preterm birth or second-trimester pregnancy loss. Short cervix-indicated cerclages were cerclage procedures performed due to a cervical length measured at 30 mm or less by transvaginal ultrasonography. Emergency cerclages, on the other hand, encompass cerclage procedures performed in the presence of cervical dilatation or funnelling.

In the history-indicated cerclage group, cerclage placement was performed at the end of the first trimester, while in the short cervix indication-based and emergency cerclage groups, it was performed at the time of diagnosis. Before the cerclage procedure, all patients were evaluated for fetal viability, chorioamnionitis, and placental abruption. Cervical cerclage procedures were performed by physicians with sufficient experience in this field (at the associate professor and professor level).

All patients underwent cervical cerclage under spinal anaesthesia according to the McDonald procedure [11]. The procedures performed were described in detail in the surgical notes available in our hospital's medical records; while the patient was in the lithotomy position, after antiseptic preparation of the vagina and cervix, the anterior and posterior lips of the cervix were grasped, and a 5 mm braided polyester filament (Mersilene®) suture material was placed circumferentially around the cervicovaginal junction. The suture was advanced counterclockwise starting at the 11 o'clock position without entering the endocervix and tied at the 12 o'clock position.

In cases with advanced cervical dilatation and prolapsed membranes, the operating table was placed in a pronounced Trendelenburg position to allow the membranes to retract under the effect of gravity. Fixation sutures were placed around the external cervical os, and the cervix was gently pulled back, using the fingertips to push the membranes towards the uterus. In addition, amnioreduction was performed via transabdominal amniocentesis under ultrasound guidance in three patients with prolapsed membranes. Approximately 150 ml of fluid was removed via

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amnioreduction, reducing the pressure in the prolapsed sac and allowing it to retract into the uterine cavity.

All patients received prophylactic antibiotics (Cefazolin 1 g, IV) during surgery, regardless of indication. In indications based on physical examination (emergency cerclage), indomethacin 100 mg loading dose followed by 25 mg every 6 hours for 48 hours was administered as a tocolytic. All patients were also supported with progesterone therapy to prevent preterm delivery. This prophylactic treatment involved the daily administration of 200 mg of vaginal progesterone from 16+0 weeks to 36+0 weeks of gestational age. Additional progesterone therapy to prevent preterm delivery was initiated according to our clinic's protocol at that time. Patients without symptoms such as pain, bleeding, or membrane rupture within 24 hours after surgery were discharged. Cerclages were removed between 36+0 and 37+0 weeks of gestational age; however, they were removed earlier in cases of infection symptoms, bleeding, spontaneous contractions, or membrane rupture.

Preterm delivery was subdivided according to gestational age (GA) at delivery, in accordance with the WHO subclassification:

- Immature delivery: <24+0 weeks GA
- Extremely preterm birth: 24+0 – 27+6 weeks GA
- Very preterm birth: 28+0 – 31+6 weeks GA
- Mid-to-late preterm birth: 32+0 – 36+6 weeks GA
- Term birth: ≥37+0 weeks GA

Perioperative complications are defined as complications occurring during the cerclage procedure or within 24 hours after the procedure (e.g., haemorrhage, membrane rupture). All outcomes were defined separately for the three groups.

Baseline characteristics and study outcomes were transferred to and analysed using IBM SPSS Statistics (Version 22.0; IBM Corp., Armonk, NY, USA) statistical software. The normality of the distribution of variables was assessed using the Kolmogorov-Smirnov and Shapiro-Wilk tests. Continuous variables are presented as mean ± standard deviation or median, while categorical data are presented as number (n) and percentage (%). Parametric tests, such as Student's t-test or one-way ANOVA test for multiple groups, were used for continuous variables with a normal distribution; non-parametric tests, such as the Mann-Whitney U test or Kruskal-Wallis test, were used for non-normal distributions. The Chi-square test or Fisher's Exact Test was used for categorical variables. Multivariate logistic regression and linear regression were applied to examine the determining factors affecting gestational age, gestational week groups, and live birth rates. $p<0.05$ was considered statistically significant.

3. Results

Descriptive statistics for the continuous variables of the study population are presented in Table 1.

Table 1. Descriptive statistics for continuous variables.

Variable	Mean ± SD	Median (25–75 pct.)	Min–Max	Skewness	Kurtosis
Age (years)	29.66 ± 5.26	30 (26–33)	17–42	0.13	–0.26
Gestational age at cerclage (weeks)	15.32 ± 3.87	14 (13–16.5)	12–25	1.35	0.59
Gestational age at delivery (weeks)	33.74 ± 5.89	36 (30.5–38)	15–40	–1.37	1.20
Pregnancy prolongation (days)	129.27 ± 55.44	155 (88–171)	0–188	–1.04	–0.23
Gravidity (n)	4.12 ± 2.35	4 (2–5.5)	1–12	0.86	0.61

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Parity (n)	1.62 ± 1.96	1 (0–2.5)	0–12	2.22	7.86
Abortus (n)	1.52 ± 1.54	1 (0–2)	0–6	1.20	1.05
Living children (n)	0.83 ± 1.24	0 (0–1)	0–5	1.49	1.36
Cervical length (mm)	27.40 ± 9.55	30 (23.5–34)	0–45	–1.20	0.96
Maternal BMI (kg/m²)	26.85 ± 3.86	26 (24–29.3)	19–39	0.63	0.24

Examination of the skewness and kurtosis values in Table 1 reveals that most variables, excluding age, gravida, and maternal body mass index (BMI), fall outside the normal distribution limits (±1). In particular, significant positive skewness and high kurtosis are observed in the variables of parity, abortion, and number of living children, indicating sensitivity to outliers. Gestational age, pregnancy prolongation, and cervical length also deviate from the normal distribution. The mean age of pregnant women who underwent cerclage was 29.66 ± 5.26 years, and the procedure was performed at an average of 15.32 ± 3.87 weeks of gestation. The average gestational age was 33.74 ± 5.89 weeks, and pregnancies were prolonged by an average of 129.27 ± 55.44 days after cerclage. Obstetric history parameters were determined as follows: gravida 4.12 ± 2.35, parity 1.62 ± 1.96, abortion 1.52 ± 1.54, and number of living children 0.83 ± 1.24. The mean cervical length was 27.40 ± 9.55 mm, and maternal BMI was 26.85 ± 3.86 kg/m².

According to Table 2, the majority of cases were in the 25–34 age range (65.6%), and therefore the study group consisted mainly of young adults. Maternal BMI distribution was balanced among normal (37.6%), overweight (38.7%), and obese (23.7%) groups. The majority of participants did not smoke (78.5%).

Table 2. Descriptive statistics regarding demographic and obstetric characteristics.

Variable	**Category**	**n**	**%**
Age group	<20 years	2	2.2
	20–24 years	14	15.1
	25–29 years	28	30.1
	30–34 years	33	35.5
	35–39 years	12	12.9
	≥40 years	4	4.3
Maternal BMI group	Normal	35	37.6
	Overweight	36	38.7
	Obese	22	23.7
Smoking status	No	73	78.5
	Yes	20	21.5

The vast majority of cerclage indications in Table 3 were history-based (71.0%), with short cervix (16.1%) and emergency cerclage (12.9%) occurring at lower rates. Regarding gestational age, approximately half of the cases reached term (≥37 weeks, 47.3%), while 23.7% delivered between 32 and 36+6 weeks. The live birth rate at discharge was high at 89.2%. Perioperative complications were extremely rare (1.1%). Early removal of the cerclage occurred in 46.2% of cases, most frequently due to membrane rupture (39.5%) and spontaneous contractions (37.2%). Funneling was not observed in most cases during cervical evaluation (75.3%), but was present in approximately one-quarter (23.7%).

Table 3. Descriptive statistics of variables related to cerclage.

Variable	Category	n	%

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Cerclage indication	History-indicated cerclage	66	71.0
	Short cervix	15	16.1
	Emergency cerclage	12	12.9
Gestational age group at delivery	<24 weeks	6	6.5
	25–27 weeks + 6 days	11	11.8
	28–31 weeks + 6 days	10	10.8
	32–36 weeks + 6 days	22	23.7
	≥37 weeks	44	47.3
Live birth at discharge	Yes	83	89.2
	No	10	10.8
Perioperative complication	None	92	98.9
	Bleeding	1	1.1
Early cerclage removal	No	50	53.8
	Yes	43	46.2
Reason for Early Cerclage Removal	Infection	1	2.3
	Bleeding	5	11.6
	Membrane rupture	17	39.5
	Spontaneous contractions	16	37.2
	Other	4	9.3
Funneling	None	70	75.3
	Present	22	23.7
	Pouch in vagina	1	1.1

According to Table 4, the most frequently preferred regimen for progesterone treatment is the vaginal + intramuscular combination (80.6%), with other forms used at very low rates. Perioperative antibiotics were administered to all patients, indicating a standard approach at the center. The rate of tocolytic use was more limited (28%). While most maternal comorbidities were absent (66.7%), the most common concomitant conditions were thyroid disorders (11.8%) and diabetes (9.7%).

Table 4. Descriptive statistics regarding treatment and comorbidities.

Variable	Category	n	%
Progesterone use	Oral	5	5.4
	Vaginal capsule	11	11.8
	Vaginal + intramuscular	75	80.6
	Oral + intramuscular	1	1.1
	Vaginal gel	1	1.1
Perioperative antibiotic use	Yes	93	100.0
	No	0	0
Perioperative tocolytic use	Yes	26	28.0

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	No	67	72.0
Maternal comorbidity	None	62	66.7
	Diabetes	9	9.7
	Hypertension	2	2.2
	Thyroid disorder	11	11.8
	Anemia	1	1.1
	Renal disease	2	2.2
	Cardiac disease	1	1.1

According to Table 5, approximately half of the cases showed no obstetric complications (46.2%), while the most frequent complication was preterm birth (38.7%). Rates of IUGR, GDM, and preeclampsia were low. Uterine anomalies were mostly absent (86.0%), but the most common anomalies were uterine septum (5.4%) and didelphys uterus (4.3%). Cesarean section was significantly more prevalent in terms of delivery method (78.5%), while vaginal delivery was low (15.1%).

Table 5. Descriptive statistics regarding obstetric complications, uterine anomalies, and mode of delivery.

Variable	**Category**	**n**	**%**
Obstetric complication	None	43	46.2
	Preeclampsia	2	2.2
	IUGR	4	4.3
	GDM	4	4.3
	Preterm birth	36	38.7
	Abortion	2	2.2
	Intrauterine fetal demise	2	2.2
Uterine anomaly	None	80	86.0
	Uterine septum	5	5.4
	Bicornuate uterus	1	1.1
	Unicornuate uterus	1	1.1
	Didelphys uterus	4	4.3
	T-shaped uterus	2	2.2
Mode of delivery	Cesarean section	73	78.5
	Vaginal delivery	14	15.1
	Abortion	4	4.3
	Hysterotomy	2	2.2

Gestational age at delivery differed significantly according to the indication for cerclage, with the highest mean rank value in the history-based cerclage group and the lowest value in the emergency cerclage group (Kruskal–Wallis H = 13.624; sd = 2; p = 0.001). The presence of funneling and early removal of the cerclage were significantly associated with gestational age at delivery; cases without funneling and without early removal of the cerclage had significantly higher gestational age at delivery (Mann–Whitney U = 224.5; Z = −5.029; p = 0.001 and Mann–Whitney U = 10.5; Z = −8.259; p = 0.000). There was no statistically significant difference between tocolytic use, progesterone regimens, and maternal comorbidity groups and gestational age at delivery (p > 0.05). (Table 6).

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Table 6. Comparison of gestational age at birth according to clinical variables.

Variable	Group	Mean Rank	p-value
Cerclage indication	History-indicated	53.14	**0.001**
	Short cervix	38.03	
	Emergency cerclage	24.46	
	Kruskal–Wallis H = 13.624; df = 2		
Funneling	Absent	54.29	**0.001**
	Present	21.70	
	Mann–Whitney U = 224.5; Z = −5.029		
Early cerclage removal	No	68.29	**0.000**
	Yes	22.24	
	Mann–Whitney U = 10.5; Z = −8.259		
Tocolytic use	No	34.85	0.060
	Yes	51.72	
	Mann–Whitney U = 555.0; Z = −2.724		
Progesterone regimen	Oral	61.40	0.092
	Vaginal capsule	63.14	
	Vaginal + intramuscular (IM)	44.21	
	Oral + IM	28.50	
	Vaginal gel	25.00	
	Kruskal–Wallis H = 7.390; df = 4		
Maternal comorbidity	None	49.35	0.749
	Diabetes mellitus	36.00	
	Hypertension	46.00	
	Thyroid disorder	41.55	
	Anemia	10.00	
	Renal disease	65.00	
	Cardiac disease	70.50	
	Others	45.50	
	Kruskal–Wallis H = 4.266; df = 7		

There was a difference between the groups in terms of the prolongation of gestational age at delivery according to the cerclage indication, with the highest mean rank value in the history-based cerclage group and the lowest value in the emergency cerclage group (p=0.000). The presence of funneling was found to be significantly associated with the prolongation of gestational age. The mean rank value was significantly higher in cases without funneling compared to those with funneling. Early removal of the cerclage had a significant effect on the prolongation of gestational age; mean rank values were significantly higher in cases where early removal was not performed (Mann–Whitney U = 190.5; Z = −6.819; p= 0.000).

A statistically significant relationship was found between the use of tocolytics and the prolongation of gestational age; mean rank values were higher in cases using tocolytics compared to those not using them (Mann–Whitney U = 331.5; Z = −4.621; p < 0.001). No statistically significant difference was found in terms of pregnancy duration between progesterone use regimens and

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maternal comorbidity groups (Kruskal–Wallis H = 5.531; sd = 4; p = 0.092 and Kruskal–Wallis H = 5.829; sd = 7; p = 0.560). (Table 7).

Table 7. Comparison of prolongation of gestational age at delivery according to clinical variables.

Variable	Group	Mean Rank	p
Cerclage indication	History-indicated	56.48	0.000
	Short cervix	33.70	
	Emergency cerclage	11.46	
	Kruskal–Wallis H =32.636; df = 2		
Funneling	Absent	56.22	0.000
	Present	15.57	
	Mann–Whitney U = 89.5; Z = −6.232		
Early cerclage removal	No	64.69	0.000
	Yes	26.43	
	Mann–Whitney U = 190.5; Z = −6.819		
Tocolytic use	No	26.25	0.000
	Yes	55.05	
	Mann–Whitney U = 331.5; Z = −4.621		
Progesterone regimen	Oral	34,80	0.092
	Vaginal capsule	38,18	
	Vaginal + intramuscular (IM)	48,44	
	Oral + IM	72,00	
	Vaginal gel	72,00	
	Kruskal–Wallis H = 5.531; df = 4		
Maternal comorbidity	None	45,75	0.560
	Diabetes mellitus	56,50	
	Hypertension	48,75	
	Thyroid disorder	50,86	
	Anemia	72,00	
	Renal disease	25,50	
	Cardiac disease	25,50	
	Others	44,10	
	Kruskal–Wallis H = 5.829; df = 7		

Live birth and discharge rates were evaluated based on several maternal, obstetric, and perioperative factors. The live birth and discharge rate was significantly lower in cases with detected funneling compared to those without funneling (p = 0.001). Early removal of the cerclage was associated with a significant decrease in live birth and discharge rates; in cases without early removal, all pregnancies resulted in live birth (p < 0.001). Similarly, the presence of obstetric complications significantly reduced live birth and discharge rates. All cases without complications resulted in live birth and discharge (p < 0.001). No statistically significant relationship was found between cerclage indication and maternal comorbidities and live birth and discharge. However, a near-significant trend was observed for both variables (p = 0.068 and p = 0.054). (Table 8).

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Table 8. Maternal, Obstetric, and Perioperative Factors Associated with Live-Born Infant Discharge

Category	Variable	Live-born discharge		*p*
		Yes n (%)	No n (%)	
Cerclage indication	History-indicated	62 (93.9)	4 (6.1)	0.068
	Short cervix	12 (80.0)	3 (20.0)	
	Emergency cerclage	9 (75.0)	3 (25.0)	
Funneling	Absent	67 (95.7)	3 (4.3)	0.001
	Present / membranes prolapsed	16 (72.7)	6 (27.3)	
Maternal comorbidity	Absent	57 (91.9)	5 (8.1)	0.054
	Present	26 (83.9)	5 (16.1)	
Early cerclage removal	No	50 (100.0)	0 (0.0)	0.000
	Yes	33 (76.7)	10 (23.3)	
Obstetric complications	Absent	43 (100.0)	0 (0.0)	0.000
	Present	40 (80.0)	10 (20.0)	

Table 9 generally evaluates the gestational age at birth according to maternal, obstetric, and perioperative variables. A significant relationship persists between the indication for cerclage and the gestational age at birth (p=0.001). In pregnancies where cerclage was performed based on history, the majority of births occurred at ≥37 weeks of gestation (57.6%), while in the emergency cerclage period, the rate of premature birth was higher, with a significant proportion of cases giving birth at 25–27+6 and 28–31+6 weeks of gestation. The presence of a funnel significantly correlates with the gestational age at birth (p=0.000). In pregnancies without a conversion funnel, the majority of births occurred at ≥37 weeks of gestation (58.6%), while in cases with funneling or prolapse of membranes into the vagina, the rate of births at earlier gestational weeks was significantly increased. No significant association was found between the presence of maternal comorbidities and gestational age at birth (p = 0.079). However, it was noted that the rates of early and moderate preterm births were higher in pregnancies with comorbidities. Early removal of the cerclage was strongly correlated with gestational age at delivery (p=0.000). The vast majority of pregnancies where the cerclage was not removed early delivered at ≥37 weeks (88.0%), while in cases with early cerclage removal, no delivery occurred at ≥37 weeks, and all deliveries were at preterm gestational age.

Table 9. Gestational Age at Delivery According to Maternal, Obstetric, and Perioperative Variables

Category	Variable	<24 weeks	25–27+6 weeks	28–31+6 weeks	32–36+6 weeks	p
Cerclage indication	History-indicated	2 (3.0)	5 (7.6)	5 (7.6)	16 (24.2)	0.001
	Short cervix	3 (20.0)	1 (6.7)	2 (13.3)	5 (33.3)	
	Emergency cerclage	1 (8.3)	5 (41.7)	3 (25.0)	1 (8.3)	

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Funneling	Absent	1 (1.4)	5 (7.1)	4 (5.7)	19 (27.1)	0.000
	Present / membranes prolapsed	5 (21.7)	6 (26.1)	6 (26.1)	3 (13.0)	
Maternal comorbidity	Absent	3 (4.8)	5 (8.1)	8 (12.9)	15 (24.2)	0.079
	Present	3 (9.7)	6 (19.4)	2 (6.5)	7 (22.6)	
Early cerclage removal	No	0 (0.0)	0 (0.0)	0 (0.0)	6 (12.0)	0.000
	Yes	6 (14.0)	11 (25.6)	10 (23.3)	16 (37.2)	
Obstetric complications	Absent	0 (0.0)	0 (0.0)	0 (0.0)	5 (11.6)	0.000
	Present	6 (12.0)	11 (22.0)	10 (20.0)	17 (34.0)	

Table 10 presents the correlations between cervical length, gestational age at cerclage, and pregnancy outcomes. A strong and significant positive correlation was found between gestational length (days) and cervical length ($r = 0.618$; $p < 0.01$). Similarly, a very strong positive correlation was observed between gestational length and gestational age at delivery ($r = 0.802$; $p < 0.01$). A moderate-to-strong negative correlation was found between gestational age at cerclage and gestational length ($r = -0.567$; $p < 0.01$). Furthermore, a negative and significant correlation was found between cerclage week and cervical length ($r = -0.539$; $p < 0.01$). In contrast, no statistically significant relationship was observed between the gestational age at which cerclage was performed and the gestational age at delivery ($r = -0.137$; $p > 0.05$). A moderately positive and statistically significant correlation was found between cervical length and gestational age at delivery ($r = 0.394$; $p < 0.01$). These findings suggest that longer cervical lengths and cerclage performed at an earlier gestational age may be associated with a longer gestation period and delivery at a later gestational age.

Table 10. Correlation matrix between cervical length, cerclage week, and pregnancy outcomes

Variables	Pregnancy prolongation (days)	Cervical length (mm)	Gestational age at cerclage (weeks)	Gestational age at delivery (weeks)
Pregnancy prolongation (days)	—	**0.618****	**−0.567****	**0.802****
Cervical length (mm)	**0.618****	—	**−0.539****	**0.394****
Gestational age at cerclage (weeks)	**−0.567****	**−0.539****	—	−0.137
Gestational age at delivery (weeks)	**0.802****	**0.394****	−0.137	—

Values represent **Spearman's rank correlation coefficients (r);** ** $p < 0.01$ (two-tailed); Statistically significant correlations are shown in **bold.**

Table 11 analyzes cervical length, presence of funneling, early removal of cerclage, maternal comorbidity, and cerclage indication variables. No statistically significant relationship was found between each 1 mm increase in cervical length and the probability of live birth (OR = 1.01; 95% CI: 0.88–1.16; $p = 0.918$). Although the presence of funneling tended to increase the probability of live

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birth, this relationship was not statistically significant (OR = 8.59; 95% CI: 0.42–175.90; p = 0.163). Similarly, no significant relationship was observed between the presence of maternal comorbidity and live birth (OR = 2.79; 95% CI: 0.48–16.24; p = 0.255).

The calculated odds ratio for the variable of early cerclage removal was quite high, the inability to calculate the confidence interval and the insignificant p-value (p = 0.997) indicate that a statistically reliable relationship could not be established for this variable. The overall effect of cerclage indication on live birth was not found to be significant (p = 0.748). In subgroup analyses, no statistically significant difference was found in the probability of live birth when comparing cerclage performed due to short cervix with history-based cerclage (OR = 0.31; 95% CI: 0.01–11.29; p = 0.525) and when comparing emergency cerclage with history-based cerclage (OR = 0.42; 95% CI: 0.04–4.80; p = 0.485).7

Table 11. Determinants of live birth in cases undergoing cervical cerclage

Variables	OR	95% CI	p value
Cervical length (per mm increase)	1.01	0.88–1.16	0.918
Funneling	8.59	0.42–175.90	0.163
Early cerclage removal	2.83×10^{8}	—*	0.997
Maternal comorbidity	2.79	0.48–16.24	0.255
Cerclage indication (overall)	—	—	0.748
Short cervix vs history-indicated	0.31	0.01–11.29	0.525
Emergency cerclage vs history-indicated	0.42	0.04–4.80	0.485

Table 12 shows that the relationships between maternal age, cervical length, pregnancy prolongation, and gestational week at delivery were evaluated using Spearman rank correlation analysis. No statistically significant relationship was found between maternal age and cervical length, pregnancy prolongation, and gestational week at delivery (all p > 0.05). A strong and positive correlation was observed between cervical length and gestational age (r = 0.618; p < 0.01). Similarly, a moderately positive and statistically significant relationship was found between cervical length and gestational week at delivery (r = 0.394; p < 0.01).

A very strong positive correlation was found between pregnancy prolongation and gestational week at delivery (r = 0.802; p < 0.01). This finding indicates that gestational age is closely related to delivery at a later gestational week.

Tablo 12. Relationships between cervical length, gestational age, and gestational week at delivery.

Variables	Maternal age (years)	Cervical length (mm)	Pregnancy prolongation (days)	Gestational age at delivery (weeks)
Maternal age (years)	—	0.070	−0.030	−0.129
Cervical length (mm)	0.070	—	**0.618****	**0.394****
Pregnancy prolongation (days)	−0.030	**0.618****	—	**0.802****
Gestational age at delivery (weeks)	−0.129	**0.394****	**0.802****	—

**p<0.01.

4. Discussion

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In the study is a single-centre retrospective investigation aiming to evaluate the effects of cervical cerclage procedures performed for different indications in cases of cervical insufficiency on gestational duration, gestational age groups, and perinatal outcomes. Indeed, cervical insufficiency affects approximately 0.05–2% of the obstetric population and is considered a significant cause of second-trimester pregnancy losses and preterm births. Therefore, effective management of cervical insufficiency is critical in terms of maternal, obstetric, and perioperative factors [26,27]. In this context, a detailed examination of the decisive role of the indication and timing of cerclage on clinical outcomes may contribute to the development of individualised obstetric management strategies.

History-based (prophylactic) cerclage has been found to be associated with delivery at more advanced gestational weeks and a significantly longer gestational period compared to the ultrasound-detected short cervix and emergency cerclage groups. Similarly, the highest live birth rates were observed in the history-based cerclage group, suggesting a better perinatal profile. The findings indicate that prophylactic cerclage, when performed in the early second trimester under stable clinical conditions and before significant cervical changes develop, provides a more favourable environment for prolonging pregnancy and fetal maturation. The literature indicates similarities between history-based and ultrasound-indicated cerclage groups in terms of gestational age and perinatal outcomes; emergency cerclage is associated with more adverse obstetric and perinatal outcomes, including advanced cervical dilation, increased risk of intrauterine infection, and higher baseline prematurity likelihood [28–32]. In this context, the findings indicate that the indication for cerclage and the timing of the intervention significantly affect pregnancy outcomes, and that emergency cerclage should be made more favourable by evaluating clinical parameters and selecting appropriate patients. In this context, emergency cerclage should be considered not as an absolute failure method, but as a ‘rescue strategy’ to prolong pregnancy in carefully selected cases.

Due to the progressive nature of cervical insufficiency, funneling occurs in the literature, disrupting the integrity of the cervical structure at the level of the internal os and weakening the mechanical barrier function of the cervix. This situation triggers an intrauterine inflammatory response and increases the likelihood of preterm birth, along with an increased risk of infection due to the early loss of the cervical mucus plug and the consequent disappearance of the protective immunological and mechanical barrier provided by the uterine cavity against microorganisms [33,34]. According to research findings, the presence of funneling (cervical funnel formation) emerged as a strong and independent negative predictor in terms of prolonged gestation and live birth rates. It was observed that in pregnancies without funneling, delivery occurred at more advanced gestational weeks and neonatal outcomes were significantly better. Similarly, the presence of funneling has been shown in the literature to constitute an additional risk factor for preterm delivery, independent of cervical shortening, and has been associated with poorer obstetric and perinatal outcomes, particularly when detected in the second trimester [30,31]. Within the scope of the findings, funneling represents an important prognostic indicator of advanced cervical insufficiency, and it is considered necessary to carefully examine not only cervical length but also cervical morphology and the presence of funneling when evaluating candidates for cerclage.

Early removal of cerclage has been associated with a significantly shorter gestation period and reduced live birth rates. Indeed, the literature reports that the most common causes of early cerclage removal include preterm premature membrane rupture, clinical or subclinical intrauterine infection, and early uterine contractions. These conditions indicate advanced cervical insufficiency and are powerful biological stress factors that limit the continuation of pregnancy [30–32]. Early cerclage removal is often not an isolated surgical decision but rather a clinical reflection of pathological processes. Adverse pregnancy outcomes associated with early cerclage removal are likely due to the activation of the infection-inflammation axis and the disruption of foetal membrane integrity [23]. Increased inflammatory response triggers uterine activity and further reduces cervical stability, making it difficult to prolong pregnancy and adversely affecting the perinatal prognosis. Therefore, it should be considered a clinical indicator of serious obstetric complications and poor perinatal prognosis.

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Meta-analyses and retrospective studies report that salvage/physical examination-indicated cerclage can prolong pregnancy by approximately 4–5 weeks and reduce the risk of delivery before 34 weeks of gestation by almost half [28–33]. Therefore, even in the presence of cervical dilation, emergency cerclage may remain a valuable option with appropriate patient selection and careful exclusion of infection.

Among maternal factors, body mass index (BMI), previous preterm birth or second-trimester loss, and inflammatory markers such as C-reactive protein (CRP), in particular, have been highlighted in the literature as important predictors of adverse outcomes. While Poggi et al. reported increased rates of preterm delivery after cerclage in obese women [34], other studies have not demonstrated a significant association between BMI and pregnancy outcome [35,36]. More recent studies have demonstrated that combined risk models incorporating BMI, obstetric history, and CRP levels have strong predictive value in forecasting delivery before 28 weeks of gestation [33,34]. These findings highlight the importance of multidimensional risk assessment models in the clinical management of cervical insufficiency.

The significant relationship identified between the use of tocolytic therapy and the duration of pregnancy prolongation is considered clinically important, particularly in cases where emergency cerclage is performed and in high-risk cases. Although tocolytics do not directly increase term birth rates, they can provide uterine stability in the postoperative period by suppressing uterine contractions and contribute to prolonging the pregnancy for a certain period [24]. This situation should be considered as a supportive approach to tocolytic treatment in the post-cerclage period.

The study found no significant difference in gestational duration or perinatal outcomes between the progesterone administration methods. The role of progesterone in preventing preterm birth is controversial in the literature, and it has been reported that its additional contribution may be limited, especially in cases where cerclage has been performed [37]. In this study, the lack of an independent and significant relationship between progesterone use and gestational age at delivery or live birth rates reflects the ongoing uncertainty in the literature regarding the role of progesterone in preventing preterm birth. Early randomised controlled trials have indicated that progesterone reduces the risk of preterm birth, particularly in pregnant women with a history of spontaneous preterm birth [38]. However, larger studies published in subsequent years, involving more heterogeneous patient populations, particularly the PROLONG study, have failed to confirm this protective effect and suggest that progesterone may have a limited impact on pregnancy outcomes [19,39]. These conflicting findings suggest that the efficacy of progesterone may vary depending on patient selection, timing of administration, type of preparation, and accompanying obstetric interventions. Current American College of Obstetricians and Gynaecologists (ACOG) guidelines continue to support the use of progesterone in selected high-risk pregnancies, but report insufficient evidence that the use of progesterone in combination with cervical cerclage provides additional benefit in terms of prolonging gestation or improving perinatal outcomes [8].

5. Conclusion

The results showed that cerclage indication, funnel formation, early cerclage removal, and obstetric complications were the key determinants of prolonged gestation and live birth rates. While cerclage indicated based on history and ultrasound had similar pregnancy outcomes, emergency cerclage, despite having a lower success rate, was still beneficial in selected cases. Monitoring cervical shortening and performing cerclage in a timely manner will improve pregnancy and neonatal birth outcomes.

More individualised and evidence-based outcome assessments by clinicians in the management of cervical insufficiency will further reduce PTB rates. Correlation analyses have revealed a strong positive relationship between cervical length and gestational age and week of delivery. Longer cervical length is associated with a longer pregnancy duration and delivery occurring in later weeks. However, the fact that cervical length does not emerge as an independent predictor of live birth in logistic regression analyses suggests that anatomical measurements alone may be insufficient for

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predicting clinical outcomes. This finding highlights that cervical insufficiency is a dynamic process rather than a static condition and that clinical decisions should be based on a comprehensive assessment of factors such as the presence of funneling, timing of surgery, and perioperative complications, rather than cervical length alone.

The impact of maternal comorbidities and demographic characteristics on pregnancy outcomes was limited in the study. Although there was a higher tendency for early and moderate preterm birth in cases with comorbidities, this relationship did not reach statistical significance. This finding suggests that perinatal outcomes in cervical insufficiency are largely determined by cervical pathology and obstetric processes. Therefore, the focus of patient management should be on the dynamic assessment of the cervical condition rather than maternal characteristics.

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