

2024-2025

THÈSE

pour le

DIPLÔME D'ÉTAT DE DOCTEUR EN MÉDECINE

Qualification en GYNÉCOLOGIE OBSTÉTRIQUE.

Cervical cerclage : Obstetric and neonatal outcomes and risks factors for failure

(Cerclage du col utérin : issues obstétricales et néonatales et facteurs de risque d'échec)

DEPECKER Louise

Née le 13 novembre 1997 à Lesquin (59)

Sous la direction de Monsieur le Professeur LEGENDRE Guillaume

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« Au moment d'être admise à exercer la médecine, je promets et je jure d'être fidèle aux lois de l'honneur et de la probité. Mon premier souci sera de rétablir, de préserver ou de promouvoir la santé dans tous ses éléments, physiques et mentaux, individuels et sociaux. Je respecterai toutes les personnes, leur autonomie et leur volonté, sans aucune discrimination selon leur état ou leurs convictions. J'interviendrai pour les protéger si elles sont affaiblies, vulnérables ou menacées dans leur intégrité ou leur dignité. Même sous la contrainte, je ne ferai pas usage de mes connaissances contre les lois de l'humanité. J'informerai les patients des décisions envisagées, de leurs raisons et de leurs conséquences. Je ne tromperai jamais leur confiance et n'exploiterai pas le pouvoir hérité des circonstances pour forcer les consciences. Je donnerai mes soins à l'indigent et à quiconque me les demandera. Je ne me laisserai pas influencer par la soif du gain ou la recherche de la gloire.

Admise dans l'intimité des personnes, je tairai les secrets qui me seront confiés. Reçue à l'intérieur des maisons, je respecterai les secrets des foyers et ma conduite ne servira pas à corrompre les mœurs. Je ferai tout pour soulager les souffrances. Je ne prolongerai pas abusivement les agonies. Je ne provoquerai jamais la mort délibérément.

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Liste des abréviations

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Introduction: Preterm birth remains a leading cause of neonatal morbidity and mortality. Cervical insufficiency is a specific risk factor, for which cervical cerclage is the reference treatment. The aim of this study was to evaluate obstetric and neonatal outcomes according to the type of cerclage performed, and to identify risk factors associated with cerclage failure (defined as delivery before 28 weeks of gestation).

Methods: We conducted a retrospective single-centre study at Angers University Hospital between January 2014 and October 2024. All women who underwent cervical cerclage during pregnancy were included, except in cases of multiple gestations, definitive cerclage, or incomplete records. Demographic, obstetric, surgical, and neonatal data were collected. Statistical analyses were performed using uni- and multivariate logistic regression to identify independent predictors of cerclage failure.

Results: A total of 152 women were included. Live birth rates were significantly higher following prophylactic (88.1%) and ultrasound-indicated cerclage (93.3%) compared with rescue cerclage (53.8%, $p = 0.005$). Mean gestational age at delivery was 37.8 ± 6.3 weeks for prophylactic cerclage, 36.7 ± 6.9 weeks for ultrasound-indicated cerclage, and 30.4 ± 8.5 weeks for rescue cerclage ($p = 0.014$). Pregnancy prolongation also differed according to cerclage type: 21.3 weeks (prophylactic), 15.1 weeks (ultrasound-indicated), and 7.1 weeks (rescue) ($p < 0.001$). Multivariate analysis did not identify any clinically relevant independent risk factors for delivery before 28 weeks, apart from a history of ≥ 2 late miscarriages and/or preterm births (aOR = 4.96; 95% CI [1.34–22.67], $p = 0.024$).

Conclusion: Perinatal outcomes were significantly better following prophylactic or ultrasound-indicated cerclage compared with rescue cerclage, the latter being performed in inherently less favourable emergency contexts. Nevertheless, our findings suggest that rescue cerclage remains a reasonable therapeutic option in women at high risk of late miscarriage. No clinically relevant independent predictors of cerclage failure before 28 weeks were identified in our cohort, apart from severe obstetric history, such as recurrent late miscarriage or preterm birth (cervical incompetence).

INTRODUCTION

Preterm birth remains a major obstetric challenge worldwide, with rates ranging from 4% to 16% depending on the country. In France, recent estimates indicate that approximately 7% to 7.5% of live births occur preterm, corresponding to about 55,000 births each year (1,2). According to a recent report published by United Nations agencies and their partners, an estimated 13.4 million babies were born preterm in 2020, and nearly one million died due to complications related to prematurity (3). This corresponds to approximately one in ten births worldwide occurring before 37 weeks of gestation. Preterm birth is the leading cause of mortality in children under five years, accounting for more than one in five deaths. Survivors face an increased risk of long-term complications, including disability and developmental delay. Marked inequalities in survival persist across countries (4).

Moreover, prematurity also represents a major economic challenge in our society. In France, preterm birth represents a major economic burden for the healthcare system. Healthcare expenditures are strongly correlated with gestational age: the earlier the birth occurs, the higher the costs. Compared with term-born infants, preterm infants generate, on average, approximately seven times higher costs, rising to as much as twenty-five times higher for very preterm infants (≤ 32 weeks of gestation). Most of these expenditures are attributable to hospital stays (5). The annual cost of prematurity to the French national health insurance system has been estimated at over €1.5 billion, considering only immediate care (6).

Among these preterm births, approximately 0.5 to 1% are attributed to cervical insufficiency (7). However, the exact incidence of this condition remains difficult to establish due to the absence of a consensus definition. According to the guidelines of the French National College of Gynaecologists and Obstetricians (CNGOF), the Royal College of Obstetricians and

Gynaecologists (RCOG), and the American College of Obstetricians and Gynaecologists (ACOG), the diagnosis of cervical insufficiency is primarily retrospective ; based on a history of late miscarriage and/or spontaneous preterm birth associated with asymptomatic cervical dilatation, most often after three or more episodes of midtrimester pregnancy loss and/or preterm birth (8–11).

Cervical insufficiency corresponds to the inability of the gravid cervix to maintain a pregnancy during the second trimester in the absence of uterine contractions, before 37 weeks of gestation. Anatomically, it is characterized by a functional or structural defect of the circular muscle fibers and connective tissue matrix of the internal cervical os, resulting in loss of the cervical “lock” mechanism (12).

The primary treatment for cervical insufficiency is cervical cerclage, which can be classified into four categories based on timing and urgency (12):

- Prophylactic cerclage, performed between 13 and 16 weeks of gestation, indicated preconceptionally in patients with significant obstetric history (more than three late miscarriages or preterm births before 37 weeks of gestation).
- Ultrasound-indicated (therapeutic) cerclage, performed between 16 and 24 weeks of gestation in patients with cervical changes on ultrasound and a moderate risk profile based on previous preterm birth or late miscarriage.
- Rescue cerclage, performed before 27 weeks in symptomatic patients presenting with threatened late miscarriage, regardless of obstetric history.
- Definitive (i.e. cervico-isthmic) cerclage, indicated for patients with at least two late miscarriages or preterm births despite previous prophylactic or therapeutic cerclage.

Cervical cerclage has been shown to be effective in prolonging pregnancy in women at high risk of late miscarriage. However, data comparing obstetric outcomes between prophylactic

cerclage, ultrasound-indicated cerclage, and rescue cerclage remain limited. Most studies compare urgent cerclage procedures (including ultrasound-indicated and rescue cerclage) with prophylactic cerclage. While some studies have reported less favourable obstetric outcomes following urgent cerclage, most of the available evidence suggests that overall pregnancy outcomes are comparable between the two approaches. In this context, the question arises as to which risk factors may contribute to cerclage failure, to determine whether early intervention could improve patient management and further prolong pregnancy. Nevertheless, the literature remains inconsistent regarding the precise identification of such risk factors.

This study aimed to compare success and failure rates, as well as maternal and perinatal outcomes, following emergency, therapeutic, and ultrasound-indicated cervical cerclage in singleton pregnancies. In addition, outcomes of emergency cerclages (including ultrasound-indicated and rescue cerclage) were compared with those of prophylactic cerclage. Furthermore, the study sought to evaluate the risk factors for cerclage failure, defined as delivery before 28 weeks of gestation.

MATERIALS AND METHODS

The primary outcome was to identify the risk factors for cerclage failure, defined as preterm delivery before 28 weeks of gestation.

Secondary outcomes included the obstetric complications such as the cerclage-to-delivery interval, surgical procedure-related complications, mid-trimester loss, live birth rate, premature rupture of membranes (PPROM), use of tocolytics, administration of antenatal corticosteroids, intrauterine foetal death, prematurity and admission to the neonatal intensive care unit (NICU).

This was a retrospective observational study conducted in the Department of Obstetrics and Gynaecology at the University Hospital of Angers, a level III maternity centre.

The analysis collected data from all patients who underwent cervical cerclage coded as JNDB001 between January 2014 and October 2024.

All pregnant women who received a cervical cerclage during pregnancy—regardless of the indication or type of procedure (elective, ultrasound-indicated, emergency)—were included. Patients who had undergone a definitive cerclage were not included. Exclusion criteria were multiple pregnancies and incomplete clinical data concerning the primary outcome.

Data collection

Retrospective data collection was performed using electronic medical records, supplemented by obstetrical records in paper format. The maternal characteristics included age, parity, body mass index (BMI), smoking status, and obstetric history (previous late miscarriage, preterm delivery, or history of cervical cerclage). Gynaecological history was also recorded, including previous hysteroscopy, cervical conization, uterine evacuation procedures, pelvic surgery, and

polycystic ovary syndrome (PCOS). The type of conception (spontaneous or achieved through assisted reproductive technology (ART)) was recorded.

Cerclage-related variables included the type of cerclage (prophylactic, ultrasound-indicated, or rescue), gestational age at placement, cervical length, cervical dilatation, presence of bulging membranes, foetal presentation, and laboratory findings (white blood cell count, C-reactive protein (CRP), vaginal swab, and urine culture results).

Surgical data included the technique used, type of anaesthesia, operative time, and intraoperative complications.

Obstetric outcomes comprised pregnancy complications such as midtrimester loss, PPRM, chorioamnionitis, use of tocolytic therapy, administration of antenatal corticosteroids, and intrauterine foetal demise. Gestational age at cerclage removal, gestational age at delivery, and mode of delivery were also collected.

Neonatal outcomes contained birth weight, live birth rate, 5-minute APGAR score, and admission to the NICU.

Patients who underwent multiple cerclage procedures were considered as separate cases for each new cerclage.

Statistical analysis

Quantitative variables were described as mean and standard deviation or as median and interquartile range according to their distribution. Qualitative variables were presented as counts and percentages. Comparisons between the three groups were performed using the Kruskal-Wallis rank test for quantitative variables, and Pearson's Chi-square test or Fisher's exact test for qualitative variables, depending on expected frequencies.

To identify factors associated with delivery before 28 weeks of gestation, univariate analyses were conducted using simple logistic regression, reporting odds ratios with 95% confidence

intervals and p-values. Variables with an association at $p < 0.25$ in univariate analysis were included in a multivariate logistic regression model to estimate adjusted odds ratios.

The multivariate model adjustment allowed control for potential confounding factors. Statistical significance was set at 5% ($p < 0.05$).

All analyses were performed using R software, version 4.4.2.

ETHICAL CONSIDERATIONS

This observational study was performed in strict compliance with the French reference methodology MR-004, established by the French institutional authority for personal data protection (*CNIL-Commission Nationale de l'Informatique et des Libertés*). In accordance with ethical standards, informed consent was not necessary for demographic, physiological, and hospital-outcome data analyses because this observational study did not modify existing diagnostic or therapeutic strategies. The CNIL and our institutional review board (reference ar24-0089v0) approved the methodology.

RESULTS

During the study period, 170 patients underwent a cervical cerclage procedure coded as JNBD001. Patients with a definitive cerclage were not included. Of these, 114 received a prophylactic cerclage, 13 a rescue cerclage, and 34 an ultrasound-indicated cerclage. Delivery data were unavailable for 8 patients (4 in the prophylactic group and 4 in the ultrasound-indicated group). One case of prophylactic cerclage involved a twin pregnancy. Ultimately, 152 patients were included in the final cohort analysis: 109 in the prophylactic group, 43 in the emergency group, including 13 rescue cases and 30 ultrasound-indicated cases (Figure 1).

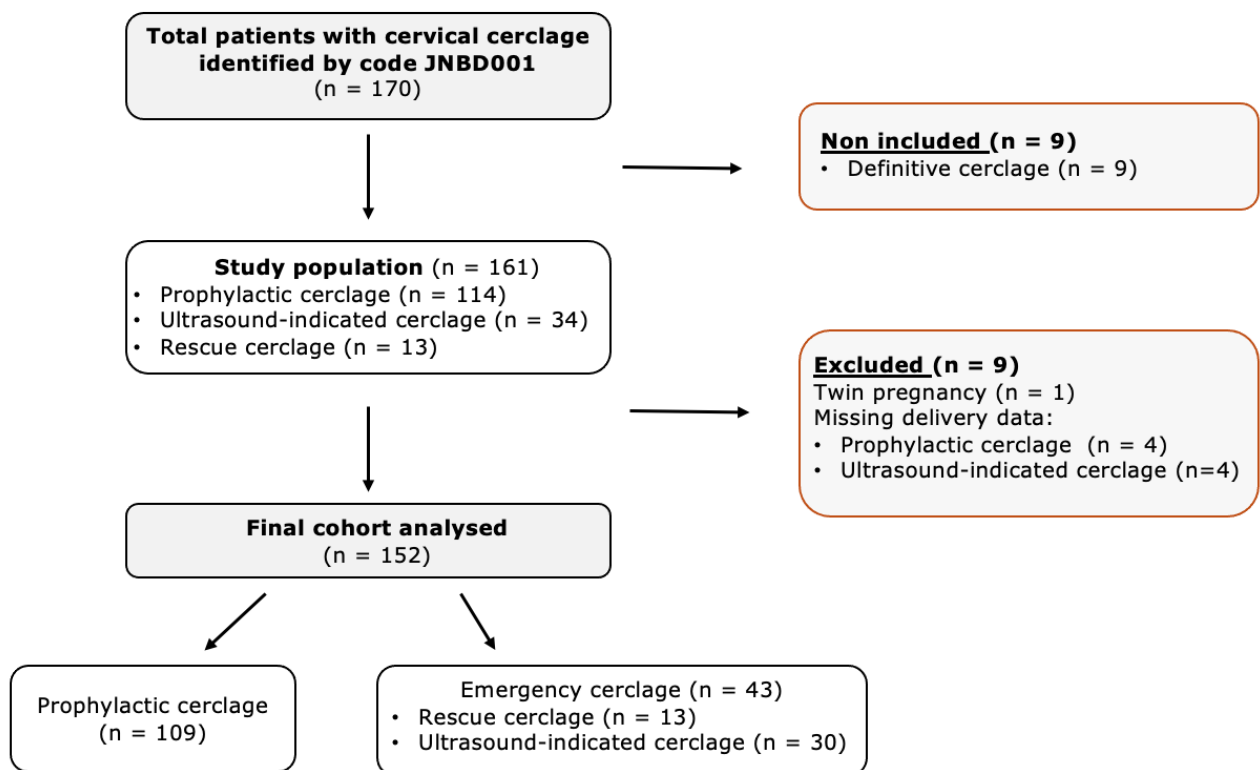


Figure 1: Flow chart

1. Patient characteristics

1.1. Maternal characteristics

Maternal age differed significantly across groups, with younger women in the ultrasound-indicated (29.6 ± 4.2 years) and rescue groups (30.9 ± 6.2 years) compared with the prophylactic group (32.7 ± 4.6 years, $p = 0.001$). BMI was similar across groups ($p = 0.461$). Nulliparity was more frequent in the rescue cerclage group (53.8%) compared with the ultrasound-indicated (36.7%) and prophylactic groups (19.3%, $p = 0.0007$).

There were no significant differences in smoking habits before or during pregnancy, hypertension, or diabetes. A history of early spontaneous miscarriage was common (46.1% overall) without intergroup differences. In contrast, a history of mid-trimester miscarriage was significantly more frequent in the prophylactic group (77.1%) compared with ultrasound-indicated (50.0%) and rescue cerclage (30.8%, $p < 0.001$). Similarly, a history of two or more previous mid-trimester losses or preterm deliveries was most frequent in the prophylactic group (55.0%) and was absent in the rescue group ($p < 0.001$).

Prior gynaecological history, including hysteroscopy, evacuation curettage, pelvic surgery, and conization, was comparable between groups. Uterine anomalies were rare and did not differ significantly. Additional investigations (3D ultrasound, hysteroscopy, or hysterosalpingography) were performed in 54.6% of cases overall, with 3D ultrasound being more frequent in the ultrasound-indicated group (53.3%, $p = 0.039$).

At the time of cerclage, gestational age was significantly higher in the rescue group (23.3 ± 2.8 weeks) compared with the ultrasound-indicated (21.6 ± 4.1 weeks) and prophylactic

groups (16.4 ± 2.4 weeks, $p < 0.001$). Prolapsed membranes were also more frequent in the rescue group (69.2%) compared with 0–3.3% in the other groups ($p < 0.001$).

Microbiological findings revealed that positive vaginal swabs were more frequent in the rescue group ($p = 0.007$). Urine culture positivity was also significantly higher in the rescue group ($p < 0.001$). Regarding laboratory markers, white blood cell count was significantly higher in the ultrasound-indicated group compared with the others ($p = 0.022$), while CRP levels were not significantly different across groups (Table I).

Table I : Patient characteristics

Characteristics	Overall population (n = 152)	Cerclage type			p-value ³
		Prophylactic (n = 109)	Ultrasound-indicated (n = 30)	Rescue cerclage (n = 13)	
Age² (years)	32.0 (±4.8)	32.7 (±4.6)	29.6 (±4.2)	30.9 (±6.2)	0.001
BMI² (kg/m²)	26.5 (±6.2)	26.7 (±6.2)	26.9 (±6.8)	24.2 (±4.8)	0.461
Nulliparity¹	39 (25.7)	21 (19.3)	11 (36.7)	7 (53.8)	0.0007
Smoking¹					
- Before pregnancy	24 (15.8)	18 (16.5)	5 (16.7)	1 (7.7)	0.868
- During pregnancy	15 (9.9)	12 (11.0)	3 (10.0)	0 (0.0)	0.599
Hypertension¹	5 (3.3)	4 (3.7)	1 (3.3)	0 (0.0)	0.999
Diabetes¹	1 (0.7)	0 (0.0)	1 (3.3)	0 (0.0)	0.283
Obstetric history¹					
- Previous early spontaneous loss	70 (46.1)	53 (48.6)	11 (36.7)	6 (46.2)	0.508
- Previous midtrimester loss	103 (67.8)	84 (77.1)	15 (50.0)	4 (30.8)	< 0.001
- Previous preterm birth	55 (36.2)	40 (36.7)	13 (43.3)	2 (15.4)	0.199
- Previous midtrimester loss and/or preterm delivery	138 (90.8)	105 (96.3)	27 (90.0)	6 (46.2)	< 0.001
- Previous midtrimester loss and/or preterm delivery ≥ 2	62 (40.8)	60 (55.0)	2 (6.7)	0 (0.0)	< 0.001
History of cerclage¹	62 (40.8)	59 (54.1)	2 (6.7)	1 (7.7)	< 0.001
- Rescue	13 (8.6)	12 (11.0)	0 (0.0)	1 (7.7)	0.138
- Ultrasound-indicated	8 (5.3)	7 (6.4)	1 (3.3)	0 (0.0)	0.999
- Prophylactic	47 (30.9)	46 (42.2)	1 (3.3)	0 (0.0)	< 0.001
- Definitive	1 (0.7)	1 (0.9)	0 (0.0)	0 (0.0)	0.999
History of hysteroscopy¹					0.155
- Operative	13 (8.6)	11 (10.1)	0 (0.0)	2 (15.4)	
- Diagnostic	22 (14.5)	15 (13.8)	7 (23.3)	0 (0.0)	
- No	116 (76.3)	82 (75.2)	23 (76.7)	11 (84.6)	
Uterine malformation¹					0.402
- No	146 (96.1)	105 (96.3)	28 (93.3)	13 (100.0)	
- Dysmorphic	1 (0.7)	0 (0.0)	1 (3.3)	0	
- Partial uterine septum	5 (3.3)	4 (3.7)	1 (3.3)	0	
History of¹					
- Conization	12 (7.9)	10 (9.2)	2 (6.7)	0	0.783
- Evacuation curettage	39 (25.7)	27 (24.8)	10 (33.3)	2 (15.4)	0.481
- Pelvic surgery	19 (12.5)	16 (14.7)	2 (6.7)	1 (7.7)	0.641
Polycystic ovary syndrome¹	10 (6.6)	5 (4.6)	4 (13.3)	1 (7.7)	0.158
Additional investigations performed¹ (3D ultrasound, hysteroscopy, hysterosalpingography)	83 (54.6)	60 (55.0)	19 (63.3)	4 (30.8)	0.142
3D ultrasound¹	54 (35.5)	36 (33.0)	16 (53.3)	2 (15.4)	0.039
Results 3D ultrasound¹					0.206
- No uterine anomaly	41 (27.0)	26 (23.9)	13 (43.3)	2 (15.4)	
- Fibroids	7 (4.6)	5 (4.6)	2 (6.7)	0 (0.0)	
- Uterine septum	1 (0.7)	1 (0.9)	0 (0.0)	0 (0.0)	
- Resected uterine septum	4 (2.6)	4 (3.7)	0 (0.0)	0 (0.0)	
- Unicornuate uterus	1 (0.7)	0 (0.0)	1 (3.3)	0 (0.0)	
- No 3D ultrasound	98 (64.5)	73 (67.0)	14 (46.7)	11 (84.6)	
Type of pregnancy¹					0.096
- Spontaneous	136 (89.5)	101 (92.7)	24 (80.0)	11 (84.6)	
- ART pregnancy	16 (10.5)	8 (7.3)	6 (20.0)	2 (15.4)	
GA at cerclage² (in weeks)	18.0 (±3.9)	16.4 (±2.4)	21.6 (±4.1)	23.3 (±2.8)	< 0.001
Uterine contractions¹	13 (8.6)	0 (0.0)	3 (10.0)	10 (76.9)	< 0.001
Vaginal bleeding¹	3 (2.0)	0 (0.0)	0 (0.0)	3 (23.1)	< 0.001
Cervical length² (mm)	17.8 (±10.1)	34.0 (±13.1)	18.5 (±7.4)	6.7 (±5.8)	0.002
<i>Missing data</i>	118	106	5	7	
Foetal presentation¹					0.520
- Cephalic	11 (7.2)	0	6 (20.0)	5 (38.5)	
- Breech	9 (5.9)	0	5 (16.7)	4 (30.8)	
- Transverse lie	6 (3.9)	1 (0.9)	4 (13.3)	1 (7.7)	
<i>Missing data</i>	126 (82.9)	108 (99.0)	15 (50.0)	3 (23.1)	
Prolapsed membranes¹	10 (6.6)	0	1 (3.3)	9 (69.2)	< 0.001
Vaginal swab¹					0.007
- Negative	58 (38.2)	35 (32.1)	17 (56.7)	6 (46.2)	
- Positive	23 (15.1)	16 (14.7)	2 (6.7)	5 (38.5)	
<i>Missing data</i>	71 (46.7)	58 (53.2)	11 (36.7)	2 (15.4)	
Urine culture¹					< 0.001
- Negative	27 (17.8)	8 (7.3)	12 (40.0)	7 (53.8)	
- Positive	3 (2.0)	0 (0.0)	0 (0.0)	3 (23.1)	
<i>Missing data</i>	122 (80.3)	101 (92.7)	18 (60.0)	3 (23.1)	
White blood cell count² (G/L)	10.1 (±3.6)	7.9 (±1.5)	11.1 (±4.4)	9.6 (±2.1)	0.022
<i>Missing data</i>	103	99	4	0	
CRP² (mg/L)	9.4 (±7.7)	7.0 (±4.2)	10.2 (±8.9)	8.8 (±7.0)	0.966
<i>Missing data</i>	123	107	16	0	
Diagnosis–cerclage interval² (hours)	29.6 (±21.5)	-	31.8 (±23.5)	25.5 (±17.6)	0.508
<i>Missing data</i>	115	-	7	0	

¹ n (%); ² Mean (standard deviation); ³ Kruskal-Wallis Test, Fisher's exact test, Pearson's Chi-squared test

1.2. Surgical characteristics

All procedures were performed using the McDonald technique. Spinal anaesthesia was the predominant modality (96.1% overall), with general anaesthesia used in 3.9% of cases, without significant differences between groups ($p = 0.774$).

Reduction of bulging membranes was performed exclusively in the rescue cerclage group (53.8% vs. 0–3.3% in the other groups, $p < 0.001$). Mean operating time was significantly longer in the rescue group (24.5 ± 9.6 minutes) compared with ultrasound-indicated (16.7 ± 5.2 minutes) and prophylactic cerclage (13.8 ± 6.0 minutes, $p < 0.001$).

Post-cerclage ultrasound findings were not significantly different between groups ($p = 0.320$).

All procedures were technically successful, and no cases of PPRM occurred during cerclage placement.

Regarding adjuvant therapy, postoperative progesterone was administered more frequently in the ultrasound-indicated and rescue cerclage groups than in the prophylactic group ($p < 0.001$).

Length of hospital stay differed significantly between groups, with the rescue cerclage group staying longest (mean 4.1 ± 3.6 days vs. 0.6 ± 0.8 days for ultrasound-indicated and 0.1 ± 0.4 days for prophylactic cerclage, $p < 0.001$) (Table II).

Table II : Surgical characteristics

Characteristics	Overall population (n = 152)	Cerclage type			p-value ³
		Prophylactic (n = 109)	Ultrasound- indicated (n = 30)	Rescue cerclage (n = 13)	
Anaesthesia¹					0.774
Spinal anaesthesia	146 (96.1)	105 (96.3)	28 (93.3)	13 (100.0)	
General anaesthesia	6 (3.9)	4 (3.7)	2 (6.7)	0 (0.0)	
Reduction of bulging membranes¹	8 (5.3)	0 (0.0)	1 (3.3)	7 (53.8)	< 0.001
Operating time² (minutes)	15.2 (±6.7)	13.8 (±6.0)	16.7 (±5.2)	24.5 (±9.6)	< 0.001
Missing data	15.0 [10.0–20.0] 13	12.5 [10.0–15.0] 9	15.0 [15.0–20.0] 1	25.0 [15.0–35.0] 3	
Post cerclage ultrasound² (mm)	27.7 (±11.5)	32.8 (±14.4)	35.0 (±0.0)	22.2 (±7.9)	0.320
Missing data	27.5 [17.0–35.0] 142	31.0 [24.0–41.5] 105	35.0 [35.0–35.0] 29	20.0 [17.0–24.0] 8	
Postoperative progesterone¹	34 (22.4)	16 (14.7)	10 (33.3)	8 (61.5)	< 0.001
- Oral	9 (5.9)	5 (4.6)	1 (3.3)	3 (23.1)	
- Vaginal	15 (9.9)	6 (5.5)	4 (13.3)	5 (38.5)	
- Intramuscular	10 (6.6)	5 (4.6)	5 (16.7)	0 (0.0)	
Length of stay (LOS)² (in days)	0.6 (±1.6)	0.1 (±0.4)	0.6 (±0.8)	4.1 (±3.6)	< 0.001

¹ n (%); ² Mean (standard deviation) ; Median [Q1 - Q3] ; ³ Kruskal-Wallis Test, Fisher's exact test

2. Perinatal outcomes according the three type of cerclage

2.1. Obstetric outcomes

Mid-trimester loss occurred in 6.6% of the overall cohort, without significant differences between groups ($p = 0.323$). Mean gestational age at delivery was significantly lower in the rescue cerclage group (30.4 ± 8.5 weeks; median 29.0 [23.0–35.0]) compared with the prophylactic (37.8 ± 6.3 weeks; median 40.0 [36.0–42.0]) and ultrasound-indicated groups (36.7 ± 6.9 weeks; median 40.0 [32.0–41.0]) ($p = 0.014$) (Table III).

The rate of PPROM was 19.1% overall, highest in the rescue cerclage group (38.5% vs. 17.4% and 16.7% in the prophylactic and ultrasound-indicated groups, respectively), though this difference was not statistically significant ($p = 0.216$). Chorioamnionitis was more frequent in the rescue group (15.4%) compared with the prophylactic (5.5%) and ultrasound-indicated (0.0%) groups ($p = 0.109$). Threatened preterm labour was reported in 16.4% of patients, with no significant variation between groups. Antenatal corticosteroid therapy was

administered in 21.1% of cases, most frequently in the ultrasound-indicated group (30.0%), but without statistical significance ($p = 0.320$). Tocolytic therapy was used in 7.9% of women, with no cases in the rescue group ($p = 0.693$). Intrauterine foetal demise occurred in 3.3% of cases, including two in the rescue group (15.4%) ($p = 0.073$).

The mean gestational age at cerclage removal was significantly earlier in the rescue group (29.5 ± 7.8 weeks) compared with the prophylactic (36.0 ± 5.7 weeks) and ultrasound-indicated groups (34.9 ± 6.6 weeks) ($p = 0.011$). The most frequent indication for cerclage removal was reaching term (64.8%), followed by PPRM (18.6%) and uterine contractions (13.8%). The distribution of indications differed significantly between groups ($p = 0.011$), with term removal predominating in prophylactic cases (71.2%), while contractions and PPRM were more common in the rescue group (38.5% and 30.8%, respectively). Regarding labour onset, 61.2% of women experienced spontaneous labour, 27.0% required induction, and 11.2% delivered without labour. These distributions were not significantly different across groups ($p = 0.179$). Vaginal delivery occurred in 73.7% of cases, with caesarean section in 26.3%, of which 60.0% were emergency procedures. The mode of delivery did not differ significantly between cerclage groups ($p = 0.328$ for vaginal vs. caesarean, $p = 0.655$ for elective vs. emergency caesarean).

The mean interval between cerclage and delivery was 18.8 ± 8.4 weeks overall but differed significantly between groups ($p < 0.001$). The longest interval was observed in the prophylactic group (21.3 ± 6.9 weeks), followed by the ultrasound-indicated group (15.1 ± 7.8 weeks), and the shortest in the rescue group (7.1 ± 8.1 weeks). When expressed in days, the interval was also significantly shorter in the rescue group (mean 50 ± 57 days; median 35 [7–70])

compared with the ultrasound-indicated (106 ± 55 days; median 112 [70–140]) and prophylactic groups (149 ± 48 days; median 161 [133–189]) ($p < 0.001$).

Gestational age at delivery varied significantly by cerclage type. Delivery before 20 weeks was rare (2.0% overall). Before 24 weeks, the proportion was highest in the rescue group (30.8% vs. 3.7% and 6.7% in the prophylactic and ultrasound-indicated groups, respectively; $p = 0.007$). Similarly, delivery before 28 weeks occurred in 46.2% of the rescue group compared with 13.8% and 13.3% in the prophylactic and ultrasound-indicated groups ($p = 0.020$).

Preterm delivery before 32 weeks was recorded in 53.8% of rescue cerclage cases, significantly higher than in the prophylactic (16.5%) and ultrasound-indicated (23.3%) groups ($p = 0.012$). Delivery before 34 weeks was also most frequent in the rescue group (53.8% vs. 18.3% and 30.0%; $p = 0.013$). Conversely, delivery beyond 34 weeks was achieved in 71.7% of the overall cohort, but only in 30.8% of the rescue group compared with 77.1% and 70.0% in the prophylactic and ultrasound-indicated groups ($p = 0.002$). Term delivery beyond 37 weeks occurred in 64.5% overall, but only 23.1% of the rescue group compared with 68.8% and 66.7% in the other two groups ($p = 0.005$).

2.2. Neonatal outcomes

Overall, 86.2% of pregnancies resulted in live births, with the highest rate observed in the ultrasound-indicated group (93.3%) and prophylactic group (88.1%), compared with only 53.8% in the rescue group ($p = 0.005$).

The mean 5-minute Apgar score was 9.5 ± 1.5 overall. There were no significant differences in Apgar scores between cerclage types ($p = 0.478$).

Mean birthweight was 2592 ($\pm$ 1152) grams overall but differed significantly between groups ($p = 0.047$). Infants in the rescue cerclage group had the lowest mean birthweight (2128 $\pm$ 1348 g; median 2015 [290–3090]) compared with the ultrasound-indicated (2552 $\pm$ 1013 g; median 2870 [1717–3285]) and prophylactic groups (2691 $\pm$ 1138 g; median 2950 [2480–3470]).

Admission to the NICU occurred in 20.4% of newborns overall, with similar rates across groups (18.3% in the prophylactic group, 26.7% in the ultrasound-indicated group, and 23.1% in the rescue group, $p = 0.509$) (Table III).

Table III : Obstetric and neonatal outcomes according to three type of cerclage

Characteristics	Overall population (n = 152)	Cerclage type			p-value ³
		Prophylactic (n = 109)	Ultrasound- indicated cerclage (n = 30)	Rescue cerclage (n = 13)	
GA at delivery² (weeks)	36.9 ($\pm$ 6.9)	37.8 ($\pm$ 6.3)	36.7 ($\pm$ 6.9)	30.4 ($\pm$ 8.5)	0.014
By GA¹					
- < 20 GA	3 (2.0)	2 (1.8)	1 (3.3)	0 (0.0)	0.637
- < 24 GA	10 (6.6)	4 (3.7)	2 (6.7)	4 (30.8)	0.007
- < 28 GA	25 (16.4)	15 (13.8)	4 (13.3)	6 (46.2)	0.020
- < 32 GA	32 (21.1)	18 (16.5)	7 (23.3)	7 (53.8)	0.012
- < 34 GA	36 (23.7)	20 (18.3)	9 (30.0)	7 (53.8)	0.013
- > 34 GA	109 (71.7)	84 (77.1)	21 (70.0)	4 (30.8)	0.002
- > 37 GA	98 (64.5)	75 (68.8)	20 (66.7)	3 (23.1)	0.005
Missing data	1 (0.7)	1 (0.9)	0 (0.0)	0 (0.0)	
Interval cerclage – delivery²					
- In weeks of gestation (weeks)	18.8 ($\pm$ 8.4)	21.3 ($\pm$ 6.9)	15.1 ($\pm$ 7.8)	7.1 ($\pm$ 8.1)	< 0.001
- In day (day)	132 ($\pm$ 59)	149 ($\pm$ 48)	106 ($\pm$ 55)	50 ($\pm$ 57)	< 0.001
Missing data	2	2	0	0	
Obstetric outcomes					
Midtrimester loss ¹	10 (6.6)	6 (5.5)	2 (6.7)	2 (15.4)	0.323
PPROM ¹	29 (19.1)	19 (17.4)	5 (16.7)	5 (38.5)	0.216
Chorioamnionitis ¹	8 (5.3)	6 (5.5)	0 (0.0)	2 (15.4)	0.109
Threatened preterm labour ¹	25 (16.4)	16 (14.7)	7 (23.3)	2 (15.4)	0.504
Antenatal corticosteroid therapy ¹	32 (21.1)	20 (18.3)	9 (30.0)	3 (23.1)	0.320
Tocolytic therapy ¹	12 (7.9)	9 (8.3)	3 (10.0)	0 (0.0)	0.693
Intrauterine foetal demise ¹	5 (3.3)	3 (2.8)	0 (0.0)	2 (15.4)	0.073
Labor					
Cerclage removal ² (weeks)	35.2 ($\pm$ 6.3)	36.0 ($\pm$ 5.7)	34.9 ($\pm$ 6.6)	29.5 ($\pm$ 7.8)	0.011
Missing data	8	6	2	0	
Type of labour ¹					0.179
- Not in labour	17 (11.2)	15 (13.8)	2 (6.7)	0 (0.0)	
- Spontaneous labour	93 (61.2)	66 (60.6)	21 (70.0)	6 (46.2)	
- Labour induction	41 (27.0)	27 (24.8)	7 (23.3)	7 (53.8)	
Mode of delivery ¹					0.328
- Vaginal delivery	112 (73.7)	78 (71.6)	22 (73.3)	12 (92.3)	
- C-section	40 (26.3)	31 (28.4)	8 (26.7)	1 (7.7)	
- Elective c-section	15 (9.9)	13 (11.9)	2 (6.7)	0 (0.0)	0.655
- Emergency c-section	24 (15.8)	17 (15.6)	6 (20.0)	1 (7.7)	
Missing data	1 (0.7)	1 (0.9)	0 (0.0)	0 (0.0)	
Neonatal outcomes					
Live births ¹	131 (86.2)	96 (88.1)	28 (93.3)	7 (53.8)	0.005
APGAR 5 min ²	9.5 ($\pm$ 1.5)	9.6 ($\pm$ 1.3)	9.3 ($\pm$ 2.0)	9.0 ($\pm$ 1.7)	0.478
Missing data	36	23	7	6	
Birthweight ² (in grams)	2591.5 ($\pm$ 1151.9)	2690.7 ($\pm$ 1137.9)	2551.5 ($\pm$ 1012.8)	2127.6 ($\pm$ 1347.5)	0.047
Missing data	6	2	2	2	
NICU admission ¹	31 (20.4)	20 (18.3)	8 (26.7)	3 (23.1)	0.509

¹ n (%); ² Mean (standard deviation); ³ Kruskal-Wallis Test, Fisher's exact test

3. Perinatal outcomes according to prophylactic vs emergency cerclage

To enable comparison with the existing literature, we assessed the obstetric outcomes of emergency cerclages (including ultrasound-indicated and rescue procedures) in comparison with prophylactic cerclages. A total of 152 women underwent cervical cerclage, including 109 prophylactic and 43 emergency procedures (Table IV).

3.1. Obstetric outcomes

The mean gestational age (GA) at delivery was significantly higher in the prophylactic group compared with the emergency group (37.8 ± 6.3 vs. 34.8 ± 7.8 weeks, $p = 0.038$). Similarly, the cerclage–delivery interval was longer in the prophylactic group (21.3 ± 6.9 vs. 12.7 ± 8.6 weeks, $p < 0.001$).

The rate of midtrimester loss did not differ significantly between groups (5.5% vs. 9.3%, $p = 0.470$). PPROM occurred in 19.1% of cases overall, without significant difference between prophylactic and emergency cerclage (17.4% vs. 23.3%, $p = 0.410$).

Chorioamnionitis was rare (5.3%) and similar across groups ($p = 0.999$). Antenatal corticosteroid therapy was administered in 21.1% of cases, more frequently after emergency cerclage, although this difference was not significant (18.3% vs. 27.9%, $p = 0.193$). Tocolysis was used in 7.9% of patients, with no intergroup difference.

The mean GA at cerclage removal was 35.2 ± 6.3 weeks, slightly higher in the prophylactic group compared with the emergency group (36.0 ± 5.7 vs. 33.2 ± 7.3 weeks, $p = 0.061$).

Regarding labour characteristics, most patients delivered after spontaneous labour (61.2%), followed by labour induction (27.0%), with no significant difference between groups ($p = 0.234$).

Analysis of gestational age subgroups showed that emergency cerclage was associated with significantly higher rates of extreme prematurity. Delivery before 22 weeks occurred more frequently in the emergency group (14.0% vs. 3.7%, $p = 0.032$). Similarly, delivery before 32 weeks (32.6% vs. 16.5%, $p = 0.031$) and before 34 weeks (37.2% vs. 18.3%, $p = 0.015$) was significantly more frequent after emergency cerclage. The difference was borderline for delivery before 37 weeks (44.2% vs. 27.5%, $p = 0.052$). Mode of delivery did not differ significantly, with vaginal delivery in 73.7% and c-section in 26.3% of cases ($p = 0.344$).

3.2. Neonatal outcomes

The live birth rate was 86.2% overall, with no significant difference between groups (88.1% vs. 81.4%, $p = 0.283$).

The mean APGAR score at 5 minutes was high in both groups (9.5 ± 1.5 overall, $p = 0.362$). NICU admission occurred in 20.4% of newborns, without significant difference between groups ($p = 0.319$). Mean birthweight was lower in the emergency cerclage group (2319 ± 1161 g vs. 2691 ± 1138 g), with a trend toward significance ($p = 0.076$) (Table IV).

Table IV : Obstetric and neonatal outcomes according to type of cerclage: prophylactic versus emergency cerclage (rescue and ultrasound indicated)

Characteristics	Overall population (n = 152)	Cerclage type		p-value ³
		Prophylactic (n = 109)	Emergency cerclage (n = 43)	
GA at delivery² (in weeks)	36.9 (±6.9)	37.8 (±6.3)	34.8 (±7.8)	0.038
Cerclage – delivery² (in weeks)	18.8 (±8.4)	21.3 (±6.9)	12.7 (±8.6)	< 0.001
<i>Missing data</i>	2	2	0	
Preterm birth¹				0.015
- < 34 GA	36 (23.7)	20 (18.3)	16 (37.2)	
- < 37 GA	49 (32.2)	30 (27.5)	19 (44.2)	0.052
Midtrimester loss¹	10 (6.6)	6 (5.5)	4 (9.3)	0.470
PPROM¹	29 (19.1)	19 (17.4)	10 (23.3)	0.410
Chorioamnionitis¹	8 (5.3)	6 (5.5)	2 (4.7)	0.999
Antenatal corticosteroid therapy¹	32 (21.1)	20 (18.3)	12 (27.9)	0.193
Tocolytic therapy¹	12 (7.9)	9 (8.3)	3 (7.0)	0.999
<i>Missing data</i>	1 (0.7)	1 (0.9)	0 (0.0)	
GA at cerclage removal² (in weeks)	35.2 (±6.3)	36.0 (±5.7)	33.2 (±7.3)	0.061
<i>Missing data</i>	8	6	2	
Type of labour¹				0.234
- No in labour	17 (11.2)	15 (13.8)	2 (4.7)	
- Spontaneous labour	93 (61.2)	66 (60.6)	27 (62.8)	
- Labour induction	41 (27.0)	27 (24.8)	14 (32.6)	
<i>Missing data</i>	1 (0.7)	1 (0.9)	0 (0.0)	
Mode of delivery¹				0.344
- Vaginal delivery	112 (73.7)	78 (71.6)	34 (79.1)	
- C-section	40 (26.3)	31 (28.4)	9 (20.9)	
Live birth¹	131 (86.2)	96 (88.1)	35 (81.4)	0.283
APGAR score 5 min²	9.5 (±1.5)	9.6 (±1.3)	9.2 (±1.9)	0.362
<i>Missing data</i>	36	23	13	
Birthweight² (in grams)	2592 (±1152)	2691 (±1138)	2319 (±1161)	0.076
<i>Missing data</i>	6	2	4	
NICU admission¹	31 (20.4)	20 (18.3)	11 (25.6)	0.319

¹ n (%); ² Mean (standard deviation); ³ Kruskal-Wallis Test, Fisher's exact test

4. Analysis of risk factors for cerclage failure

An exploratory analysis was conducted to identify potential risk factors associated with cerclage failure (Table V). In univariate analysis, neither maternal age (OR = 1.05; 95% CI [0.95–1.17], p = 0.339) nor BMI (OR = 1.06; 95% CI [0.99–1.15], p = 0.104) were associated with the risk of delivery before 28 weeks of gestation, although a trend was observed for BMI in multivariate analysis (aOR = 1.07; 95% CI [0.99–1.17], p = 0.100). Preconception smoking was also associated with a non-significant increase in risk (OR = 2.04; 95% CI [0.60–6.14], p = 0.223). Similarly, a history of PCOS, hysteroscopy, evacuation curettage, or pelvic surgery had no significant impact on the outcome.

By contrast, some factors appeared more relevant. Having at least two previous preterm births or late miscarriages was significantly associated with an increased risk of delivery before 28 weeks after adjustment (aOR = 4.96; 95% CI [1.34–22.67], $p = 0.024$). Nulliparity was associated with a threefold higher risk in univariate analysis (OR = 3.58; 95% CI [1.32–9.92], $p = 0.012$), although this association was no longer statistically significant after adjustment (aOR = 2.97; 95% CI [0.92–9.63], $p = 0.065$). Likewise, membrane prolapse at the time of cerclage placement was strongly associated with an increased risk, reaching significance in univariate analysis (OR = 5.16; 95% CI [0.95–25.54], $p = 0.043$) and borderline significance in multivariate analysis (aOR = 7.51; 95% CI [0.96–60.82], $p = 0.051$).

Conversely, neither the type of pregnancy (spontaneous vs. assisted reproduction), nor the urgency of the cerclage (prophylactic, ultrasound indicated or rescue cerclage), gestational age at placement, operative time, type of anaesthesia, nor postoperative progesterone administration were associated with a significant increase in the risk of severe preterm birth (Table V).

Table V : Factors associated with cerclage failure defined as delivery before 28 GA (n=133)

Characteristics	GA at delivery		OR (IC95%, p-value)	aOR (IC95%, p-value)
	< 28 GA (n = 19)	> 28 GA (n = 114)		
Age² (years)	33.1 (±4.9)	32.0 (±4.8)	1.05 (0.95–1.17, p=0.339)	-
BMI² (kg/m ²)	28.6 (±5.8)	26.1 (±6.3)	1.06 (0.99–1.15, p=0.104)	1.07 (0.99–1.17, p=0.100)
Nulliparity¹	10 (52.6)	27 (23.7)	3.58 (1.32–9.92, p=0.012)	2.97 (0.92–9.63, p=0.065)
Smoking before pregnancy¹	5 (22.7)	17 (77.3)	2.04 (0.60–6.14, p=0.223)	2.92 (0.75–10.59, p=0.106)
History of PCOS¹	1 (12.5)	7 (87.5)	0.85 (0.04–5.19, p=0.882)	-
≥2 previous preterm births or mid-trimester miscarriages¹	10 (19.2)	42 (80.8)	1.90 (0.71–5.16, p=0.196)	4.96 (1.34–22.67; p= 0.024)
Hysteroscopy¹	5 (15.6)	27 (84.4)	1.15 (0.35–3.32, p=0.804)	-
Evacuation curettage¹	3 (9.4)	29 (90.6)	0.55 (0.12–1.80, p=0.368)	-
Pelvic surgery¹	2 (11.8)	15 (88.2)	0.78 (0.12–3.10, p=0.751)	-
Pregnancy type¹				
- Spontaneous	18 (15.3)	100 (84.7)	Reference	-
- ART conception	1 (6.7)	14 (93.3)	0.40 (0.02–2.17, p=0.386)	-
Cerclage type¹				
- Prophylactic	13 (13.4)	84 (86.6)	Reference	Reference
- Ultrasound indicated	3 (11.1)	24 (88.9)	0.81 (0.17–2.76), p=0.754)	0.68 (0.08–4.77, p=0.703)
- Rescue	3 (33.3)	6 (66.7)	3.23 (0.62–13.95), p=0.126)	0.88 (0.01–22.85, p=0.943)
GA at cerclage² (weeks)	19.0 (±3.6)	17.9 (±3.9)	1.29 (0.42–3.59, p=0.633)	-
Membrane prolapses¹	3 (42.9)	4 (57.1)	5.16 (0.95–25.54, p=0.043)	7.51 (0.96–60.82, p=0.051)
Operating time² (minutes)	15.5 (±6.0)	14.9 (±6.6)	1.01 (0.94–1.09, p=0.702)	-
Anaesthesia¹				
- Spinal anaesthesia	18 (14.1)	110 (85.9)	Reference	-
- General anaesthesia	1 (20.0)	4 (80.0)	1.53 (0.08–11.08, p=0.712)	-
Postoperative progesterone¹	5 (17.9)	23 (82.1)	1.41 (0.42–4.13, p=0.545)	-

¹ n (%); ² Mean (standard deviation)

DISCUSSION

The mean gestational age at delivery was significantly lower after rescue cerclage compared with prophylactic and ultrasound-indicated procedures (30.4 vs. 37.8 and 36.7 weeks respectively, $p = 0.014$). The cerclage–delivery interval followed a similar pattern, being longest in the prophylactic group (21.3 weeks), intermediate in the ultrasound-indicated group (15.1 weeks), and shortest in the rescue group (7.1 weeks, $p < 0.001$). Live birth rates were highest in the ultrasound-indicated (93.3%) and prophylactic (88.1%) groups, but markedly reduced after rescue cerclage (53.8%, $p = 0.005$). When comparing emergency cerclage (ultrasound-indicated and rescue combined) with prophylactic cerclage, the latter was associated with a higher gestational age at delivery (37.8 vs. 34.8 weeks, $p = 0.038$) and a longer cerclage–delivery interval (21.3 vs. 12.7 weeks, $p < 0.001$), while overall live birth rates were similar (88.1% vs. 81.4%, $p = 0.283$).

In our cohort, multivariate analysis identified a history of ≥ 2 preterm births and/or late miscarriages as an independent risk factor for delivery before 28 weeks of gestation (aOR = 4.96; 95% CI [1.34–22.67], $p = 0.024$). The presence of membrane prolapses at the time of cerclage also emerged as an unfavourable factor, with an association approaching statistical significance (aOR = 7.51; 95% CI [0.96–60.82], $p = 0.051$).

Our study provides an analysis of perinatal outcomes according to different types of cerclages (prophylactic, ultrasound-indicated, or rescue). Whereas most previous studies have restricted their comparisons to prophylactic versus emergency cerclage, we chose to distinguish between ultrasound-indicated and rescue procedures, considering these to represent two significantly different clinical entities. Indeed, rescue cerclage is performed in a particularly unfavourable

context, characterised by prolapsed membranes into the vagina, whereas ultrasound-indicated cerclage corresponds to a semi-urgent situation, prompted by sonographic evidence of cervical shortening without prolapse of the membranes.

Analysis according to these three categories revealed significant differences: the live birth rate reached 93.3% after ultrasound-indicated cerclage compared with only 53.8% after rescue cerclage ($p = 0.005$), indicating that only one in two infants survives in this clinical context. Gestational age at delivery was also lower after rescue cerclage (30.4 weeks) compared with prophylactic and ultrasound-indicated cerclage (37.8 and 36.7 weeks, respectively; $p = 0.014$). Similarly, pregnancy prolongation was markedly reduced (7.1 weeks vs. 21.3 and 15.1 weeks; $p < 0.001$).

These results confirm that ultrasound-indicated and rescue cerclage should not be regarded as a single “emergency” category. They are partly consistent with the findings of Liddiard et al., who, in a study of 34 patients, reported a mean gestational age of 32 weeks for ultrasound-indicated cerclage and 26 weeks for rescue cerclage ($p = 0.24$). The live birth rate did not differ significantly between the two groups (93% vs. 98%, $p = 0.98$) (13). The retrospective study by Chen et al., involving 326 patients, further supports our conclusions, showing significantly better obstetric outcomes after prophylactic or ultrasound-indicated cerclage compared with rescue cerclage (mean gestational age 37.3 and 35.4 vs. 26.1 weeks, $p < 0.005$; foetal survival rate 88.4% and 81.4% vs. 40%) (14). Similarly, the study by Khan et al., conducted in India in 2004 on a cohort of 145 patients, reported a significantly higher mean gestational age in the prophylactic and ultrasound-indicated groups (36.1 and 35.7 weeks) compared with the rescue cerclage group (32.4 weeks; $p < 0.001$). The foetal survival rate was not reported in that study (15).

Comparative analyses using a two-group classification (prophylactic vs. urgent cerclage, Table 3) revealed a statistically significant difference in gestational age at delivery ($p = 0.038$), although the clinical relevance of this difference (37.8 vs. 34.8 weeks) remains debatable. These same analyses showed no significant difference in live birth rates between the two groups ($p = 0.283$), reinforcing the impression of limited accuracy and specificity when ultrasound-indicated and rescue cerclages are combined into a single “urgent” category, given that the three-group analysis, by contrast, demonstrated significant differences (see above).

Although questionable in terms of clinical relevance, this syndromic grouping of urgent cerclages nevertheless allows comparison of our population, practices, and outcomes with those reported in previously published studies. In our cohort, the mean gestational age at delivery was 37.8 weeks for prophylactic cerclage and 34.8 weeks for urgent cerclage ($p = 0.038$). These results are consistent with those reported in several retrospective studies, although the magnitude and statistical significance of the observed differences varied. Liddiard et al., in a study of 177 patients, reported a mean gestational age of 35 weeks for prophylactic cerclage versus 33 weeks for urgent cerclage, with no significant difference (13). Kumari et al., in India, found comparable results in their series of 91 patients (34.2 vs. 32.2 weeks; $p = 0.13$) (16). Similarly, in Turkey, Yüksel Şimşek et al. observed a mean gestational age of 35.6 weeks in the prophylactic group versus 33.6 weeks in the urgent group ($p = 0.117$) in a retrospective cohort of 75 patients (17).

In contrast, some series have demonstrated statistically significant differences. In Turkey, Jafarzade et al., in a retrospective cohort of 247 patients, reported a mean gestational age of 34.6 weeks after prophylactic cerclage compared with 30.8 weeks for urgent cerclage ($p < 0.001$) (18). Ługowski et al., in a retrospective study of 75 patients conducted between 2015 and 2025, also found a significant difference (36.1 vs. 31.4 weeks; $p < 0.001$) (19). Finally,

Vasudeva et al., in a three-year study including 39 patients, observed a mean gestational age of 37 weeks for prophylactic cerclage versus 34 weeks for rescue cerclage (20).

In our study, the mean pregnancy prolongation was 21.3 weeks for prophylactic cerclage versus 12.7 weeks for urgent cerclage ($p < 0.001$), results that are consistent with those of Vasudeva et al. (21.4 vs. 14.1 weeks, no statistical comparison) and Ługowski et al. (18.6 vs. 12.2 weeks; $p < 0.001$).

The live birth rate in our cohort was 88% for prophylactic cerclage and 81.4% for urgent cerclage ($p = 0.283$), findings comparable to those reported in the literature: Kumari et al. (93.3% in both groups, $p = 1$), Liddiard et al. (93% vs. 92%, $p = 0.26$), and Vasudeva et al. (96.2% vs. 76.2%, no statistical comparison provided). Jafarzade et al., in their series of 247 patients, reported a live birth rate of 95.2% in the prophylactic group and 89.4% in the urgent group. However, deaths before 24 weeks of gestation were excluded from their analysis. When these deaths were reassigned to the respective groups, the live birth rates differed substantially: 90.5% in the prophylactic group and 65.5% in the urgent group (18).

Multivariate analysis in our cohort did not identify any clinically meaningful risk factors for cerclage failure. However, two elements stand out. First, a history of ≥ 2 preterm births and/or late miscarriages emerged as an independent risk factor for delivery before 28 weeks of gestation (aOR = 4.96; 95% CI [1.34–22.67], $p = 0.024$), underscoring the critical role of obstetric history—and thus cervical insufficiency—in determining prognosis after cerclage. This finding is consistent with the work of Chen et al. as well as earlier reports in the literature (14). Second, the presence of membrane prolapses at the time of the procedure tended to constitute an unfavourable factor, with an association approaching statistical significance (aOR = 7.51; 95% CI [0.96–60.82], $p = 0.051$). This trend aligns with the observations of Terkildsen et al., Hong et al., and Pan et al., who reported its negative impact on neonatal survival and latency

(21–23). By contrast, we did not observe any significant association between the type of cerclage (ultrasound-indicated or rescue) and an increased risk of failure. This finding may reflect limited statistical power given the small number of emergency cerclages. Nonetheless, it suggests that cervical cerclage retains a strategic role in the management of appropriately selected patients, even when performed in urgent settings. Finally, intraoperative complications were rare, or absent, in our cohort, confirming the relative safety of the procedure. Nineteen patients had to be excluded from this analysis due to incomplete medical records for the variables included in the model. These exclusions may have reduced the statistical power of the analyses.

Urinary and genital tract infections could not be included in the logistic regression model due to the high proportion of missing data. Nevertheless, several studies suggest that urinary tract infection prior to cerclage may increase the risk of preterm birth, even after treatment (24). With regard to bacterial vaginosis, findings remain inconsistent: although it is well established as a risk factor for preterm birth in the general population, its treatment does not consistently reduce this risk, although it may lower the frequency of preterm prelabour rupture of membranes (25–28). Cassardo et al. reported that a positive vaginal swab at the time of cerclage was not associated with preterm birth, but did represent an independent risk factor for intrauterine infection and PPRM (29). In this context, systematic screening for asymptomatic bacteriuria and bacterial vaginosis before cerclage, irrespective of urgency, may be relevant. Further evaluation of the impact of appropriate treatment on obstetric outcomes is warranted.

In our cohort, progesterone did not show an effect on the risk of delivery before 28 weeks, probably due to its limited use. Vaginal progesterone is indicated when cervical length is <25

mm before 24 weeks of gestation in the absence of a history of preterm birth, while cerclage is reserved for cervical length <10 mm despite such treatment (21,30). A meta-analysis has demonstrated that combining cerclage with progesterone significantly reduces preterm birth (<34, <32, and <28 weeks), neonatal mortality, and improves perinatal outcomes (31). Hart et al. confirmed that the addition of progesterone after cerclage tends to prolong pregnancy and delay delivery, although not all differences remained statistically significant after adjustment (32). Randomised controlled trials are still needed to clarify the benefit of this association.

Cervical length prior to cerclage could not be analysed in our study due to missing data. Ridout et al. demonstrated that it was an excellent predictor of preterm birth <30 weeks (AUC = 0.96) (33). Mountain & Ng et al. also reported, in a multicentre cohort, that cervical length before and especially after cerclage was associated with the risk of preterm delivery <34 weeks, highlighting the importance of post-procedural ultrasound monitoring (34).

Our findings regarding BMI are consistent with the literature, in which the impact of maternal obesity on outcomes after cerclage remains debated. Farinelli et al. found no significant association (35), whereas more recent studies suggest a deleterious effect of obesity, with reduced gestational age and increased risk of preterm birth or late miscarriage (36–38). With respect to nulliparity, although described as an independent risk factor for failure by Terkildsen et al., it did not reach statistical significance in our study after adjustment, which may reflect limited statistical power.

The limitations of this study relate to its retrospective design, the presence of missing data, and potential selection bias linked to its single-centre recruitment, loss to follow-up, and

patient selection according to clinicians' judgement. Finally, the limited statistical power, particularly in some subgroups, may have restricted the detection of significant associations.

One of the main strengths of our study lies in the large cohort size and the ten-year study period. The use of multivariate analysis enabled a more robust categorisation of risk factors for preterm birth and assessment of the impact of cerclage type as an independent risk factor.

CONCLUSION

Perinatal outcomes appear significantly better after prophylactic or ultrasound-indicated cerclage than after rescue cerclage, the latter being, by definition, performed in an unfavourable emergency context. Nevertheless, our results suggest that rescue cerclage remains a therapeutic option for women at high risk of late miscarriage. Furthermore, no clinically meaningful independent predictors of failure were identified in our cohort, apart from a heavy obstetric history consistent with cervical insufficiency. A prospective French study could, however, be valuable in including larger sample sizes. It would also be of interest to assess additional parameters that may predict the risk of cerclage failure, such as concomitant progesterone use, cervical length before and after the procedure, and systematic preoperative vaginal swabs and urine cultures.

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ANNEXE

Table VI: Summary of available studies in literature

Authors	Period	Country	Comparison	Type of pregnancy	Type of study	Number of patients	GA at delivery (in weeks)	Interval cerclage-delivery (in weeks)	Live birth (%)
Kumari	2014-2019	India	Elective VS emergency	Singleton	Retrospective	91 patients: Elective: 66 Emergency: 25	Elective: 34.9 Emergency: 32.8	Elective: 20.8 Emergency: 11.7	Elective: 83.4 % Emergency: 88 %
Simsek	2012-2019	Turkey	Elective VS emergency	Singleton	Retrospective	75 patients: Elective: 48 Emergency: 27	Elective: 35.6 Emergency: 33.6	Elective: 21.7 Emergency: 14.2	<i>Unknow</i>
Jafarzade	2017-2022	Turkey	Elective VS emergency	Singleton	Retrospective	247 patients: Elective: 105 Emergency: 142	Elective: 34.6 Emergency: 30.8	Elective: 18.3 Urgence: 11.7	Elective: 95.2% Emergency: 89.4% <i>If births < 24 GW are considered: Elective :90.5% Emergency: 65.5%</i>
Lugowski	2015-2020	Poland	Elective VS emergency	Singleton	Retrospective	75 patients: Elective: 43 Emergency: 32	Elective: 36.1 Emergency: 31.4	Elective: 18.6 Emergency: 12.2	Elective: 100% Emergency: 93.8%
Vasudeva	2014-2017	Australia	Elective VS emergency	Singleton	Retrospective	39 patients Elective: 26 Emergency: 13	Elective:36.1 Emergency: 31.4 P < 0.001	Elective: 18.6 Emergency: 12.2 P < 0.001	Elective: 96.2% Emergency:76.2%
Liddiard	1985-2009	UK	Elective VS Emergency	Singleton	Retrospective	177 patients Elective: 116 Emergency: 61	Elective: 35 Emergency: 33	Elective: 21 Emergency: 10	Elective: 93% Emergency: 92%
			Elective VS rescue		<i>Subgroup analysis</i>	34 patients: Ultrasound: 25 Rescue: 9	Ultrasound: 32 Rescue: 26	Ultrasound: 10 Rescue: 3	Ultrasound: 93% Rescue: 93%
Chen	2004-2018	China	Elective VS ultrasound VS rescue	Singleton	Retrospective	326 patients: Elective: 232 Ultrasound: 59 Rescue: 35	Elective: 37.3 Ultrasound: 35.4 Rescue: 26.1 p < 0.05	Elective: 20.8 Ultrasound: 14.4 Rescue: 2.1 P < 0.05	Elective: 88.4% Ultrasound: 81.4% Rescue: 40%
Khan	2004-2008	India	Elective VS ultrasound VS rescue	Singleton	Retrospective	145 patients: Elective: 112 Ultrasound: 16 Rescue: 17	Elective: 36.1 Ultrasound: 35.7 Rescue: 32.4 p < 0.001	Elective: 22.3 Ultrasound: 16.9 Rescue: 11.7 p < 0.001	<i>Unknow</i>

Cerclage du col utérin : issues obstétricales et néonatales et facteurs de risque d'échec

RÉSUMÉ

Introduction : La prématurité demeure une cause majeure de morbidité néonatale. L'insuffisance cervicale en constitue un facteur de risque spécifique, dont le traitement de référence est le cerclage utérin. L'objectif de cette étude était d'évaluer les issues obstétricales et néonatales selon le type de cerclage, et d'identifier les facteurs associés à son échec (défini par un accouchement avant 28 semaines d'aménorrhée).

Méthode : Étude rétrospective monocentrique menée au CHU d'Angers entre janvier 2014 et octobre 2024. Ont été incluses toutes les patientes ayant bénéficié d'un cerclage cervical, à l'exception des grossesses multiples, des cerclages définitifs et des dossiers incomplets. Les données démographiques, obstétricales, chirurgicales et néonatales ont été recueillies. L'analyse statistique reposait sur des régressions logistiques uni- et multivariées pour rechercher des facteurs indépendants d'échec du cerclage.

Résultats : Au total, 152 patientes ont été incluses. Le taux de naissances vivantes était significativement plus élevé après un cerclage prophylactique (88,1 %) ou écho indiqué (93,3 %) comparativement au cerclage à chaud (53,8 %, $p = 0,005$). L'âge gestationnel moyen à l'accouchement était de $37,8 \pm 6,3$ SA (prophylactique), $36,7 \pm 6,9$ SA (écho indiqué) et $30,4 \pm 8,5$ SA (à chaud) ($p = 0,014$). La prolongation de grossesse différait également selon le type de cerclage : 21,3 semaines (prophylactique), 15,1 semaines (écho indiqué) et 7,1 semaines (à chaud) ($p < 0,001$). L'analyse multivariée n'a pas mis en évidence de facteur de risque cliniquement pertinent d'accouchement avant 28 SA, hormis l'antécédent d'au moins deux fausses couches tardives et/ou accouchements prématurés (aOR = 4,96 ; IC95 % [1,34–22,67], $p = 0,024$).

Conclusion : Les issues périnatales sont significativement meilleures après un cerclage prophylactique ou écho indiqué qu'après un cerclage à chaud, ce dernier étant par nature réalisé dans un contexte d'urgence défavorable. Néanmoins, nos résultats indiquent que le cerclage à chaud demeure une option thérapeutique envisageable chez les patientes à haut risque de fausse couche tardive. Par ailleurs, aucun facteur indépendant d'échec cliniquement pertinent n'a été identifié dans notre cohorte, à l'exception d'antécédents obstétricaux lourds, tels que la répétition de fausses couches tardives ou d'accouchements prématurés (béance cervicale).

Mots-clés : cerclage du col ; issues périnatales ; facteurs de risque d'échec ; cerclage urgent ; cerclage à chaud.

Cervical cerclage : Obstetric and neonatal outcomes and risks factors for failure

ABSTRACT

Introduction: Preterm birth remains a leading cause of neonatal morbidity and mortality. Cervical insufficiency is a specific risk factor, for which cervical cerclage is the reference treatment. The aim of this study was to evaluate obstetric and neonatal outcomes according to the type of cerclage performed, and to identify risk factors associated with cerclage failure (defined as delivery before 28 weeks of gestation).

Methods: We conducted a retrospective single-centre study at Angers University Hospital between January 2014 and October 2024. All women who underwent cervical cerclage during pregnancy were included, except in cases of multiple gestations, definitive cerclage, or incomplete records. Demographic, obstetric, surgical, and neonatal data were collected. Statistical analyses were performed using uni- and multivariate logistic regression to identify independent predictors of cerclage failure.

Results: A total of 152 women were included. Live birth rates were significantly higher following prophylactic (88.1%) and ultrasound-indicated cerclage (93.3%) compared with rescue cerclage (53.8%, $p = 0.005$). Mean gestational age at delivery was 37.8 ± 6.3 weeks for prophylactic cerclage, 36.7 ± 6.9 weeks for ultrasound-indicated cerclage, and 30.4 ± 8.5 weeks for rescue cerclage ($p = 0.014$). Pregnancy prolongation also differed according to cerclage type: 21.3 weeks (prophylactic), 15.1 weeks (ultrasound-indicated), and 7.1 weeks (rescue) ($p < 0.001$). Multivariate analysis did not identify any clinically relevant independent risk factors for delivery before 28 weeks, apart from a history of ≥ 2 late miscarriages and/or preterm births (aOR = 4.96; 95% CI [1.34–22.67], $p = 0.024$).

Conclusion: Perinatal outcomes were significantly better following prophylactic or ultrasound-indicated cerclage compared with rescue cerclage, the latter being performed in inherently less favourable emergency contexts. Nevertheless, our findings suggest that rescue cerclage remains a reasonable therapeutic option in women at high risk of late miscarriage. No clinically relevant independent predictors of cerclage failure before 28 weeks were identified in our cohort, apart from severe obstetric history, such as recurrent late miscarriage or preterm birth (cervical incompetence).

Keywords : cervical cerclage ; cervical stitch ; obstetric outcomes ; risk factors for failure ; emergency cerclage ; rescue cerclage.