Cervical Cerclage: A Comprehensive Monograph on Indications, Techniques, Outcomes, and Evolving Evidence

Abstract

Cervical cerclage is a surgical intervention designed to reinforce cervical integrity and prevent preterm birth (PTB) in women at high risk of cervical insufficiency. Since its introduction in the 1950s, the procedure has evolved considerably in terms of patient selection criteria, operative technique, timing, and adjunct management strategies. This monograph provides a comprehensive, evidence-based review of cervical cerclage, encompassing its historical development, pathophysiological rationale, classification of indications (history-indicated, ultrasound-indicated, and physical examination-indicated), operative approaches (McDonald, Shirodkar, and abdominal cerclage), perioperative management, outcomes, complications, and controversies. Special attention is given to the role of cervical length screening, the place of cerclage relative to competing interventions such as vaginal progesterone and cervical pessary, and the management of cerclage in multiple gestations. The monograph synthesises current evidence from randomised controlled trials, systematic reviews, and major clinical guidelines to inform contemporary obstetric practice.

Keywords: *cervical cerclage, cervical insufficiency, preterm birth, cervical length, McDonald cerclage, Shirodkar cerclage, abdominal cerclage, transvaginal cerclage, progesterone, cervical pessary*

1. Introduction

Preterm birth, defined as delivery before 37 completed weeks of gestation, remains the leading cause of neonatal morbidity and mortality worldwide, accounting for approximately 11% of all live births globally and nearly one million neonatal deaths annually (World Health Organization, 2023). Within the spectrum of causes, cervical insufficiency—historically termed "incompetent cervix"—is characterised by the inability of the uterine cervix to maintain a

pregnancy to term in the absence of clinical contractions or labour, and is implicated in up to 25% of recurrent mid-trimester pregnancy losses (American College of Obstetricians and Gynecologists [ACOG], 2022). Cervical cerclage, a surgical procedure in which a suture or tape is placed around the cervix to provide structural support, has been a cornerstone of management for cervical insufficiency for over seven decades.

First described by Shirodkar in 1955 and subsequently modified by McDonald in 1957, cervical cerclage has accumulated a complex and sometimes contested evidence base (Shirodkar, 1955; McDonald, 1957). Despite decades of research, significant debates persist regarding optimal patient selection, the superiority of one surgical technique over another, the role of cerclage in multiple gestations, and the comparative efficacy of cerclage versus non-surgical alternatives. This monograph aims to provide a thorough, critical synthesis of the available evidence, offering obstetricians, maternal-fetal medicine specialists, and trainees a scholarly reference for clinical decision-making.

2. Historical Background

The concept of surgically reinforcing the cervix emerged in mid-twentieth century obstetrics as clinicians sought to address the clinical enigma of recurrent mid-trimester losses in women with structurally normal uteri. Shirodkar (1955) described a procedure involving a submucosal purse-string suture placed at the level of the internal os after bladder dissection, a technique that remains in use, albeit with modifications. McDonald (1957) proposed a simpler technique—a purse-string suture placed at the external os without bladder dissection—which achieved comparable outcomes with less operative complexity and shorter learning curve. The abdominal approach, first described by Benson and Durfee in 1965, was developed for women in whom the vaginal approaches were technically unfeasible or had failed (Benson & Durfee, 1965).

The laparoscopic transabdominal cerclage (LTAC), introduced in the 1990s, further refined the abdominal approach, allowing interval placement (between pregnancies) with minimally invasive technique (Scibetta et al., 1998).

Over subsequent decades, the proliferation of transvaginal ultrasound enabled real-time cervical length measurement, fundamentally transforming both risk stratification and the indications for cerclage. The landmark MRC/RCOG multicentre randomised trial (Medical Research Council/Royal College of Obstetricians and Gynaecologists Working Party on Cervical Cerclage, 1993) and subsequent meta-analyses by Berghella and colleagues provided the bedrock of contemporary evidence-based practice (Berghella et al., 2011).

3. Pathophysiology of Cervical Insufficiency

The cervix performs a dual biological role during pregnancy: initially maintaining structural competence to retain the conceptus, and subsequently remodelling to facilitate parturition. This remodelling involves a tightly regulated biochemical cascade of collagen degradation, inflammatory mediator release, and smooth muscle relaxation orchestrated primarily by prostaglandins, matrix metalloproteinases (MMPs), and cytokines (Feltovich, 2017). In cervical insufficiency, premature activation of this remodelling cascade leads to painless cervical shortening, effacement, and dilation, often without the patient's awareness, resulting in mid-trimester loss or extreme preterm delivery.

The aetiology of cervical insufficiency is multifactorial. Congenital causes include Müllerian anomalies and diethylstilbestrol (DES) exposure in utero, the latter now predominantly of historical significance. Acquired causes encompass cervical trauma from prior obstetric lacerations, loop electrosurgical excision procedures (LEEP), cold knife conisation, or repeated

mechanical dilatation (Kyrgiou et al., 2016). Genetic predisposition is increasingly recognised, with polymorphisms in collagen-encoding genes hypothesised to contribute to structural cervical weakness (Romero et al., 2014). Importantly, no single objective test definitively confirms cervical insufficiency; the diagnosis remains largely clinical and retrospective, based on history of painless mid-trimester losses or documented cervical shortening on ultrasound.

4. Indications for Cervical Cerclage

4.1 History-Indicated Cerclage

History-indicated cerclage (also termed elective or prophylactic cerclage) is offered to women with a classic obstetric history suggestive of cervical insufficiency: typically three or more prior second-trimester pregnancy losses or preterm deliveries attributed to painless cervical dilation. It is placed electively, usually between 12 and 14 weeks of gestation, after confirmation of fetal viability and exclusion of major fetal anomalies (ACOG, 2022). The rationale is that the probability of recurrence is sufficiently high to justify intervention without awaiting objective cervical shortening. Evidence supporting history-indicated cerclage is largely observational; randomised data are limited, partly because equipoise is difficult to maintain in women with severe recurrent losses (Royal College of Obstetricians and Gynaecologists [RCOG], 2011).

4.2 Ultrasound-Indicated Cerclage

Ultrasound-indicated cerclage is offered to women with a singleton pregnancy, a history of at least one prior spontaneous preterm birth or mid-trimester loss, and a cervical length of 25 mm or less measured transvaginally before 24 weeks of gestation (Berghella et al., 2011). This indication is the most evidence-supported category of cerclage. The pivotal individual patient data meta-analysis by Berghella et al. (2011), drawing on five randomised controlled trials, demonstrated that cerclage in this population significantly reduced preterm birth before 35 weeks

(relative risk [RR] 0.70; 95% CI 0.55–0.89) and reduced composite perinatal morbidity and mortality (RR 0.64; 95% CI 0.45–0.91). Universal cervical length screening at the mid-trimester anomaly scan (18–24 weeks) is recommended in many high-income settings precisely to identify candidates for this indication (Society for Maternal-Fetal Medicine [SMFM], 2016).

4.3 Physical Examination-Indicated Cerclage

Physical examination-indicated cerclage (also termed emergency or rescue cerclage) is performed when advanced, painless cervical dilation is discovered on speculum or digital examination, often with visible fetal membranes at or beyond the external os. It represents the most urgent and technically challenging indication, typically presenting between 16 and 24 weeks. Systematic reviews report that rescue cerclage extends pregnancy latency by a mean of 4–9 weeks compared to expectant management or bed rest alone, and reduces perinatal mortality significantly in some cohorts (Stupin et al., 2008; Roman et al., 2015). However, the risk of membrane rupture, chorioamnionitis, and procedure failure is substantially higher than in elective settings, and patient counselling must be meticulous.

5. Surgical Techniques

5.1 McDonald Cerclage

The McDonald technique involves placing a non-absorbable purse-string suture (typically Mersilene tape or a braided nylon suture) circumferentially around the cervix as high as possible at the cervicovaginal junction without bladder dissection. Its simplicity, speed, and low complication rate have made it the most widely performed cerclage technique globally. It is usually performed under regional anaesthesia (spinal or epidural), and removal at 36–37 weeks of gestation (or earlier in labour) is straightforward and often performed without anaesthesia (ACOG, 2022). Studies comparing McDonald with Shirodkar cerclage have generally found no significant

difference in perinatal outcomes, favouring the McDonald approach for its technical ease (Harger, 1980).

5.2 Shirodkar Cerclage

The Shirodkar technique involves dissecting the vesicovaginal and rectovaginal spaces to allow suture placement at a higher level, closer to the internal os. The bladder and rectum are reflected away, enabling the suture to be placed submucosally for a potentially more anatomical repair. Proponents argue that the higher suture placement better addresses the pathological level of weakness in cervical insufficiency. However, the procedure is technically demanding, carries a higher risk of bladder injury, and suture removal requires anaesthesia. Most contemporary evidence does not demonstrate a clear outcome advantage over McDonald cerclage, and its use is increasingly reserved for specific anatomical situations (Odibo et al., 2003).

5.3 Transabdominal Cerclage

Transabdominal cerclage (TAC) is indicated when vaginal approaches are unfeasible due to an extremely short or surgically absent cervix, or when two or more prior vaginal cerclages have failed. The Mersilene tape is placed at the level of the internal os via laparotomy or laparoscopy. Because removal requires abdominal surgery, delivery must be by caesarean section. The laparoscopic approach, typically performed as an interval procedure before a subsequent conception, has largely superseded the open technique at centres with appropriate expertise (Zaveri et al., 2002; Carter et al., 2009). A Cochrane review found that TAC was associated with significantly fewer perinatal deaths and deliveries before 24 weeks compared to vaginal cerclage in women who had experienced a prior vaginal cerclage failure (Dawood et al., 2007).

6. Perioperative Management

Preoperative evaluation before cerclage includes transvaginal ultrasound to confirm fetal viability and cervical length, amniocentesis to exclude subclinical intra-amniotic infection (particularly for rescue cerclage), and screening for lower genital tract infections including bacterial vaginosis, Chlamydia trachomatis, and Group B Streptococcus. Evidence supporting routine amniocentesis before all rescue cerclages is moderate; however, the presence of subclinical intra-amniotic infection (positive amniotic fluid culture or elevated interleukin-6) is widely considered a contraindication to cerclage, as suture placement in the presence of infection substantially worsens outcomes (Romero et al., 2014).

Perioperative tocolysis is commonly administered, particularly for rescue cerclage, to reduce uterine activity that may precipitate membrane rupture. Indomethacin, a cyclo-oxygenase inhibitor, is most frequently used for this purpose. Prophylactic antibiotics are administered according to local protocols, though high-quality evidence for a specific antibiotic regimen is lacking (RCOG, 2011). Postoperative management typically includes pelvic rest, activity restriction, and serial cervical length surveillance, though the evidence for bed rest as an independent intervention is weak. Suture removal at 36–37 weeks allows for vaginal delivery in the majority of cases.

7. Outcomes and Efficacy

The efficacy of cerclage must be assessed within the context of the specific indication, as outcomes vary considerably. For history-indicated cerclage, perinatal survival rates of 85–95% are reported in cohort studies, compared to 20–30% without intervention in the most severely affected populations (RCOG, 2011). For ultrasound-indicated cerclage in singleton pregnancies with a prior preterm birth and short cervix, the Berghella et al. (2011) meta-analysis remains the definitive evidence synthesis, demonstrating significant reductions in preterm birth and perinatal morbidity.

For rescue cerclage, a systematic review by Roman et al. (2015) including over 500 cases found that cerclage prolonged pregnancy by a mean of 54 days and was associated with a neonatal survival rate of approximately 75%, substantially higher than expectant management.

Key outcome measures in cerclage research include gestational age at delivery, birthweight, neonatal intensive care unit (NICU) admission rates, neonatal respiratory morbidity, and maternal complications. The composite neonatal morbidity index (CNM), incorporating intraventricular haemorrhage, necrotising enterocolitis, respiratory distress syndrome, and retinopathy of prematurity, has increasingly been adopted as a primary endpoint in contemporary trials, reflecting the importance of quality of survival alongside survival itself (SMFM, 2016).

8. Complications

Cervical cerclage, though generally safe, is associated with a recognised range of complications. Procedure-related complications include membrane rupture (occurring in approximately 1% of elective cases but up to 9% of rescue cerclages), chorioamnionitis, cervical laceration, suture migration, haemorrhage, and inadvertent bladder or rectal injury during Shirodkar or abdominal procedures (ACOG, 2022). Cervical dystocia, caused by a retained suture or excessive scarring, can impede labour progress and necessitate emergency removal. Psychological morbidity associated with the diagnosis of cervical insufficiency and the burden of cerclage surveillance should not be underestimated; rates of antenatal anxiety and depression are elevated in this population (Kyser, 2012).

Suture-related complications include suture erosion into the cervical tissue, infection tracking along the suture material, and, in rare cases, fistula formation. The choice of suture material influences complication rates; Mersilene tape is associated with lower rates of suture

breakage but potentially higher infection risk compared to monofilament sutures. Clinicians must weigh individual patient anatomy, surgical history, and available expertise when selecting technique and material.

9. Cerclage Versus Alternative Interventions

9.1 Vaginal Progesterone

Vaginal progesterone has emerged as a significant competing intervention for preterm birth prevention in women with a short cervix. The OPPTIMUM trial (Norman et al., 2016) and subsequent PREVENT meta-analysis (Romero et al., 2018) demonstrated that vaginal progesterone (200 mg nightly) reduced the rate of preterm birth before 33 weeks by approximately 38% in asymptomatic women with a singleton pregnancy and cervical length of 25 mm or less. Critically, in women without a prior preterm birth, vaginal progesterone appears to be as effective as cerclage, and because it is non-invasive, many guidelines recommend it as first-line therapy in this group (SMFM, 2016). However, in women with both a short cervix and a prior spontaneous preterm birth, cerclage appears to confer additional benefit over progesterone alone (Berghella et al., 2011).

9.2 Cervical Pessary

The Arabin cervical pessary, a silicone device inserted vaginally to redirect uterine pressure away from the internal os, has attracted considerable research interest as a non-surgical alternative. Early trials, including the PECEP trial (Goya et al., 2012), reported significant reductions in preterm birth in women with singleton pregnancies and short cervix. However, subsequent large randomised trials, notably the COPE trial (Nicolaides et al., 2016) and the PEOPLE trial, failed to replicate these findings in unselected short-cervix populations, casting doubt on universal efficacy. In multiple gestations, the ProTWIN trial (Liem et al., 2013) found no overall benefit of pessary,

and cerclage in twins without a short cervix has also been shown to increase preterm birth risk (ACOG, 2022). Current evidence does not support cervical pessary as a superior alternative to cerclage in women with the highest-risk profiles.

10. Special Populations

10.1 Multiple Gestations

The management of cervical insufficiency in multiple gestations is particularly complex. Randomised trial evidence does not support cerclage in twin or higher-order gestations without a history of cervical insufficiency, even in the presence of a short cervix; indeed, some trials have suggested harm (Berghella et al., 2005). The Delphi consensus and SMFM guidelines recommend that cerclage in multiple gestations be limited to those with a history-based indication and, even then, counsel patients extensively about the limited evidence base (SMFM, 2016). Vaginal progesterone shows modest cervical-length-dependent benefit in twins but has not been shown to reduce adverse perinatal outcomes consistently.

10.2 Women With Prior Uterine Surgery

Women with a prior myomectomy, uterine rupture repair, or caesarean hysterotomy represent a population in whom cervical cerclage may interact with altered uterine biomechanics. No dedicated randomised trials exist for this subgroup; management decisions are guided by case series and expert opinion. The presence of a uterine scar does not per se alter cerclage technique but may influence decisions around planned delivery mode and timing of suture removal.

11. Controversies and Future Directions

Several controversies persist in the cerclage literature. The threshold cervical length below which cerclage is recommended (25 mm) is based on data predominantly from high-income countries and may not translate uniformly to populations with different baseline cervical length

distributions (Fonseca et al., 2007). The optimal gestational age window for ultrasound screening, whether 16–20 weeks or 18–24 weeks, continues to be debated. The role of biochemical markers—such as cervicovaginal fetal fibronectin, interleukin-6, and phosphorylated insulin-like growth factor binding protein-1—in refining cerclage candidacy is an active area of investigation (Honest et al., 2009).

Future directions include the development of minimally invasive laparoscopic cerclage techniques with lower morbidity, the integration of artificial intelligence-assisted cervical length measurement to reduce operator variability, the exploration of biomarker-guided patient selection, and randomised trials specifically addressing the cerclage-versus-progesterone decision in women with both a prior preterm birth and a short cervix. Additionally, patient-reported outcome measures and quality-of-life assessments are increasingly recognised as essential endpoints in cerclage research, moving beyond the traditional neonatal survival focus to encompass maternal experience and long-term child neurodevelopment (Kyser, 2012).

12. Conclusion

Cervical cerclage occupies an indispensable place in the armamentarium of preterm birth prevention. Its evidence base, while heterogeneous, consistently supports benefit in well-defined clinical scenarios: the woman with a classic history of cervical insufficiency, the singleton pregnancy with a prior spontaneous preterm birth and a short cervix, and the acute presentation of advanced cervical dilation with intact membranes. The McDonald technique remains the procedure of choice in most settings for its simplicity and comparable efficacy, while transabdominal cerclage provides a viable solution for those in whom vaginal approaches have failed. The emergence of vaginal progesterone as an evidence-based, non-invasive alternative has refined rather than displaced cerclage, creating a more nuanced, stratified approach to preterm

birth prevention. Ongoing research into biomarkers, refined imaging, and patient-centred outcomes promises to further individualise care and improve both perinatal and maternal outcomes in this vulnerable population.

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