Longitudinal change in cervical length following vaginal or abdominal cervical cerclage: a randomized comparison

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BACKGROUND: Cervical cerclage has been shown to reduce the risk of recurrent spontaneous preterm birth in a high-risk patient population; however, the mechanism is not well understood. Transabdominal cerclage is superior to low and high vaginal cerclage in reducing early spontaneous preterm birth and fetal loss in women with previous failed vaginal cerclage. Cervical length measurements are commonly used to monitor high-risk women and may explain the mechanism of success.

OBJECTIVE: This study aimed to evaluate the rate of change in longitudinal cervical length after randomized placement of low transvaginal, high transvaginal, or transabdominal cerclage in women with a previous failed vaginal cerclage.

STUDY DESIGN: This was a planned analysis of longitudinal transvaginal ultrasound cervical length measurements from patients enrolled in the Vaginal Randomised Intervention of Cerclage trial, a randomized controlled trial comparing transabdominal cerclage or high transvaginal cerclage with low transvaginal cerclage. Cervical length measurements at specific gestational ages were compared over time and between groups, using generalized estimating equations fitted using the maximum-likelihood random-effects estimator. In addition, cervical length measurements were compared in women with transabdominal cerclage placed before and during pregnancy. The diagnostic accuracy of cervical length as a predictor of spontaneous preterm birth at <32 weeks of gestation was explored.

RESULTS: This study included 78 women who underwent longitudinal cervical length assessment (70% of the analyzed cohort) with a history of failed cerclage, of whom 25 (32%) were randomized to low transvaginal cerclage, 26 (33%) to high transvaginal cerclage, and 27 (35%) to transabdominal cerclage. Abdominal cerclage was superior to low (P=.008) and high (P=.001) vaginal cerclage at maintaining cervical length over the surveillance period (14 to 26 weeks of gestation) (+0.08 mm/week, 95% confidence interval, −0.40 to 0.22; P=.580). On average, the cervical length was 1.8 mm longer by the end of the 12-week surveillance period in women with transabdominal cerclage (+1.8 mm; 95% confidence interval, −7.89 to 4.30; P=.564). High vaginal cerclage was no better than low cervical cerclage in the prevention of cervical shortening; the cervix shortened by 13.2 mm over 12 weeks in those with low vaginal cerclage (95% confidence interval, −21.7 to −4.7; P=.002) and by 20 mm over 12 weeks in those with high vaginal cerclage (95% confidence interval, −33.1 to −7.4; P=.002). Preconception transabdominal cerclage resulted in a longer cervix than those performed during pregnancy; this difference was significant after 22 weeks of gestation (48.5 mm vs 39.6 mm; P=.039). Overall, cervical length was an excellent predictor of spontaneous preterm birth at <32 weeks of gestation (receiver operating characteristic curve, 0.92; 95% confidence interval, 0.82−1.00).

CONCLUSION: In women with a previous failed cervical cerclage, in the next pregnancy, the cervical length in women treated with vaginal cerclage funneled and shortened over time, whereas there was preservation of cervical length in women who receive transabdominal cerclage. Cervical length remained longer in transabdominal procedures performed before pregnancy than in transabdominal procedures performed during pregnancy. Overall, cervical length was an excellent predictor of spontaneous preterm birth in our cohort. Our findings may explain the mechanism of benefit for transabdominal cerclage, with its high placement better maintaining the structural integrity of the cervix at the level of the internal os.

Key words: cervical cerclage, cervical length, preterm birth prediction, spontaneous preterm birth, transabdominal cerclage

Introduction

The leading cause of mortality and morbidity in early childhood is preterm birth (PTB), with an estimated global rate of 10.6% and approximately 15 million births annually.[1] Cervical cerclage is used for the management of women considered to be at high risk of late miscarriage and early spontaneous PTB (sPTB).[2,3] Meta-analysis of trials using individual patient-level data shows that, in a population of women with previous sPTB and singleton gestation and cervical length (CL) of <25 mm, vaginal cervical cerclage significantly reduces delivery before 35 weeks of gestation and composite perinatal mortality and morbidity.[4]

Unfortunately, women may experience spontaneous late miscarriage or sPTB despite cervical cerclage.[5,6] In the small number of very high-risk women where vaginal cerclage fails, transabdominal cerclage (TAC) is effective.[7,8] The Multicentre Abdominal vs Vaginal Randomised Intervention of Cerclage (MAVRIC) trial was a multicenter randomized controlled trial (RCT), which provided the first direct comparison of TAC and high vaginal cerclage (HVC) with low vaginal cerclage (LVC) in women with a previous failed cerclage in the prevention of early PTB and fetal loss.[7] This trial was an RCT that evaluated TAC and showed that, in women

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AJOG MFM at a Glance

Why was this study conducted?

Cervical cerclage has been shown to reduce the risk of recurrent spontaneous preterm birth (sPTB) in a high-risk patient population; however, the mechanism is not well understood. This study aimed to characterize the rate of change in cervical length (CL) over time in women with a history of a failed cerclage, randomized to low or high transvaginal cerclage (TVC) or transabdominal cerclage (TAC). To the best of our knowledge, there is no randomized study that reports longitudinal CL measurements comparing abdominal vs repeat TVC in a very high-risk patient population.

Key findings

In women with a previous failed cerclage, abdominal cerclage maintained CL from 14 to 26 weeks of gestation; however, the cervix shortened significantly in women with low and high TVC. CL was maintained in women with TAC performed before and during pregnancy. CLs were significantly longer when abdominal cerclage was performed before pregnancy. CL was determined to be an excellent predictor of sPTB before 32 weeks of gestation in a very high-risk patient population.

What does this add to what is known?

TAC results in the preservation of CL compared with TVC. The CL of preconception abdominal cerclage was significantly longer than procedures performed during pregnancy. Maintenance of structural integrity at the level of the internal os may explain the mechanism of benefit for TAC, which is known to be associated with improved pregnancy outcomes. CL has been determined to be a good predictor of outcome in women with cerclage.

for whom transvaginal cerclage (TVC) fails, TAC is superior.

Cervical shortening is a useful and reproducible tool to identify and monitor not only women at risk of sPTB[6,9,10] but also treatment failure. The MAVRIC trial showed that the rates of sPTB at <32 weeks of gestation were significantly lower in women who received TAC than in women who received LVC (8% vs 33%; relative risk [RR], 0.23; 95% confidence interval [CI], 0.07−0.76; *P*=.0157). There was no difference in sPTB between HVC and LVC.

It has been proposed that ascending infection leads to the activation of inflammatory pathways, which precede cervical shortening,[11,12] midtrimester miscarriage, early sPTB, and preterm premature rupture of membranes. TAC is placed via the abdominal route at a level much higher than that of a TVC. Higher cerclage is associated with improved outcomes[13]; however, the mechanism of success is unknown. We propose that a longer CL will be maintained in women with TAC, supporting the structural integrity of the cervix at the level of the internal os, where early-stage cervical remodeling begins. In addition, biochemical integrity, facilitated by the cervical mucus plug, with its antimicrobial peptides and essential innate and adaptive immune functions plays a crucial role in deterring microbial invasion of the intrauterine space, with ascent from the vagina being the most common pathway.[14] TAC may prevent the infective, inflammatory cascade associated with cervical shortening. This study aimed to report on the longitudinal CL measurements in this unique randomized high-risk cohort.

Materials and Methods

This was a planned secondary analysis of longitudinal transvaginal ultrasound (TVUS) CL measurements from patients enrolled in the MAVRIC trial, an RCT comparing TAC or HVC with LVC in women with a history of late miscarriage or sPTB at <28 weeks of gestation despite cerclage in situ (history or ultrasound indicated; rescue cerclage procedures were excluded).[7] The MAVRIC trial was funded by the J P Moulton Charitable Foundation and supported by the National Institute for Health and Social Care Research Clinical Research Network. The National Health Service Research Ethical Committee approval was obtained (REC 07/H1102/113), and the trial was registered on the International Standard Randomized Controlled Trial Registry (identification number: ISRCTN33404560). The participants were referred from hospitals across the United Kingdom and recruited at 9 sites between January 2008 and September 2014. All participants gave written informed consent and were <16 years old.

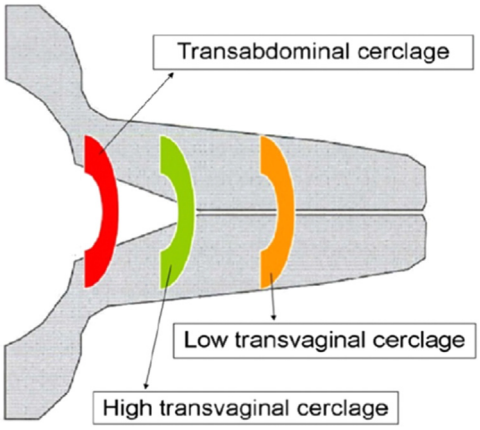
Procedures

Women with a previous failed cerclage were assigned randomly to TAC, HVC, or LVC (Figure 1). Minimization was used to balance 2 prognostic variables: pregnancy at the time of randomization and gestational age of previous late miscarriage or sPTB. Techniques used were left to the local clinician's discretion. All procedures were performed by a consultant-level surgeon. Vaginal cerclage was inserted at <16 weeks of gestation with regional anesthetic and removed at 37 weeks of gestation or earlier if preterm labor ensued. HVC involved the mobilization of the bladder from the anterior cervix that allowed the suture to be placed higher and usually required regional anesthetic for removal. TAC was placed before conception or at <14 weeks of gestation as an open procedure under either regional or general anesthetic and required an inpatient stay of up to 3 days. Women with TAC were scheduled for delivery by elective cesarean delivery (CD) at 38 to 39 weeks of gestation, with retention of the TAC for future pregnancies.

Cervical length measurement and technique

MAVRIC participants were included in this study if they had TVUS CL measurements from at least 2 of 3 clinically important time points: 14 0/7 to 17 6/7, 18 0/7 to 21 6/7, and 22 0/7 to 25 6/7 weeks of gestation. If CL measurements

FIGURE 1
A visual representation of different types of cervical cerclage



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were undertaken after 26 weeks of gestation, these were also reported. The frequency of surveillance varied between 2 and 4 weeks according to clinical need and was undertaken by a small group of trained doctors, midwives, or sonographers.

Following standardized guidelines, serial TVUS CL measurements were handled by trained operators who had fulfilled local governance and assessment requirements. The shortest total closed CL of 3 measurements was considered the length for the analysis.

Statistical analysis

Statistical analysis was performed using Stata (version 14.0; StataCorp, College Station, TX). Descriptive statistics were calculated to describe the study population. TVUS CL measurements at specific gestational age ranges were compared over time and between groups. The rate of change in CL per week was calculated for all study participants, based on the average change in CL per week. The rate of change of CL over the 12-week surveillance period (14−26 weeks of gestation) was calculated for all women with CL visits within the specified time points at the start and end of the period. Each woman was seen up to 5 times (2.9 times each on average); therefore, it was necessary to use a method of analysis that allows for repeated measures and is robust to missing data. Accordingly, comparisons of change in CL over time were performed for each group using generalized estimating equations fitted using the maximum-likelihood random-effects estimator. This method of analysis allowed information from CL measurements at other visits to be included in the analysis. Of note, 95% confidence intervals (CIs) were used. Significance was taken at $P<.05$. Smaller P values were taken as stronger evidence against the null hypothesis.

Receiver operating characteristics (ROC) curves were generated using the first CL measurement after 20 weeks of gestation to explore the diagnostic accuracy of CL (as a continuous variable) to predict sPTB at <32 weeks of gestation. CL was combined with the intervention using logistic regression to investigate the relationship among CL, intervention, and sPTB.

Results

A total of 133 participants were recruited for the MAVRIC trial and randomly allocated to an intervention group (LVC, HVC, or TAC). Of these participants, 22 women did not achieve pregnancy by the end of the study period, and 2 recruits were lost to follow-up. Of the remaining 111 participants who conceived with known outcomes, 78 (70%) received repeated TVUS CL measurements as part of specialist preterm surveillance follow-up and were included in this study. Of the participants, 25 (32%) underwent LVC, 26 (33%) underwent HVC, and 27 (35%) underwent TAC (Figure 2). Demographic characteristics are similar in all groups (Table 1). Cohort risk factors for sPTB by treatment allocation are displayed in Table 2. The average gestational age at intervention was comparable in all groups (10 2/7 and 10 4//7 weeks for women who had LVC and HVC, respectively, and 10 4//7 for women who had TAC placed during pregnancy; 10 of 27 TACs (37%) were placed before conception).

Outcomes

The CL of women receiving vaginal cerclage shortened significantly over the 14 to 26 weeks of gestation surveillance period compared with those receiving TAC (HVC vs TAC; P=.008; LVC vs TAC; P=.001).

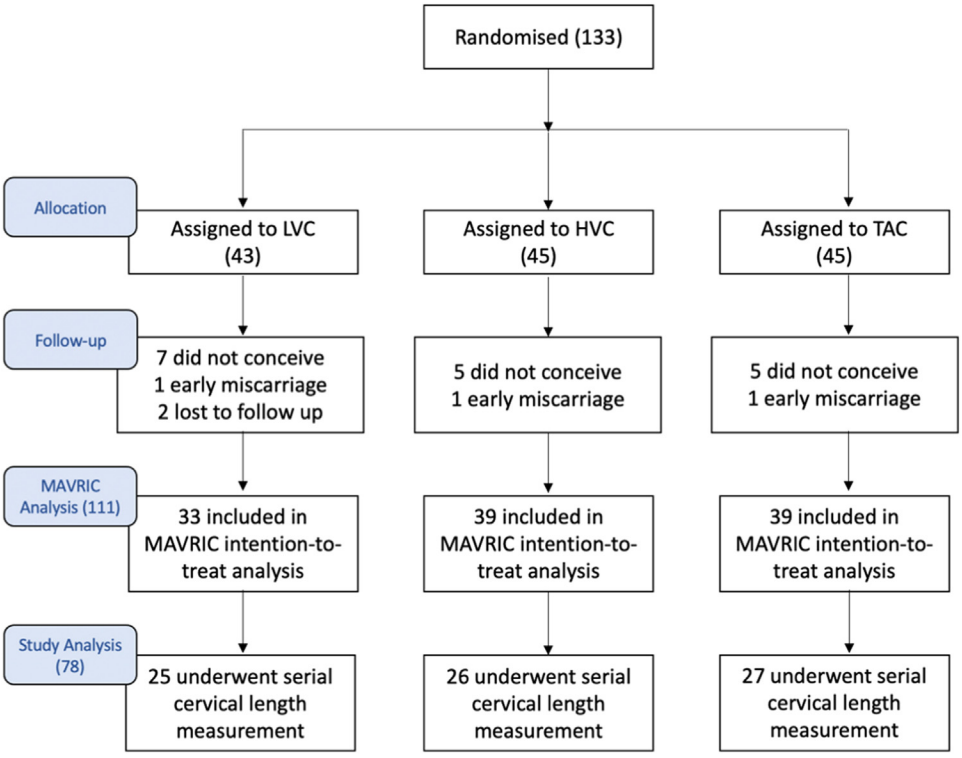
HVC was no better than LVC in the prevention of cervical shortening, a cervix shortened by 13.2 mm over the surveillance period in those receiving LVC (95% CI, −21.7 to −4.7; P=.002) and 20 mm in those receiving HVC (95% CI, −33.1 to −7.4; P=.002). The estimates of the rate of change of CL by intervention by time are displayed in Table 3 and Figure 3.

TAC was superior to both LVC (P=.008) and HVC (P=.001) at maintaining CL over the surveillance period (14 to 26 weeks of gestation) (+0.08 mm/wk; 95% CI, −0.40 to 0.22; P=.580); women who received TAC maintained their CL throughout pregnancy (0.08 mm/wk; 95% CI, −0.40 to 0.22; P=.580). On average, CL was 1.8 mm longer by the end of the 12-week surveillance period in women with TAC (+1.8 mm; 95% CI, −7.89 to 4.30; P=.564), although this was not statistically significant.

Preconception vs in-pregnancy transabdominal cerclage procedure

TVUS CL measurements were longer when the TAC was placed before

FIGURE 2
Participant flow chart showing treatment allocations, study inclusions, and exclusions



HVC, high vaginal cerclage; *LVC*, low vaginal cerclage; *MAVRIC*, Multicentre Abdominal vs Vaginal Randomised Intervention of Cerclage; *TAC*, transabdominal cerclage.

Ridout. Longitudinal change in cervical length following vaginal or abdominal cerclage. Am J Obstet Gynecol MFM 2023.

conception than when the TAC was placed during pregnancy; this difference was significant after 22 weeks of gestation (48.5 mm [standard deviation (SD), 13.5] vs 39.6 mm [SD, 7.4]; *P*=.039) (Table 4).

Cervical length after 20 weeks to predict spontaneous preterm birth less than 32 weeks' gestation

Overall, CL was an excellent predictor of sPTB at <32 weeks of gestation (ROC, 0.92; 95% CI, 0.82−1.00). Combining it with intervention using logistic regression (LVC, HVC, or TAC) did not improve the accuracy of prediction (ROC, 0.92; 95% CI, 0.81−1.00).

In Table 2, 12 of 78 women (15%) had cervical surgery. As more women with transcervical cerclage had cervical surgery (6 of 25 women [24%] received LVC vs 1 of 27 women [4%] received TAC), we confirmed that results remained statistically significant when women with cervical surgery were removed.

TABLE 1
Maternal baseline demographic characteristics

Treatment allocation	LVC (n=25)	HVC (n=26)	TAC (n=27)	All (N=78)
Age at time of consent (y)	32.8 (5.5)	32.7 (5.8)	31.0 (4.4)	32.1 (5.3)
Body mass index (kg/m^2)	29.0 (4.5)	29.8 (7.6)	31.6 (8.2)	30.2 (7.1)
Ethnicity, n (%)				
White	6 (24)	6 (23)	9 (33)	21 (27)
Black	16 (64)	17 (65)	17 (63)	50 (64)
Asian	3 (12)	2 (8)	1 (4)	6 (8)
Other	0 (0)	1 (4)	0 (0)	1 (1)

HVC, high vaginal cerclage; *LVC*, low vaginal cerclage; *TAC*, transabdominal cerclage.

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Discussion

Principal findings

This study compared the longitudinal CL measurements in very high-risk women with a previous failed cervical cerclage randomized to LVC, HVC, or TAC. TAC resulted in better maintenance of a long, closed cervix, unlike both HVC and LVC. TAC performed

TABLE 2
Cohort risk factors for spontaneous preterm birth by treatment allocation

Risk factors	LVC (n=25)	HVC (n=26)	TAC (n=27)	All (N=78)
Cervical surgery	6 (24.0)	5 (19.0)	1 (4.0)	12 (15.0)
Uterine anomaly	0 (0)	0 (0)	1 (4.0)	1 (1.0)
APS or lupus antibodies	0 (0)	2 (8.0)	1 (4.0)	3 (4.0)
Smoked during pregnancy	1 (4.0)	1 (4.0)	2 (7.0)	4 (5.0)
Gestation at the end of the last pregnancy:				
<24 wk	14 (56.0)	15 (58.0)	19 (70.0)	48 (62.0)
≥24 wk	6 (24.0)	16 (62.0)	8 (30.0)	30 (38.0)
Past or present history of:				
Recurrent UTI in pregnancy	3 (12.0)	1 (4.0)	3 (11.0)	7 (9.0)
Group B *Streptococcus*	0 (0)	7 (27.0)	8 (29.6)	15 (19.0)
Bacterial vaginosis	2 (8.0)	4 (15.0)	2 (7.0)	8 (10.0)
Recreational drug use	0 (0)	0 (0)	1 (4.0)	1 (1.0)

APS, Antiphospholipid Syndrome; *HVC*, high vaginal cerclage; *LVC*, low vaginal cerclage; *TAC*, transabdominal cerclage; *UTI*, urinary tract infection.

Ridout. Longitudinal change in cervical length following vaginal or abdominal cerclage. Am J Obstet Gynecol MFM 2023.

TABLE 3
Estimates of the rate of change of CL by intervention

Estimates of the rate of change of mean CL by intervention (mm/time in wk)			
Intervention	Change in CL (mm)	95% confidence interval	*P* value
LVC			
mm/wk	−0.7	−1.1 to −0.2	.002
mm/12 wk	−13.2	−21.7 to −4.7	.002
HVC			
mm/wk	−1.0	−1.7 to −0.3	.003
mm/12 wk	−20.2	−33.1 to −7.4	.002
TAC			
mm/wk	0.1	−0.4 to 0.2	.580
mm/12 wk	1.8	−7.9 to 4.3	.564
Comparison of the rate of change of CL between groups			
HVC compared with TAC			
mm/wk	−0.6	−1.1 to −0.2	.008
mm/12 wk	−12.8	−22.2 to −3.4	.008
LVC compared with TAC			
mm/wk	−1.1	−1.6 to 0.6	.001
mm/12 wk	−22.2	−32.4 to 12.1	.0005

CL, cervical length; *HVC*, high vaginal cerclage; *LVC*, low vaginal cerclage; *TAC*, transabdominal cerclage.

Ridout. Longitudinal change in cervical length following vaginal or abdominal cerclage. Am J Obstet Gynecol MFM 2023.

before and during pregnancy resulted in the cervix staying long, with measurements significantly longer when the TAC was placed before pregnancy. CL after 20 weeks of gestation was an excellent predictor of sPTB at <32 weeks of gestation in this cohort.

Clinical implications

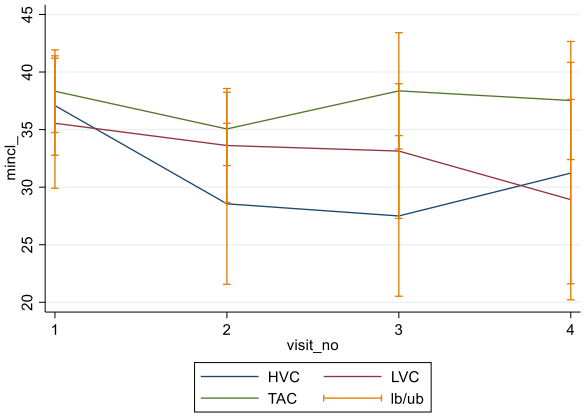
We have shown that CL is maintained in women with cerclage placed via the abdominal route at the level of the internal os, much higher than that of a TVC.[15] This contrasts with vaginal cerclage, after which the cervix significantly funnels and shortens. The MAVRIC trial confirmed that TAC is superior to vaginal cerclage in the reduction of risk of early sPTB and fetal loss in women with previous failed vaginal cerclage.[7] It has been proposed that the integrity of the internal os plays a central role in the ability of the cervix to retain and protect the fetus during pregnancy.[16] The findings from our study may explain the mechanism of benefit for TAC, with superior maintenance of biochemical and structural integrity of the cervix at the level of the internal os.

Research implications

There are multiple pathways to sPTB, the leading global cause of death in children <5 years old, but most culminate in premature cervical change, the last step in the final common pathway to delivery. The underlying mechanisms are poorly understood; however, it is well accepted that the risk of sPTB is inversely proportional to the length of the cervix; those with the shortest CL have the highest risk of prematurity.[17] In keeping with this, higher cerclage is associated with improved outcomes[13]; however, the mechanism of success is unknown.

All women randomized within the MAVRIC trial were very high risk; 105 of 111 women (95%) had experienced ≥2 previous late miscarriages, yet we were able to show that the numbers needed to treat to prevent both delivery at <32 weeks of gestation (<4 cases) and fetal loss (<6 cases) were modest in women who received TAC compared with women with vaginal suture.[7] Cook

FIGURE 3
Longitudinal change in cervical length after the intervention



The x-axis indicates visit 1 (14 0/7 to 17 6/7 weeks of gestation), visit 2 (18 0/7 to 21 6/7 weeks of gestation), visit 3 (22 0/7 to 25 6/7 weeks of gestation), and visit 4 (>26 0/7 weeks of gestation); the y-axis indicates the mean cervical length; and lb/ub indicates the lower bound and upper bound depicting 95% confidence intervals.

HVC, high vaginal cerclage; *LVC*, low vaginal cerclage; *TAC*, transabdominal cerclage.

Ridout. Longitudinal change in cervical length following vaginal or abdominal cerclage. Am J Obstet Gynecol MFM 2023.

et al[13] previously demonstrated in a cohort of women receiving cerclage for a short cervix that increased cerclage height reduced the odds of sPTB at <34 weeks of gestation (odds ratio, 0.9; 95% CI, 0.84−0.96), hypothesizing that cerclage fails to reverse the biochemical and physiological changes, which lead to premature cervical ripening, when it is placed in the cervix distally. We have shown that when a TAC is placed at the level of the internal os, either before conception or at <14 weeks of gestation, cervical shortening is prevented whatever the underlying etiology of previous recurrent preterm births. Mechanical support high in the cervix may prevent early-stage cervical change, which starts with dilation of the internal os and subsequent initiation of the inflammatory cascade, potentially explaining the significant improvement in outcomes (sPTB at <32 weeks TAC vs LVC, 8% vs 33%; RR, 0.23; *P*=.0157). Of note, 9 failed LVCs or HVCs from the MAVRIC cohort went on to have a TAC placed in their subsequent pregnancy; TAC resulted in successful pregnancy in all cases (median gestational age at delivery, 37 0/7 weeks [interquartile range, 35 5/7 to 38 6/7])[18] giving further strong evidence that it is the height of the cerclage that is key to success. Future work should establish which women are most likely to benefit from TAC rather than limiting its use to those with a failed cerclage. TAC requires CD; morbidity associated with this intervention vs the morbidity associated with failed pregnancy needs further evaluation.

Late labor stage and full dilatation CDs (FDCDs) are associated with recurrent early sPTB and late miscarriage,[19−21] with an absolute risk of recurrence of more than 50% and a 6-fold risk of recurrent loss at <24 weeks of gestation.[22] The mechanism for this increased risk is unknown, and there are uncertainties concerning the clinical management; however, it is proposed that pathology may be due to an inadvertently low uterine incision, with the incision and trauma close to the internal os at the time of FDCD, compromising its subsequent integrity. Furthermore, this might explain why vaginal cerclage is less effective, that is, because cerclage cannot be placed high enough vaginally to reach above the level of the CD niche. TVC seems less effective among pregnant women who have had an emergency CD followed by an sPTB or a late miscarriage compared with other high-risk women to prevent PTB.[23] Shennan et al[7] have compared pregnancy outcomes in women with either a TAC or a vaginal cerclage with a history of in-labor CD and subsequent sPTB or late miscarriage; 100% of women with a TAC had a live baby at discharge, compared with only 60% of women with vaginal cerclage. Future RCTs should consider comparing vaginal cerclage or TAC in women with a history of in-labor CD followed by sPTB or late miscarriage and include prospective CL measurement and assessment of CD scar and niche[24] to establish a predictive model and further investigate the mechanism of sPTB in this high-risk group.

Although there is currently insufficient evidence to recommend before or during pregnancy abdominal

TABLE 4
Comparison of transvaginal cerclage length measurement in women with transabdominal cerclage placed before conception or during pregnancy

Timing of suture (wk of gestation)	14 0/7 to 17 6/7	18 0/7 to 21 6/7	22 0/7 to 25 6/7	≥26
Before conception (n=10)	43 mm SD=9.7	43.9 mm SD=9.9	48.5 mm SD=13.5	49.7 mm SD=12.1
Placed during pregnancy	39.7 mm SD=8.7 (n=14)	38.4 mm SD=7.3 (n=14)	39.6 mm SD=7.4 (n=16)	40.3 mm SD=8.4 (n=16)
P value	.39	.13	.04	.03

SD, standard deviation.

Ridout. Longitudinal change in cervical length following vaginal or abdominal cerclage. Am J Obstet Gynecol MFM 2023.

procedures,[25] our results indicate a potential mechanism of benefit for the TAC to be placed before conception, removing possible risks to the pregnancy and of rupturing the membranes and, therefore, increasing the surgeon's confidence to place the cerclage higher in the cervix. Although the numbers are small, and our study does not have adequate power, these findings are in line with the overall message of the article. Future randomized trials should evaluate obstetrical and neonatal outcomes of abdominal cerclage before or during pregnancy.

Strengths and limitations

Our study provides insight into the mechanism of improved maternal and perinatal outcomes in women with TAC and confirms that CL is a strong predictor of outcome in high-risk patients with a cerclage in situ. The choice of cerclage is a modifiable factor, making this important to investigate. Data were collected prospectively from randomized groups. We included women with failed cerclage in their subsequent pregnancy, which reduced selection bias and increased generalizability.

We acknowledge certain limitations in our study. The numbers of women in each group are small. Women with a history of failed cerclage are rare, and it is challenging to randomize such women into a trial when there are often strong previous beliefs for both clinicians and women about the perceived risk or benefit of the intervention, therefore creating a lack of equipoise.

CL surveillance was not universally performed at all sites. All sites that provided CL data were included. The numbers were not significantly different between intervention groups, and the groups were balanced by place of intervention. In addition, the availability of scanning is unrelated to treatment allocation in the randomized design; therefore, we did not think this would introduce a significant bias; however, it should be acknowledged as a limitation of the study.

Absolute numbers of women with previous cervical surgery and histories of urinary tract infections or bacterial vaginosis do differ slightly between arms; as per the Consolidated Standards of Reporting Trials guidance, it is not recommended to perform comparisons of randomized differences because these are likely to be the result of chance rather than bias and can be misleading.[26] However, during an exploratory analysis, which removed women with cervical surgery, the primary outcome remained statistically significant.

The multiple and varied risk factors in the TAC group suggested that the treatment effect may be unrelated to etiology (Table 2).

Conclusion

There are multiple pathways to sPTB, but most culminate in premature cervical change. We have shown that transvaginal cervical cerclage results in shortening in CL over time in women with a previous failed cervical cerclage and that there is the preservation of length in women with TAC. CL is better preserved when TAC is placed before pregnancy rather than during pregnancy. Overall, CL is an excellent predictor of sPTB in high-risk patients.

TAC has been determined to be superior to LVC and HVC in reducing the risk of PTB in women with a history of failed cerclage. Our findings may explain the mechanism of benefit, with the cerclage preventing the initiation of the inflammatory cascade and maintaining the structural integrity of the cervix when placed at the level of the internal os. ■

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