Cervical cerclage is the placement of a stitch within and around the perimetre of the cervix, with the aim to reinforce its integrity and keep it closed, to prevent or treat cervical insufficiency and consequent spontaneous preterm birth (PTB). Transvaginal cerclage in pregnancy was first reported in 1955; the case was performed by Dr V. Shirodkar, an Indian obstetrician, in 1951.1 Many investigators have reported variations on the surgical technique of transvaginal cerclage, and the most common of these is the McDonald procedure.2,3 A variety of technical aspects of cervical cerclage have been investigated for their efficacy in prolonging gestation.

Safety and effectiveness of technical aspects of cerclage may vary by the indications for this procedure. When first described, cerclage was used for 2 indications: initially for prior second-trimester loss with painless cervical dilation in the current pregnancy (ie, physical examination indicated) and soon after for recurrent second-trimester loss, not attributable to other causes (ie, history indicated).1,2

The objective was to review the evidence supporting various perioperative technical and management strategies for transvaginal cervical cerclage. We performed MEDLINE, PubMed, EMBASE, and COCHRANE searches with the terms, cerclage, cervical cerclage, cervical insufficiency, and randomized trials, plus each technical aspect (eg, suture, amniocentesis, etc) considered. The search spanned 1966 through September 2012 and was not restricted by language. Each retrieved manuscript was carefully evaluated, and any pertinent references from the reports were also obtained and reviewed. All randomized trials covering surgical and selected perioperative, nonsurgical aspects of cerclage were included in the review. The evidence was assessed separately for history-, ultrasound-, and physical examination-indicated cerclage. Evidence levels according to the new method outlined by the US Preventive Services Task Force were assigned based on the evidence. There are no grade A high-certainty recommendations regarding technical aspects of transvaginal cervical cerclage. Grade B moderate-certainty recommendations include performing a fetal ultrasound before cerclage to ensure fetal viability, confirm gestational age, and assess fetal anatomy to rule out clinically significant structural abnormalities; administering spinal, and not general, anesthesia; performing a McDonald cerclage, with 1 stitch, placed as high as possible; and outpatient setting. Unfortunately, no other recommendations can be made regarding the other technical aspects of cerclage.

Key words: cervical cerclage, stitch, technique

Contemporary indications and nomenclature are listed in Table 1.4-9 In women with prior spontaneous preterm birth, singleton gestation, and transvaginal ultrasound (TVU) cervical length of less than 25 mm before 24 weeks, a meta-analysis of randomized trials has shown that ultrasound-indicated cerclage is associated with a significant 30% decrease in preterm birth less than 35 weeks and a significant 36% decrease in perinatal morbidity and mortality.10 Current guideline statements now support cerclage placement for this indication.11,12

These recent efficacy data make a review of the technical aspects of cerclage and their effect on pregnancy outcome timely. An evaluation of the indications, gestational age of placement, contraindications, and complications of cerclage is beyond the scope of this report.13 Because cerclage placement has not been shown to be beneficial in multiple gestations,14,15 the assumption in this review is that cerclage is placed in a woman carrying a singleton. Review of technical aspects of old preconception techniques such as Lash or Mann is not planned because these techniques are used rarely, if at all. Additionally, a review of the technical aspects of transabdominal or laparoscopic cerclage is not planned because these are in many ways technically quite different from transvaginal cerclage.

Our objective was to review the evidence for efficacy of various perioperative technical and management strategies associated with transvaginal cerclage placement, as analyzed by the different indications (Table 1) for this surgical procedure. Each strategy will be reviewed separately. Clinical assessment of the published data will follow evidence-based criteria, emphasizing level I evidence (based on randomized clinical trials [RCT] or meta-analyses) when available.

Sources MEDLINE, PubMed, EMBASE, and COCHRANE searches were performed with the terms, cerclage, cervical cerclage, cervical insufficiency, and ran-
dominated trials, plus each technical aspect (eg, suture, amniocentesis, etc) considered. The search spanned 1966 through September 2012 and was not restricted by language.

**Study selection**

Each retrieved manuscript was carefully evaluated, and any pertinent references from the reports were also obtained and reviewed. All randomized trials covering surgical and selected perioperative, non-surgical aspects of cerclage were included in the review. In the absence of randomized trials adequately covering the intervention or related strategy, analytical data were reviewed. In the absence of experimental or analytical data, observational data were evaluated.

Exclusion criteria included cerclage in multiple gestations, Lash or Mann procedures, cervical occlusion, and open or laparoscopic transabdominal cerclage.

Each aspect of the cerclage technique was reviewed separately. These included preoperative, intraoperative, and postoperative strategies. Preoperative considerations were fetal ultrasound; amniocentesis; screening for infection; and the use of prophylactic antibiotics, tocolytics, and progesterone. Intraoperative considerations included anesthesia method, cervicovaginal preparations, cerclage type (Shirodkar, McDonald), choice of suture, needle and number of stitches, cerclage height, and techniques for reducing prolapsed membranes. Postoperative considerations included outpatient vs inpatient cerclage, activity restriction, and use of reinforcing cerclage.

After each strategy was reviewed, evidence levels were assigned based on the evidence according to the new method outlined by the US Preventive Services Task Force (Table 2).16

**Results**

**Preoperative considerations**

*Fetal ultrasound.* There are no specific randomized trials assessing the effectiveness of performing an ultrasound before a cerclage (Table 3). Based on indirect evidence and clinical common sense, an ultrasound should be performed before every cerclage placement to ensure fetal viability, confirm gestational age, and assess fetal anatomy to rule out clinically significant structural abnormalities.13 At least a crown-rump length and some method of aneuploidy screening or testing should be offered when cerclage is performed before 18 weeks (eg, history indicated), and an anatomic survey performed when cerclage is planned later (eg, ultrasound or physical exam indicated) (recommendation B; level: low; Table 3).

*Amniocentesis.* We could identify no RCT assessing the effectiveness of performing a precerclage amniocentesis. Placing a cerclage in a woman with overt, clinical intraamniotic infection (IAI) places both fetus and mother at great morbidity and even mortality risks and is considered an absolute contraindication.17,18 The prevalence of subclinical IAI depends on the clinical circumstance and cerclage indication.

We could identify no published report investigating the prevalence of subclinical IAI in women undergoing history-indicated cerclage, but it is probably present in less than 1% of these women because their cervix is typically closed and long. Therefore, amniocentesis is not indicated before history-indicated cerclage.

Subclinical IAI complicates about 1-2% of pregnancies in women undergoing ultrasound-indicated cerclage.19 The prevalence can be as high as 4-9% if the fluid is also cultured for Ureaplasma and Mycoplasma species20,21; however, the clinical significance of colonization with these microbes is unclear. In general, shorter cervical length (CL) is associated with higher rates of IAI.21 In approximately 75% of cases, women screened with TVU and found to have a short CL will have a closed and long cervix when examined by speculum and/or manual examination,22 and their rate of IAI is extremely low. The presence of sludge as detected by ultrasound has been associated with IAI in asymptomatic patients with a short cervix.23 Nonetheless, we could find no report that suggests improved pregnancy outcomes result from using amniocentesis, and thus, it is not recommended.

Subclinical IAI is discovered in approximately 13-28% of women with acute cervical insufficiency (mostly asymptomatic cervical dilatation on digital examination) in the second trimester and who may be considered candidates for physical examination-induced cerclage.18,24 Amniotic fluid harvested from women with cervical dilatation of 2 cm or more, and cultured for Ureaplasma and Mycoplasma, reveals an approximately 50% incidence of IAI.17

We could find no RCT evaluating the safety and efficacy of amniocentesis for women with cervical changes prior to physical examination-induced cerclage, but an ongoing RCT may help address this important clinical issue.25 Amniocentesis to rule out infection in women with second-trimester cervical dilatation up to 4 cm has not been associated with higher PTB or preterm premature rupture of membranes rates.24
Amniocentesis might help select patients who will benefit most from physical examination-indicated cerclage and eliminate from consideration those who will likely not benefit. Although the use of precerclage amniocentesis has been associated with better outcomes compared with management without amniocentesis, women managed with amniocentesis were not compared with the women who declined to have the amniocentesis in these reports.\textsuperscript{18,21,24-26} For example, in one study, women without IAI as confirmed by amniocentesis were compared with and had better pregnancy outcomes than women who had either positive cultures or who declined amniocentesis (some of whom likely had positive cultures).\textsuperscript{26} If amniotic fluid is sent for culture, it may take several days for the laboratory to confirm no growth, but results from other methods for detecting subclinical IAI such as amniotic fluid Gram stain and glucose can be obtained rapidly.

In summary, amniocentesis is unnecessary for women before history-indicated cerclage (recommendation D; level: low; Table 3). There is insufficient evidence to recommend an amniocentesis for women with cervical shortening before ultrasound-indi-
Perioperative assessment for genital tract infection and empiric antibiotic treatment. We could identify no specific randomized trial assessing the effectiveness of assessing for genital tract infection and empiric antibiotic treatment before cerclage. There is insufficient evidence to evaluate whether the common practice of perioperative screening for and treating gonorrhea, chlamydia, or other sexually transmitted infections (STIs) is beneficial. STI screening should probably be done based on risk factors.²⁷

In women undergoing a history-indicated cerclage, whose cervix is not short or dilated, the empiric use of prophylactic antibiotics is not indicated because this strategy has not been found to be beneficial.²⁸

In candidates for ultrasound- or physical examination–indicated cerclage because of cervical changes, the association with IAI and inflammation is directly proportional to the severity of cervical changes (the more the cervix is dilated or short, the higher the incidence of IAI) and indirectly related to the gestational age at which these changes are detected (the earlier in pregnancy the cervix dilates and/or shortens, the higher the incidence of IAI).²⁹,¹⁷ Ureaplasma ureali­ticum, if cultured for, is the most common organism isolated.¹⁷,²⁹

Four of the RCTs that evaluated the efficacy of ultrasound-indicated cerclage...
used antibiotics at the time of cerclage.\textsuperscript{7,19,30,31} Unfortunately, no separate analysis was performed regarding their effect, except for an abstract, which reported no benefit from the use of antibiotics and tocolytics compared with the use of neither.\textsuperscript{32} In at least 2 RCTs,\textsuperscript{19,30} the control group received the same antibiotics as the cerclage group.

Although some small retrospective and poorly controlled studies have suggested benefit to antibiotics (and tocolytics) for physical-indicated cerclage, the evidence is insufficient to recommend their use.

In summary, we recommend caution for use of antibiotics at the time (perioperative) of either ultrasound- or physical examination–indicated cerclage. Antibiotics for the prevention of PTB have been associated with harm in other populations at infectious risk for PTB\textsuperscript{34,35} (recommendation D; level: moderate; Table 3).

**Tocolytic agents.** We could find no randomized trial specifically assessing the effectiveness of prophylactic tocolytics before a cerclage.

Asymptomatic women receiving a history–indicated cerclage, usually performed at 12-14 weeks, are not experiencing contractions and therefore would not be expected to have any benefit from tocolysis. Painful uterine contractions with cervical change (ie, clinical preterm labor) in symptomatic patients is an absolute contraindication to cerclage placement.\textsuperscript{2}

Regarding ultrasound–indicated cerclage, most asymptomatic women with a short CL at less than 24 weeks have evidence of some contractions when they are placed on external monitoring.\textsuperscript{8} Usually these are irregular and not felt by the patient who has been screened with a scheduled TVU CL. Cervical mucus inflammatory markers, such as interleukin (IL)–8, fetal fibronectin, and others, have been reported as being helpful in predicting who might benefit from cerclage,\textsuperscript{37} but at this time their use is investigational. In a cohort of women with short CL less than 25 mm, those with normal cervicovaginal IL–8 had less PTB with cerclage, whereas in those with elevated IL–8, cerclage was associated with higher rates of PTB, as compared with no cerclage.\textsuperscript{38}

Prostaglandin metabolite levels are high both before and after cerclage in women with second-trimester cervical dilatation.\textsuperscript{39} These associations raise the question of the utility of tocolytics (including antiinflammatory agents) with (or without) cerclage for asymptomatic women with a short CL. In an RCT, women at high risk for PTB because of both a prior poor obstetric history and a short TVU CL received either indomethacin and an ultrasound–indicated cerclage or bed rest alone.\textsuperscript{30} The combination of indomethacin and cerclage was associated with a significantly decreased incidence of PTB compared with those who did not receive either. Thus, the attributable effect of indomethacin could not be formally assessed.\textsuperscript{30} This is the RCT,\textsuperscript{30} albeit small, in which cerclage seemed to be most effective compared with other similar RCTs.\textsuperscript{7,19,31,40} In women who received ultrasound–indicated cerclage, perioperative indomethacin for short TVU CL less than 25 mm at 14-23 weeks did not prevent PTB less than 35 weeks.\textsuperscript{41}

In women undergoing physical examination–indicated cerclage, indomethacin has been associated with nonsignificant trends for preventing PTB as compared with no indomethacin.\textsuperscript{42}

In summary, there is insufficient evidence to routinely recommend tocolytics at the time of cerclage (recommendation D; level: low for history–indicated cerclage; recommendation C; level: low for ultrasound– and physical examination–indicated cerclage; Table 3).

**Progestogens.** There are no specific randomized trials assessing specifically the effectiveness of giving progestogens before a cerclage. 17-alpha hydroxyprogesterone (17P) has been shown to be effective in preventing recurrent PTB in women with prior spontaneous PTB.\textsuperscript{43,44} Women already on 17P because of a prior PTB, who also have indication(s) for cerclage, should continue 17P.

Although there were no significant statistical differences, the use of 17P in women with prior PTB was associated with trends for a cumulative beneficial effect with ultrasound–indicated cerclage placed for short CL.\textsuperscript{45}

In summary, the evidence is insufficient to assess the risks and benefits of progesterone use at the time of cerclage. We do not suggest its routine use perioperatively (recommendation D; level: low; Table 3). Women already on 17P because of a prior PTB, who also have indication(s) for cerclage, should continue the 17P.

**Intraoperative strategies**

**Anesthesia**

We could find no randomized trial comparing general with regional anesthesia for cerclage. General anesthesia was originally suggested for the cerclage operation (nitrous oxide in McDonald’s report).\textsuperscript{2} A small RCT comparing spinal with general anesthesia for women undergoing mostly history–indicated cerclage showed similar rates of PTB as well as oxytocin concentrations and postoperative uterine activity.\textsuperscript{46} A retrospective review also did not show differences in outcome between regional vs general anesthesia for cerclage placement.\textsuperscript{47} Regional anesthesia is now preferred for its general safety compared with general anesthesia for cerclage placement, based mostly on noncerclage and anesthesia literature.\textsuperscript{48}

Spinal anesthesia is usually the preferred regional technique because the surgery rarely lasts longer than 30 minutes. A small RCT compared small-dose bupivacaine plus fentanyl vs lidocaine for spinal anesthesia and found them to have similar efficacy.\textsuperscript{48}

Pudendal anesthesia has been shown to be as effective as regional in a small prospective, nonrandomized study.\textsuperscript{49}

In summary, spinal anesthesia seems to be the preferred anesthesia for cerclage (recommendation B; level: low; Table 3).

**Intraoperative precerclage cervicovaginal preparations**

There are several precerclage preparations that are performed in the operating room prior to suture placement. None of these have been assessed by an RCT or any controlled study. After the patient is placed in the dorsal lithotomy position and the bladder is emptied to reduce the
chance of bladder injury, surgical preparation of the perineum and vagina is commonly performed, usually with Betadine. This step is done gently in the vagina if the membranes are protruding from the cervix. The cervix at this point can be examined manually or with TVU.

Optimal exposure of the entire cervix is crucial for optimal suture placement and avoiding adjacent structures. Many surgeons utilize a weighted speculum in the posterior vagina, Breisky retractors (Thomas Medical, Inc, Indianapolis, Indiana) for lateral vaginal wall retraction and Sims retractors (Thomas Medical, Inc) for anterior retraction. The primary surgeon performs the cerclage, and the assistants help with retraction aimed at optimal visualization. We and others utilize sponge ring forceps on the cervix to optimize visualization of the cervix and provide the necessary countertraction at the suture entry and exit sites. None of these intraoperative steps have been evaluated in controlled trials.

In summary, there is insufficient evidence to assess the effectiveness of any of these precerclage intraoperative steps (recommendation I; level: low).

Cerclage type: Shirodkar vs McDonald

Transvaginal cerclage is usually performed using either the McDonald or Shirodkar approach with or without modifications, which have been reported. Although proponents for each surgical method exist, we could locate no RCT comparing these 2 surgical methods.

In the McDonald technique, a purse-string suture is placed in 4-6 bites circumferentially around the cervix, just distal to the vesicocervical reflection (at the junction of the ectocervix and the anterior ruggated vagina) and posteriorly, just distal to the vaginal-rectal reflection2 (Figure 1).50 About 1 cm of spacing can be left between the exit of the last bite and the entry of the new bite of suture into the cervix. It is unclear whether placing the suture completely submucosally has any effects, as suggested by some.51 Each pass should be deep enough to capture sufficient cervical stroma to avoid pulling through and later displacement but not so deep as to enter the endocervical canal (and risk rupture of the membranes, especially in women with digital cervical changes present). The uterine vessels should be avoided laterally (Figure 2).50 The suture should be placed as high as feasible, as originally described,2 at least 2 cm or more above the external os, as confirmed by recent data (see also Cerclage height section below).

In particular, the suture bite should be placed securely on the posterior aspect of the cervix because this is the most likely site of suture displacement50 (Figure 2). The operator changes his/her position standing toward the side of the patient and places the posterior bite in a forward way, this may facilitate optimal suture placement. The suture is tied after removing any slack with gentle traction on the suture and countertraction on the stroma; successive knots are tied, and the ends are left long enough (2-3 cm) to allow easy identification and removal (Figure 3).50 Although we and others tie the suture anteriorly, no recommendations can be made regarding whether the knot should be placed anteriorly or posteriorly because RCTs have not addressed this issue.

The main difference between the McDonald and Shirodkar techniques is that the Shirodkar requires cephalad dissection of the bladder and rectum off the cervix to facilitate placement of the suture as close as safely possible to the internal os (ie, as high as possible). Although surgical dissection with the Shirodkar techniques theoretically allows higher suture placement, this has not been conclusively demonstrated. The McDonald technique also recommended placing the suture as high as possible to approximate the level of the internal os.7 With proper technique the McDonald suture can be placed close to the internal os52 (Figure 3). The dissection and longer operating time for suture placement (and later removal) of the Shirodkar cerclage could theoretically cause more complications than the McDonald technique, but this again has not been evaluated in an RCT.

Considering only history-indicated cerclages, several series have shown sim-
The suture is usually tied anteriorly, tight enough to admit a fingertip at the external os but closed at the internal os. Successive knots are placed (we usually place at least 5), and the ends are left long enough (eg, 2 cm) to facilitate later removal.50

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The sutures utilized, including human fascia lata,1 such as Mersilene,2 silk, Prolene, Tevdek, and metal wire as well as Mersilene tape and others.1,2,5,7,19,30,65 Today the most commonly used are Mersilene 5 mm tape (Thicron RS-21 or D-8113; Ethicon Inc, Somerville, NJ)5,7,30,65 and large-caliber nonabsorbable monofilament (eg, Prolene, Ethicon, Inc).19

In women undergoing history-indicated cerclage, there are no specific data to suggest the best suture. The largest RCT ever reported, and which showed a benefit in women with 3 or more second-trimester losses or PTBs, used Mersilene tape.5

In women receiving ultrasound-indicated McDonald cerclage, Mersilene tape was associated with similar rates of PTB (24% vs 35%, respectively; P = .24) compared with polyester-braided thread (Mersilene or Ethibond) in a secondary analysis of a RCT that included women with singleton gestations, prior PTB 16–33 6/7 weeks, and CL less than 25 mm between 16 and 22 6/7 weeks.10 Most patients included in RCTs analyzed in metaanalyses that showed benefit from cerclage in singleton gestations with prior PTB and short CL less than 25 mm used Mersilene tape.14,66

Considering women with physical examination–indicated McDonald cerclage, 1 retrospective study compared Mersilene tape, Tevdek, and Prolene.67 The rates of PTB were similar in the 3 groups.67 Another small retrospective study found braided suture to be associated with decreased rates of PTB less than 28 weeks and improved neonatal survival compared with Mersilene tape.68 In a small study that used mixed history- and physical examination–indicated McDonald cerclage, gestational age at delivery and latency were similar in women who received Mersilene tape vs those who received Prolene.69

Some surgeons lubricate the Mersilene tape with either gel or Betadine for easier threading through cervical tissue, but this measure has not been evaluated in any study. There are also no data to make a recommendation regarding the numbers of knots or the placement of the knot anterior vs posterior.

In summary, in the absence of data suggesting the superiority of one suture type, the choice of suture should be in-

ular efficacy of McDonald compared with Shirodkar cerclage.53,54 In women undergoing history–indicated cerclages, a simpler Shirodkar technique, requiring only anterior fornix dissection, was associated with similar incidence of PTB compared with traditional Shirodkar in a quasi-RCT.55 Given equivalent success rates and easier insertion and removal of the McDonald cerclage, investigators have favored McDonald cerclage.53

Several investigators have compared the efficacy of McDonald vs Shirodkar cerclage in cohorts with different cerclage indications, limiting the interpretation and external validity of the results. In women receiving either history- or physical examination–indicated cerclage, several series have shown similar efficacy in preventing PTB of the McDonald compared with the Shirodkar cerclage.53,56-60 Increased incidence of cesarean section for cervical dystocia was noted with the Shirodkar technique in one series.60 In women receiving either ultrasound- or physical examination–indicated cerclage, outcomes were similar for the McDonald and Shirodkar techniques.61 Given equivalent success rates and easier insertion and removal of the McDonald cerclage, many obstetricians have favored the McDonald cerclage.53,56-60

In a patient-level metaanalysis of 4 RCTs analyzing only ultrasound-indicated cerclage for short CL in singleton gestations, the rates of PTB were similar for McDonald vs Shirodkar techniques.52 It should be noted that the 3 randomized trials that used the McDonald cerclage used a short CL <25 mm (mean, 17 mm) as inclusion criteria,19,30,46 whereas the one trial using Shirodkar used a short CL ≤15 mm (mean, 10 mm) as inclusion criteria.31 A regression analysis controlling for CL and other baseline characteristics confirmed no differences in the incidences of PTB less than 35, less than 32, and less than 28 weeks between the 2 techniques.62 A small retrospective review found a decreased incidence of PTB less than 32 weeks (other rates of PTB were not reported) in their adjusted analysis with Shirodkar compared with the McDonald cerclage.63

Analyzing only physical examination–indicated cerclages done for manually detected cervical dilation (usually of ≥1 cm), the rates of PTB were similar for McDonald vs Shirodkar techniques.53,64 Randomized trials7,14,30,65 and a metaanalysis10 of selected trials that confirmed ultrasound-indicated cerclage efficacy for the prevention of PTB reported data mostly on pregnancies in which the McDonald cerclage was utilized. In the RCT in which the Shirodkar ultrasound-indicated cerclage was used, cerclage was not found to be efficacious.51

In summary, given these data, the McDonald technique is preferred over Shirodkar because of its easier placement and removal, and its proven comparative effectiveness.5,7,14,30,65,66 (recommendation B; level: moderate; Table 3).

**Suture**

We could identify no randomized trials specifically comparing different types of cerclage suture. Several types of materials have been utilized, including human fascia lata,4 sutures such as Mersilene,7 silk, Prolene, Tevdek, and metal wire as well as Mersilene tape and others.1,2,5,7,19,30,65 Today the most commonly used are Mersilene 5 mm tape (Thicron RS-21 or D-8113; Ethicon Inc, Somerville, NJ)5,7,30,65 and large-caliber nonabsorbable monofilament (eg, Prolene, Ethicon, Inc).19

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Some surgeons lubricate the Mersilene tape with either gel or Betadine for easier threading through cervical tissue, but this measure has not been evaluated in any study. There are also no data to make a recommendation regarding the numbers of knots or the placement of the knot anterior vs posterior.

In summary, in the absence of data suggesting the superiority of one suture type, the choice of suture should be in-

**FIGURE 3**

McDonald cerclage

The suture is usually tied anteriorly, tight enough to admit a fingertip at the external os but closed at the internal os. Successive knots are placed (we usually place at least 5), and the ends are left long enough (eg, 2 cm) to facilitate later removal.50

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vestigated further and currently left to the operators’ preference (recommendation I; level: moderate; Table 3).

Needle
We could locate no specific randomized trial comparing different types of needles for cerclage. Shirodkar first described the use of an aneurism needle for cerclage, to pass through the cervical stroma at 3 and 9 o’clock inferior to the bladder and rectal reflections dissected off the cervix. No controlled study has compared this option with other types of needles, such as Mayo, etc. There is no study comparing blunt vs sharp vs cutting needles.

In summary, there are insufficient data to make any recommendation regarding the safest and most effective needle to use at the time of cerclage (recommendation I; level: low; Table 3).

Cerclage height
The distance from cerclage to external os, as measured by TVU, is termed cerclage height. We were unable to identify a specific randomized trial comparing different cerclage heights for cerclage. Because one of the goals of cerclage is to reconstitute a closed endocervical canal, both Shirodkar and McDonald techniques described placing the suture as high as possible to approximate the level of the internal os. Unless the surgeon takes special care at this step of the procedure, most McDonald and even (importantly) most Shirodkar cerclages are placed in the middle third of the endocervical canal. Although the Shirodkar technique might have a theoretical advantage in creating a larger cervical height, a retrospective study found no difference in cerclage height 2 weeks after either the McDonald or Shirodkar procedure. Patient selection may have explained this lack of difference (ie, women with a shorter presurgery cervix may have been more likely to undergo Shirodkar). Thus, selection bias could explain the null finding.

Several retrospective studies of history-indicated cerclage suggested that placing the stitch close to the internal os would result in better outcomes. It is notable that cerclage increases cervical length in both the history-indicated and ultrasound-indicated cerclage. In a recent study, the incidence of PTB less than 35 weeks was 24% if the history-indicated cerclage height was less than 10 mm, 17% if 10-19 mm, and 10% if 20 mm or greater. It is interesting to note that a transabdominal cerclage, in which the stitch is placed at the anatomic internal os, is associated with effective pregnancy prolongation, even in women at the highest risk for PTB.

Most studies of ultrasound-indicated cerclage suggest that placing the suture close to the internal os, or as high as possible, is associated with a lower risk of PTB compared with placement in the middle or lower third of the cervix. A cerclage height of 18 mm or greater was associated with a lower incidence of PTB (4%) compared with placement less than 18 mm (33%). The adjusted odds ratio was 0.10. Instead, in a study of 74 women who underwent ultrasound-indicated cerclage, the cerclage height demonstrated considerable variability and minimal correlation with gestational age at delivery.

In physical examination–indicated cerclage, a cervical height of less than 10 mm was also associated with the highest rates of PTB, and the recommendation was to place the stitch near the internal os to allow full restoration of the state of the cervix.

In summary, retrospective controlled data confirm the original recommendation of Shirodkar and McDonald: try to place the stitch as high as possible, close to the internal os, hopefully attaining a cerclage height of more than 2 cm because this technical detail is associated with better prevention of PTB compared with placing the stitch lower along the cervical canal (recommendation B; level: moderate; Table 3).

Number of cerclage stitches
As a modification of the McDonald method, some investigators have advocated placing an additional stitch (total of 2). Originally a second stitch was placed to support the first suture and prevent its displacement. More recently an additional goal is to place the second suture above the first, closer to the internal os if anatomically feasible. One RCT and 3 retrospective studies evaluated the efficacy of cerclage with either placement of 2 or 1 stitch. The randomized trial included only history-indicated cerclages. The incidence of PTB less than 34 weeks was lower with 2 stitches (12%) compared with the group with 1 stitch (41%), but this was not statistically significant. Moreover, the incidence of PTB was unusually high in the 1-stitch group, according to the authors. Cervical length was significantly longer after 2 compared with after 1 stitch. The 1-stitch technique did not recommend placing the suture as high as possible but instead aimed to place it in the middle third of the cervix. The 2-stitch technique included placing 1 suture in the lower and 1 in the upper third of the cervix.

In the first of 3 retrospective studies identified, patients with both history- and ultrasound-indicated, and who underwent both McDonald and Shirodkar cerclages, were included and reported together, limiting the external validity in any of these 4 groups. The type of suture used was also not reported. There was no statistically significant difference in PTB outcomes and complications in women who received 2 vs 1 stitch. In the second retrospective study, women with history-, ultrasound-, and physical examination–indicated cerclages were analyzed together. The incidence of PTB less than 35 weeks was similar in the 2- (48%) vs 1-stitch (41%) groups. Interestingly, cerclage height was also higher in the 2- vs 1-stitch groups. In the third and most recent retrospective study, by far the largest (n = 444 cerclages), history- and ultrasound-indicated cerclages were analyzed separately. PTB less than 37 weeks was not significantly different between the 2- and 1-stitch groups for both the history-indicated group (39% vs 35%, adjusted odds ratio [aOR], 1.38; 95% confidence interval [CI], 0.64–3.01) and the ultrasound-indicated group (44% vs 49%; aOR, 0.66; 95% CI, 0.27–1.61), even after adjusting for demographic differences and suture type.
Placing a second stitch at the external os, aiming to keep the mucus plug in place, has been termed cervical occlusion. A recent RCT showed no additional benefit from this second cervical occlusion stitch compared to just one stitch. 82

In summary, placing one stitch, as originally described, appears sufficient, especially if well placed (as high as possible). It does not appear that placing a second stitch is beneficial compared with placing just one stitch for cerclage. We suggest placing a second stitch at the time of initial cerclage only if the initial stitch is observed to be too low on the cervix, and gentle pulling on this first stitch may allow placing a second stitch much closer to the internal os, at least 2 cm above the external os (recommendation B; level: moderate; Table 3).

Management of membrane prolapse and/or advanced cervical dilatation

We could find no RCT to assess the comparative effectiveness of techniques aimed at reducing membrane prolapse and allow placement of cerclage. Several technical suggestions have been described. 83 Trendelenburg can be used to harness the effect of gravity. Iatrogenic bladder filling can also assist membrane replacement. For example, infusion of 500 mL of saline in the bladder helps retract the membranes but also elevates the cervix in the vaginal canal, which requires significant deep exposure to accomplish cerclage. A moist sponge on ring forceps or a 16-French Foley balloon (with tip cut) have been used successfully to replace membranes mechanically. 83

Amniocentesis can also be used to reduce membrane prolapse and facilitate physical examination–indicated cerclage. 84-87 The amount of fluid removed is usually about 150-250 mL. 86,87 The only study with controls who did not receive amniocentesis demonstrated a 90 day longer interval to delivery in the amniocentesis group. 87 Stay suture around the cervix around the Foley to then be described,86 using stay silk sutures to pull the cervix with traction have also been described.86 It does not appear that placing a second stitch is beneficial compared with just one stitch.82

Trendelenburg can be used to reduce membrane prolapse and allow placement of cerclage and allow observation of cervix in these women (recommendation I; level: low; Table 3).

Postoperative care

Outpatient vs inpatient cerclage

The length of hospitalization for the placement of cerclage has been evaluated in a few studies, including an RCT.

For history–indicated cerclages, there was no benefit from continued hospitalization for 48 hours as compared with same–day discharge 2-4 hours after the procedure in a retrospective study. 90

The only RCT identified comparing outpatient (discharge after 3–5 hours) vs inpatient (for 3 days) cerclage included history–indicated, ultrasound–indicated, and physical examination–indicated procedures. 91 Incidence of PTB and complications was similar, and the authors concluded that outpatient cerclage was preferable and associated with cost savings and less time away from home for patients. 91

For physical examination–indicated cerclages, McDonald had originally suggested 5 days of hospitalization. 2 Outpatient procedures, with discharge after 2-4 hours and “advice to take it easy for 48 hours,” was associated with similar outcomes compared with inpatient stay in a retrospective study. 92

In summary, given the lack of evidence for the benefit of hospitalization, it appears that cerclage can be safely performed in the outpatient setting (ie, discharge the same day of the procedure). In women with cervical changes at higher risk for infection and PTB, especially if after 20 weeks, a brief 24 hour postoperative stay might be considered for observation (recommendation B; level: moderate; Table 3).

Activity restriction

We could locate no controlled study of postcerclage activity restriction. Both Drs Shirodkar (a “fortnight”) and McDonald (3 to 7 days) suggested bed rest after their physical examination–indicated cerclages. 1,2 There is evidence that decreased activity such as bed rest, inpatient (as just described) or outpatient, does not prevent PTB. 93 There is level I evidence that prophylactic bed rest increases PTB in twin gestations. 94 Women placed on decreased activity should be advised there is no proven benefit associated with this intervention and there are potential life-threatening risks such as thromboembolism. Although historically vaginal intercourse was restricted after cerclage placement, there are no data to support this recommendation.

In summary, there is insufficient evidence to recommend any type of activity restriction after cerclage placement (recommendation I; level: low; Table 3).

Reinforcing (repeat) cerclage and cerclage revision

Reinforcing cerclage, defined as a cerclage placed in a woman with a preexisting cerclage, has not been evaluated by an RCT. TVU CL after cerclage predicts the incidence of PTB. 74-76 However, no intervention has been shown to prevent PTB if the CL shortens further after cerclage. In women with a history–indicated cerclage who develop a short TVU CL less than 25 mm at 14–23 6/7 weeks, reinforcing (second or repeat) cerclage is associated with a higher incidence of PTB. 95 There is insufficient (no) evidence to recommend the placement of a second cerclage should the original one become displaced (cerclage revision).

In summary, there is insufficient evidence to recommend the placement of a reinforcing cerclage. Based on limited data that show harm, 95 we do not advocate reinforcing cerclage (recommendation D; level: low; Table 3).

Conclusion

More than 60 years after the first cerclage in pregnancy was performed, 1,2 there still are not any grade A recommendations or any level of certainty high evidence as to how the procedure should be...
optimally performed (Table 3). In fact, for certain aspects, such as intraoperative vaginal cleansing preparations, we could not locate any controlled data evaluating their effectiveness.

This lack of evidence guiding any evidence-based methods for performing a cerclage may have been at least partly related to the fact that for decades there was insufficient level 1 evidence supporting the effectiveness of cerclage itself, regardless of indication. In the last 20 years, though, randomized trials have reported a reduction in PTB for history–indicated cerclage (at least in women with ≥3 prior preterm births or second-trimester losses), for ultrasound–indicated cerclage (for singleton gestations with prior PTB and short TVU CL <25 mm before 24 weeks), and for physical examination–indicated cerclage. Now that we have accumulated the evidence of efficacy in selected populations, randomized trials should assess the related aspects of perioperative care to optimize the clinical result.

In general, proper surgical technique, proven to be associated with the fewest complications from the general surgical literature, can be hypothesized to be associated with lower morbidity also with cerclage. Obstetricians should adhere to the best universal surgical techniques to decrease adhesions, minimize tissue trauma, and avoid ischemia and inflammation.

Table 3 summarizes the evidence for pre-, intra-, and selected postoperative management aspects of cerclage. As feasible, the evidence has been summarized separately for history-, ultrasound-, and physical examination–indicated cerclage. Although there are no grade A recommendations, grade B include the following: (1) performing a fetal ultrasound before the cerclage to ensure fetal viability, confirm gestational age, and assess fetal anatomy to rule out clinically significant structural abnormalities; (2) administering spinal, and not general, anesthesia; (3) performing a McDonald cerclage, with 1 stitch, placed as high as possible; and (4) the use of an outpatient (same-day surgery) setting. Unfortunately, no other recommendations can be made regarding the other technical aspects of cerclage (Table 3).

REFERENCES


