Thieme

Laparoscopic Transabdominal Needle-free Emergency Cerclage in the Early Second Trimester of Pregnancy after Failed Transvaginal Cerclage: Two Case Reports and a Review of the Literature

Laparoskopische transabdominale nadelfreie Notfallcerclage im frühen 2. Trimenon bei fehlgeschlagener transvaginaler Cerclageeinlage: 2 Fallberichte mit Literaturübersicht

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ABSTRACT

Purpose

The aim of the study was to describe the preventive option and safety of laparoscopic transabdominal emergency cerclage in pregnant women with advanced cervical shortening after failed vaginal cerclage or in whom vaginal cerclage is no longer possible.

Method

Laparoscopic isthmo-cervical emergency cerclage was carried out in two patients at 13 + 0 and 15 + 5 weeks of gestation (GW) respectively. Both patients had cervical shortening and it was no longer possible to expose the cervix after conization or re-conization. The attempts to carry out transvaginal cerclage were unsuccessful. The technical aspects, feasibility, safety, and pregnancy outcomes after laparoscopic transabdominal cerclage are presented here, based on two case reports.

Results

The cerclages were placed after blunt dissection of the uterine vessels and careful introduction of a KELLY forceps through the avascular space between the ascending and

descending branches of the uterine vessels without using a needle. The operating times were 93 and 134 minutes (min), respectively. The estimated blood loss during the procedure was less than 50 ml and neither perioperative nor postoperative complications occurred. The subsequent course of both pregnancies was uneventful and fetal development in both cases was normal. In the first case, the baby was delivered by secondary cesarean section following premature rupture of membranes in week 35 + 4 of gestation. The baby had a birthweight of 2786 g, APGAR scores of 8/9/10 and an umbilical cord arterial pH of 7.36. In the second case, delivery was by primary cesarean section in week 39 + 5 of gestation. The infant had a birth weight of 4160 g, APGAR scores of 5/9/10 and an umbilical cord arterial pH of 7.20.

Conclusion

Laparoscopic transabdominal cerclage is a safe and effective treatment option, even early in the second trimester of pregnancy, for patients in whom transvaginal cerclage is no longer possible due to anatomical factors. The method is technically very feasible and is associated with positive obstetric outcomes. The overall risk of perioperative complications is within acceptable limits.

ZUSAMMENFASSUNG

Ziele

Präsentation der präventiven Möglichkeit und Sicherheit einer laparoskopischen transabdominalen Notfallcerclage bei Schwangeren mit fortgeschrittener Zervixverkürzung, wenn eine vaginale Cerclage fehlgeschlagen oder nicht mehr möglich ist.

Methode

Bei 2 Patientinnen mit 13 + 0 bzw. 15 + 5 Schwangerschaftswochen (SSW) wurde bei einer Muttermundverkürzung und nicht mehr fassbaren Portio nach Konisation bzw. Re-Konisation nach einem erfolglosen Versuch der transvaginalen Cerclage eine laparoskopische, isthmozervikale Notfallcerclage durchgeführt. Anhand von 2 Fallberichten werden die Aspekte der Technik, Durchführbarkeit, Sicherheit und des Schwangerschaftsoutcomes dargestellt.

Ergebnisse

Die Cerclagen wurden nach stumpfer Freipräparation der uterinen Gefäße und der vorsichtigen Einführung einer KELLY-Fasszange durch den avaskulären Raum zwischen den aufsteigenden und absteigenden Ästen der uterinen Gefäße ohne Verwendung einer Nadel durchgeführt. Die Operationszeit betrug 93 und 134 Minuten (min). Der geschätzte Blutverlust während der Eingriffe lag bei weniger als 50 ml, und es traten weder peri- noch postoperative Komplikationen auf. Beide Schwangerschaften verliefen im Anschluss unauffällig bei zeitgerechter Kindsentwicklung beider Kinder. Im 1. Fall erfolgte die Entbindung nach vorzeitigem Blasensprung per sekundärer Sectio caesarea in 35 + 4 SSW mit einem Gewicht von 2786 g, APGAR 8/9/10 und NA-pH: 7,36. Im 2. Fall erfolgte die Geburt per primärer Sectio in 39 + 5 SSW mit einem Gewicht von 4160 g, APGAR 5/9/10 und NA-pH: 7,20.

Schlussfolgerung

Die laparoskopische transabdominale Cerclage stellt auch im frühen 2. Trimenon eine sichere und effektive Behandlungsoption für Patientinnen dar, bei denen eine transvaginale Cerclage aufgrund von anatomischen Gegebenheiten nicht mehr möglich ist. Diese Methode ist technisch gut durchführbar und kann zu positiven geburtshilflichen Ergebnissen führen, bei insgesamt akzeptablem Risiko für perioperative Komplikationen.

Introduction

Cervical cerclage is used to treat cervical insufficiency and to prevent miscarriages and preterm births in the second trimester of pregnancy. The indication for cerclage is based on cervical insufficiency, which is diagnosed using the following criteria: one or more previous miscarriages in the second trimester of pregnancy; occurrence of painless cervical dilation without contractions; and sonographic confirmation of a cervical length of < 25 mm before week 24 + 0 of gestation (GW) in patients who had a previous miscarriage or late term spontaneous abortion before the 34 th GW [1, 2, 3]. Vaginal cervical cerclage is an established method to treat cervical insufficiency. A purse-string stitch (using non-resorbable sutures) is placed around the cervix and securely tied for cervical cerclage [4]. To create an additional barrier against ascending microorganisms, Erich Saling has described a total cervical occlusion procedure. After de-epithelialization of the cervix, it is closed using a running suture with resorbable sutures [5, 6]. Different vaginal cerclage (VC) techniques were developed over the last five decades. They include purse-string sutures placed as high as possible at the cervicovaginal transition, as described by McDonald, and Shirodkar's technique, in which the cerclage is placed as close as possible to the inner cervix after the bladder neck is dissected from the cervix [2, 7]. Non-resorbable sutures (either polyfilament [Mersilene tape, Ethibond] or monofilament [Prolene]) are used and are removed prior to delivery of the infant. Removal is done electively at between weeks 36–37 of gestation if the aim is to have a spontaneous vaginal birth or during cesarean section.

Transabdominal cerclage is an alternative approach used in complex cases where vaginal cerclage has no prospects of success or vaginal placement is no longer possible due to extreme cervical shortening (e.g., after conizations or previous cervical surgery) or the anatomical condition of the cervix [7, 8, 9]. Bension already described an abdominal cerclage procedure as an alternative approach in 1965 [10]. The first minimally invasive methods used to place a cerclage were experimental procedures described in 1998 by Lesser et al. and Scibetta et al. [11, 12]. Studies report that laparoscopic transabdominal cervical cerclage (LTC) has similar success rates (85–90 %), better pregnancy outcomes and a lower risk of infection compared to vaginal cerclage [13]. The data demonstrate the feasibility and success rates of laparoscopic transabdominal cerclage [7, 8, 10, 14, 15, 16, 17, 18, 19].

We present two case studies here, in whom cerclage placement early in the second trimester was necessary due to cervical shortening. As a transvaginal cerclage was no longer possible due to prior conizations which almost obliterated the exocervix, laparoscopic transabdominal emergency cerclage was carried out instead.

The focus of this article is to highlight the feasibility and the protective effect of laparoscopic transabdominal cerclage early in the second trimester of pregnancy, especially in cases for whom vaginal cerclage is not possible.

Method

The technical aspects, feasibility, safety, and pregnancy outcomes of laparoscopic transabdominal isthmo-cervical emergency cerclage in the early second trimester of pregnancy are discussed here.

Two patients presented to our university hospital to plan how to protect their pregnancies. Prenatal screening had identified cervical shortening in both cases due to conization with preterm birth and re-conization. The first patient was in week 13 + 0 of gestation; the transvaginal cervix could not be exposed, resulting in a primary indication for emergency laparoscopic cerclage. The second patient was in week 15 + 4 of her pregnancy but planned placement of a transvaginal cerclage could not be carried out because it was not possible to expose the transvaginal cervix intraoperatively. Both patients underwent needle-free transabdominal laparoscopic isthmo-cervical emergency cerclage without the use of a manipulator at 13 + 0 and 15 + 5 weeks of gestation, respectively. The written consent of both patients was obtained. Ethical approval was not required for this publication.

To exclude malformations, the patients underwent extended sonographic screening preoperatively. Endocervical smear tests for chlamydia and mycoplasma and vaginal smear tests for pathogens were carried out prior to surgery to ensure that the patients had no infections.

Case I

A 32-year-old patient (gravida 8, para 3) who had had two previous spontaneous births and one secondary cesarean section for amnion infection syndrome in week 24 + 3 of gestation due to preterm rupture of membranes (PROM) in 23 + 0 GW presented to our department in week 13 + 0 of gestation with a cervical length of 2 cm measured on sonography. The patient's prior history included two healthy children and a preterm infant who died from respiratory distress syndrome. The patient had also had four early spontaneous abortions followed by curettage and conization two years previously for cervical dysplasia. Known comorbidities included antiphospholipid syndrome, protein Z deficiency and hypothyroidism. Her body mass index (BMI) was 22.3.

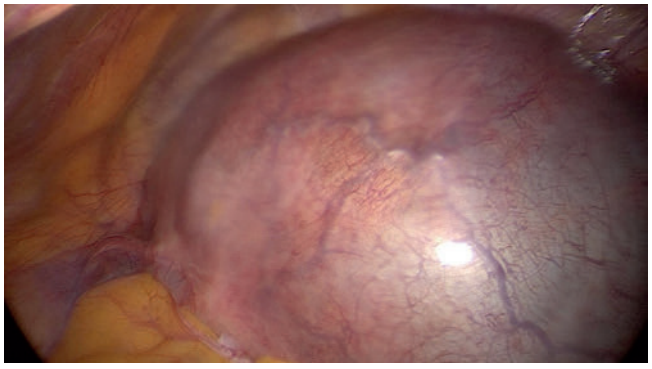
The patient had a sonographic cervical length of 2 cm; the cervix could not be identified transvaginally following previous conization, making it impossible to place a vaginal cerclage. Laparoscopic isthmo-cervical emergency cerclage was indicated in week 13 + 0 of gestation after the patient had been provided with information and advised.

Case II

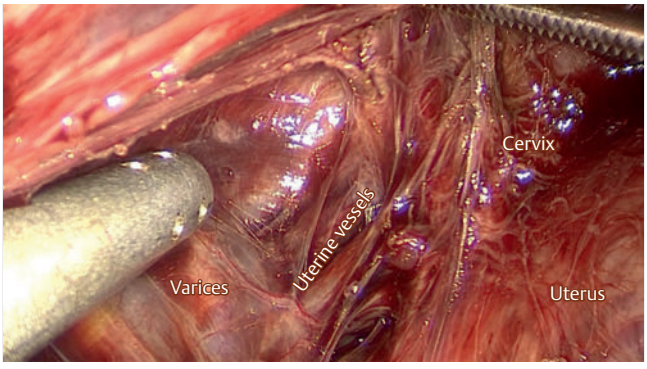
Vaginal cerclage was indicated in week 15 + 5 of gestation in a 35-year-old patient (gravida 1, para 0) who had previously had 3 × conizations (two of them nine years previously, and one three years previously) and a sonographic cervical length of 2.4 cm. In this case, intraoperative speculum examination was unable to identify the (remnant of the) cervix, which made it impossible to carry out a vaginal procedure. Laparoscopic isthmo-cervical cerclage was therefore indicated. The patient had a body mass index (BMI) of 31.1. She had no known relevant pre-existing conditions.

Surgical Technique

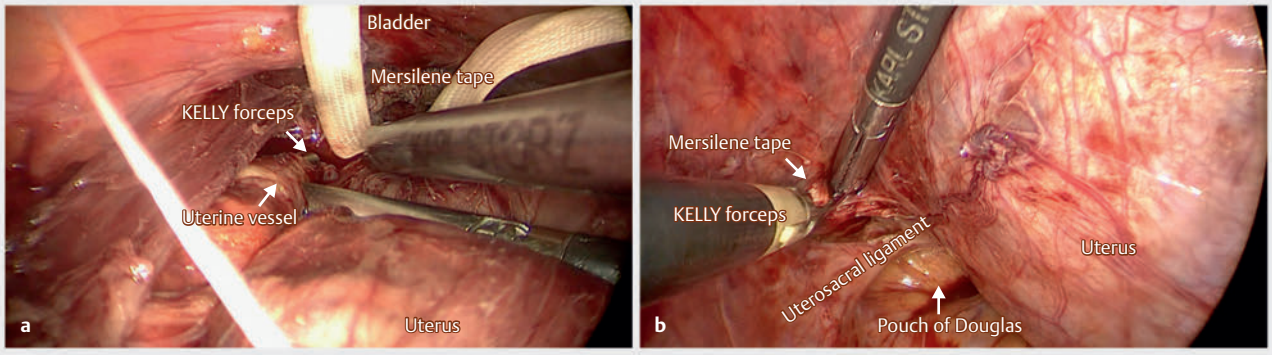
Laparoscopic transabdominal cerclage (LTC) procedures were carried out under general anesthesia with the patients in a lithotomy position. A size 14 Foley bladder catheter was inserted into the bladder under sterile conditions. Laparoscopic access was via the Palmer point (left subcostal). After insertion of a Verres needle (closed technique), CO_2 was insufflated until a pressure of 12 mmHg was achieved. The intervention was carried out using a 5 mm 30° optical trocar. Three working trocars (inserted in the lower abdomen [5 mm] laterally on the left and right and above the symphysis [12 mm]) were introduced under direct vision. The uterovesical peritoneum was opened using bipolar coagulation scissors. The bladder was carefully dissected from the uterine isthmus and pushed aside. This was followed by preparation and exposure of the uterine vessels. In the second case, the uterus was soft, corresponding to the more advanced week of gestation in this patient, and sufficiently enlarged up to the level of the navel (see ▶ **Fig. 1**). No uterus manipulator was used. An Endo Paddle Retract (Covidien) was used to push the uterus aside as required for the procedure. The uterine vessels were carefully prepared and exposed from the ventral and dorsal side (see ▶ **Fig. 2**). A KELLY forceps (Storz, Germany) was then carefully inserted from dorsal to ventral through the avascular space between the ascending and descending branches of the uterine vessels in the paracervical region (see ▶ **Fig. 3a**). A KELLY forceps was then used to pull the 5 mm Mersilene tape (Ethicon, Somerville, NJ, USA) in an anteroposterior direction between the uterine vessels and the isthmocervical transition (see ▶ **Fig. 3b**). On the right side of the uterus the tape was pulled in a posteroanterior direction using a KELLY forceps. After correct positioning of the tape about 1 cm above the uterosacral ligaments, the tape was tied ventrally below the



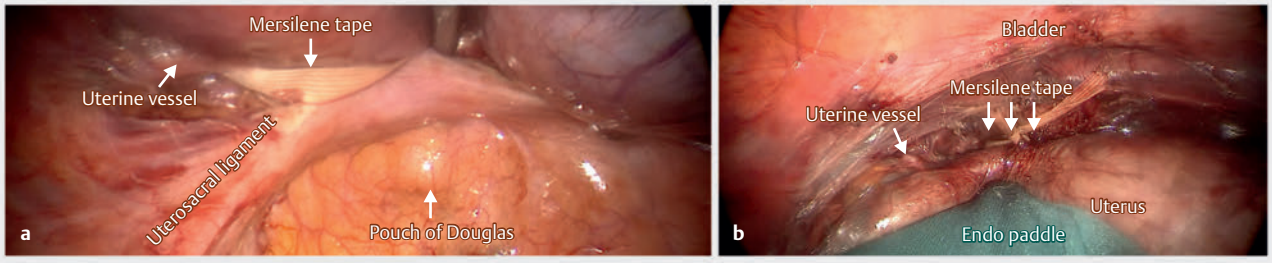
▶ **Fig. 1** View of the pregnant uterus in week 15 + 5 of gestation.



▶ **Fig. 2** Intraoperative view after dissection and exposure of the uterine vessels.



▶ **Fig. 3** Intraoperative view during placement of the tape around the cervix: **a** ventral view, **b** dorsal view.



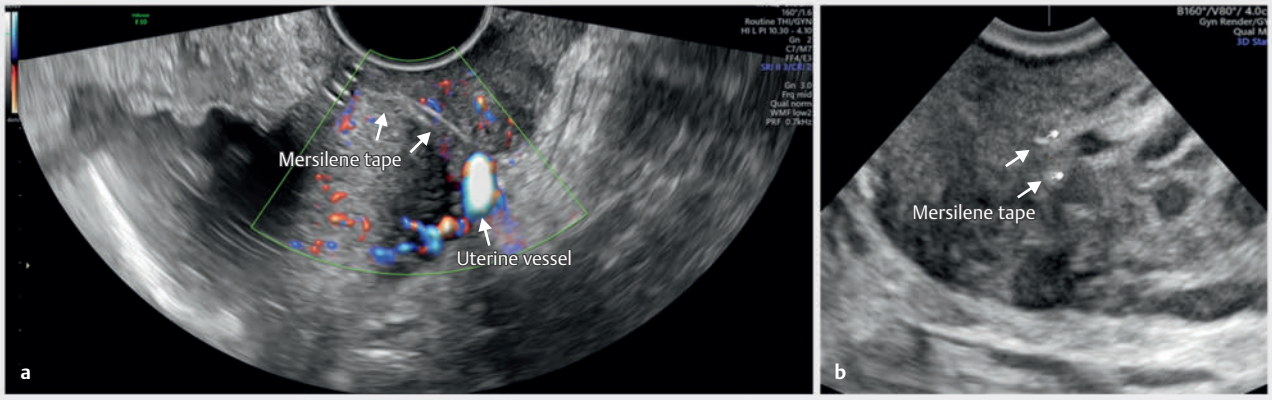
▶ **Fig. 4** Intraoperative view after placement of the cerclage tape: **a** dorsal view before the tape was tied, **b** ventral view after the tape was tied.

ascending uterine vessels at the isthmo-cervical transition (see ▶ **Fig. 4a** and **b**). The uterovesical peritoneum was not closed. The bladder catheter was removed at the end of the operation. Neither of the patients received tocolytics during the procedure or immediately afterwards. Both patients received a single perioperative prophylactic dose of antibiotics consisting of cefuroxim 1.5 g administered intravenously. Sonography was carried out postoperatively to check fetal vitality and correct positioning of the tape (see ▶ **Fig. 5**). The patients were subsequently monitored in hospital for one or two days. They were discharged home in good health with intact pregnancies.

Results

Case I

Adhesions between the bladder and the uterus were found intraoperatively as the patient was status post-cesarean delivery; the adhesions were dissected. Placement of the cerclage was successful. The operating time was 93 min (blood loss approx. 45 ml) and



▶ **Fig. 5** Postoperative transvaginal control sonography **a, b** ultrasound and Doppler sonography imaging of the uterine vessels and the tape.

the cerclage had a stabilizing effect. The postoperative course was uncomplicated and the control sonography and CTG examinations were unremarkable. The patient was discharged home in a good general condition on the second postoperative day and was followed up as an outpatient. The further course of the pregnancy was uneventful and without complications but ended in week 36 of gestation. The patient was delivered in another hospital by secondary repeat cesarean section due to premature rupture of membranes. A salpingectomy was carried out as the patient did not wish to have more children and the Mersilene tape was removed. The female neonate weighed 2786 g and her APGAR scores were 8/9/10. Blood gas analysis showed an umbilical cord arterial pH of 7.36. Both mother and child were healthy when they were discharged home from hospital.

Case II

Extended adhesions between the bowel, adnexa, uterus and pelvis were found intraoperatively. The adhesions were dissected and placement of the cerclage was successful. The operating time was 134 min. The estimated blood loss was 40 ml. The postoperative course was uncomplicated and the patient was discharged home in a good general condition on the first postoperative day and followed up as an outpatient. After successful cerclage placement, the further course of the pregnancy was without complications. The patient was delivered by primary cesarean section in week 39 + 5 of gestation. The Mersilene tape was removed intraoperatively. The male neonate weighed 4160 g and his APGAR scores were 5/9/10. Blood gas analysis showed an umbilical cord arterial pH of 7.20. Both mother and child were healthy when they were discharged home from hospital.

Discussion

This study presents the outcomes of two patients who underwent laparoscopic isthmo-cervical emergency cerclage for cervical insufficiency in week 13 + 0 and week 15 + 5 of gestation, respectively. In both patients, the cervix could no longer be exposed vaginally due to previous conizations. Surgical protection of the pregnancy required transabdominal cerclage placement.

In a large case series of 101 participants, Lotgering et al. were able to demonstrate the protective effect of transabdominal isthmo-cervical cerclage in women with cervical insufficiency in whom transvaginal cerclage was not possible. The mean gestational age was 14 weeks of gestation for elective cerclage and 18 GW for emergency cerclage. Perioperative complications included heavy bleeding (n = 3), premature iatrogenic rupture of membranes (n = 2) and bladder injury (n = 1). Without cerclage placement, a preterm birth before week 32 of gestation occurred in 76 % of cases and the survival rate was 27.5 %. After cerclage placement, the preterm birth rate was 7 % and the survival rate increased to 93.5 %. The patients were monitored as inpatients for an average of 5 days [20]. As the expertise in minimally invasive surgical techniques continues to improve, laparoscopic transabdominal cerclage has prevailed as the preferred method compared to a laparotomy approach [7, 9, 18]. The laparoscopic approach is characterized by low complication rates including fewer cases with perioperative bleeding and a lower risk of iatrogenic rupture of membranes and miscarriage [18]. The advantages associated with a laparoscopic approach include not having to carry out large abdominal incisions, shorter hospital stays, faster recovery times and better aesthetic results [7, 9].

Carrying out LTC in an advanced stage of pregnancy is a greater surgical challenge. The limited visibility due to the enlarged uterus and the difficult of manipulating a soft pregnant uterus amply supplied with blood make the procedure considerably more difficult. For this reason, most LTC procedures reported in the literature are carried out prior to conception or in the early weeks of pregnancy [7, 9, 14, 21]. Saridogan et al. reported on 54 patients with prior conization who had LTC prior to conception. Of the 37 subsequent pregnancies, 92 % (34 births) were successful, with no significant intraoperative or postoperative complications reported [7]. In a retrospective case series by Burger et al., complications such as uterine perforations or pelvic infection occurred in 3 of 66 cases who had LTC prior to conception. Of the 52 patients who were followed up, 69.2 % became pregnant, and 77.1 % of the 35 preg-

nancies which were fully followed up ended in the third trimester. The overall fetal survival rate was 77.1 %; the rate for the surviving pregnancies was 90.0 % [21].

In addition to reports on LTCs carried out prior to conception, there are numerous publications on LTC procedures carried out during pregnancy [2, 7, 8, 15, 17, 18, 22, 23]. The data clearly show the safety and effectiveness of LTC in preventing late miscarriage and preterm births in women with cervical insufficiency or women who previously had unsuccessful transvaginal cerclage [8, 9, 14, 15, 19, 23, 24, 25, 26].

A study by Whittle et al. included 65 patients and had a high rate of perioperative complications. In 13 cases, it was necessary to switch to laparotomy because of bleeding from the uterine vessels (n = 5) or limited visibility (n = 2). There were two cases of perioperative miscarriage. Six pregnancies ended in the second trimester due to acute or subacute chorioamnionitis followed by late spontaneous abortion. Despite the high rate of perioperative complications and miscarriages, the neonatal survival rate was 89 %, and the mean duration of pregnancy until delivery was 35.8 ± 2.9 weeks of gestation [9]. The intraoperative use of a needle to place the cerclage as reported in the study by Whittle et al. could be one factor which might explain the higher rate of complications. In contrast to their findings, other studies in which LTCs were carried out prior to conception or in the first trimester showed significantly lower or no perioperative complications [7, 8, 14, 15].

In their study of 11 cases, Abdel Azim et al. showed that LTC can be carried out until week 12 + 3 of gestation without complications and without miscarriages until the second trimester of pregnancy. The mean operating time of 64 min is significantly shorter than that reported for our two cases, which could be ascribed to the LTC being carried out in the early weeks of gestation or prior to conception. A needle-free technique was also employed to minimize complications and the uterine vessels were completely dissected [14]. Ades et al. und Zhao et al. confirmed these positive results and reported on the feasibility of LTC in the first trimester with high fetal survival rates and no complications. Zhao et al., in particular, emphasized the benefits of needle-free LTC performed without a manipulator, reporting successful results for all (n = 10) investigated patients [15, 27]. Cho et al. showed the effectiveness of LTC in patients (n = 20) who had previously had miscarriages in the second trimester or in whom transvaginal cerclage had failed. Although one case resulted in an injury to the uterine vein, all other LTC procedures had no surgical or immediate postoperative complications [25]. Shin et al. also demonstrated the feasibility and protective effect of LTC, with an overall pregnancy survival rate of 90 %. Even though several spontaneous abortions occurred (n = 8; six spontaneous abortions in the first trimester due to fetal anomalies and two miscarriages in the second trimester), the duration of the pregnancies after LTC show that LTC can effectively reduce the risk of late miscarriage and preterm birth [23].

The retrospective study by Chung et al. presents the results of LTC in 299 patients including the neonatal outcomes. The procedure was generally carried out in week 12.5 of gestation with a mean operating time of 47.4 min and a mean intraoperative blood loss of 70.1 ml. LTC was performed largely free of complications and the fetal survival rate was 85.9 %. 80 % of preterm births occurred at a late stage between week 32 and week 37 of gestation. Postnatally, 23 neonates (13.1 %) needed to be transferred to neonatal intensive care but there were no long-term sequelae. The mean gestational age at delivery was 37 weeks and the mean birthweight was 2678 g. The cerclage tape was left in place during cesarean delivery, and 29 women went on to have a further successful pregnancy with the tape already in place [19]. The shorter operating times but higher blood loss in this study compared to those recorded for our cases could indicate that they used special needles and possibly manipulators to position the tape, although this is not clear from the available information. These results do not just show the safety and effectiveness of LTC as a preventive measure against repeated spontaneous loss of pregnancy but also the positive effects on neonatal outcomes, especially for patients in whom other cerclage methods have failed.

In the study by Kavallaris et al., laparoscopic emergency cerclage was generally carried out in week 14.4. of gestation (14.2–16 GW), and no perioperative or postoperative complications were reported. The average operating time was 88 min (80–95 min) and the estimated blood loss during the procedure was less than 100 ml. In contrast to our approach, they placed the cerclage tape under ultrasound monitoring using a tape needle. All of the women in their study were delivered after the 38 th GW by elective cesarean section and the perinatal survival rate was 100 % [8]. In our two cases, the mean operating time was 113.5 min (93–134 min), which is about 25 min longer than in the study by Kavallaris et al. In contrast to Kavallaris et al., we weighed up the risk of complications and decided against using a needle, opting instead for blunt dissection to place the tape. This definitely prolonged the operating times. In one of our patients, surgery was made even more complicated by the presence of extensive adhesions. With a blood loss of less than 50 ml, our estimated blood loss was significantly lower compared to the study by Kavallaris et al.

Bolla et al. demonstrated another technique with the successful use of the Goldfinger dissector (Ethicon Endo Surgery, Somerville, NJ, USA) to place a Mersilene tape in a mixed cohort of pregnant women and women who had not yet conceived. The procedure was carried out without complications and with minimal blood loss. The inclusion of different manipulators according to gestational age demonstrates an adaptive approach to minimize the risks [24].

Wolfe et al. described the options and challenges of robot-assisted cerclages, which were successfully carried out without immediate complications despite the longer operating times. But one of their patients had a uterine rupture, which highlights the potential risk of these interventions but also emphasizes the importance of LTC as a protective measure after conventional methods have failed [28].

In their study, Wang et al. presented an innovative method for transabdominal cervical cerclage in which the tape is placed laparoscopically and removed transvaginally. This technique combines the benefits of both approaches by reducing the risk of unnecessary cesarean sections or abdominal surgery in the event of a late miscarriage by providing the option of removing the cerclage knot. The procedure was carried out in 24 women, three of whom were pregnant. The mean operating time was 35.50 ± 11.23 min

and the procedure was carried out without complications and with a minimal blood loss of less than 30 ml. All of the pregnant patients delivered at or near term [13]. Despite the obvious benefits of this approach, there are some circumstances where this method is unsuitable, especially if (as was the case in our two patients) there is no visible residual cervix and the pregnancy is advanced. In such a situation, the risk of serious complications such as vascular injury or damage to the uterus can increase significantly. This underscores the need to select patients carefully and to assess risks on an individual basis before using this method.

Data are also available which examine the effectiveness of laparoscopic transabdominal cerclage compared to other cerclage methods in women with a high risk of late miscarriage and preterm birth due to cervical insufficiency.

In a prospective study, Carter et al. analyzed the effectiveness of LTC compared to abdominal cerclage (AC) in a cohort of 19 patients. LTC was typically carried out earlier in pregnancy (median: 9 ± 2 GW) than AC (median: 12 ± 2 GW; p = 0.02), and LTC was no longer considered an option after week 13 of gestation due to the increasing size of the uterus. No intraoperative or postoperative complications occurred and 75 % of the pregnancies treated with LTC and 71 % of the pregnancies treated with AC led to the birth of a viable infant. LTC had a higher success rate of 80 % compared to 60 % for AC [29]. These findings were supported by the study by Huang et al., which compared LTC with standard transvaginal cerclage (VC) in 289 patients. LTC was usually carried out early in the first trimester (8–10 GW) whereas VC was carried out between the 12 th and the 18 th week of gestation or as an emergency measure between the 17 th and the 25 th GW. LTC led to lower preterm birth rates and a higher median gestational age at delivery of 38.3 weeks compared to 36.4 weeks with VC. Moreover, the LTC group had a significantly lower hospitalization rate for imminent preterm births. Serious complications such as cervical tears und postpartum bleeding were only observed in the VC group. Although there were no significant differences between the groups with regards to severe neonatal complications, the LTC group had a higher fetal survival rate (98.3 % compared to 89.4 %), better neonatal outcomes with regards to birth weight and APGAR scores and a lower rate of admission to neonatal intensive care [30]. The study by Chen et al. also emphasizes the superior effectiveness and safety of LTC compared to VC. This study evaluated 134 patients who had LTC before week 14 of gestation with no use of a manipulator, while non-pregnant patients had a hysteroscopy using a manipulator. The Mersilene tape was placed twice around the cervix using a needle with no perioperative or postoperative complications. The results showed significantly better outcomes for the LTC group compared to the VC group. There were more deliveries at term (24 of 26 in the LTC group vs. 15 of 33 in the VC group, p = 0.0001) and a higher neonatal survival rate (25 of 26 in the LTC group vs. 23 of 32 in the VC group, p = 0.0001). The mean duration of pregnancy at delivery was also longer in the LTC group (37.88 ± 0.83 weeks for the LTC group vs. 32.91 ± 7.20 weeks for the VC group, p = 0.0001) [17]. These results underscore the advantages of LTC in preventing preterm births and improving pregnancy outcomes in high-risk patients with cervical insufficiency.

Bleeding from the uterine vessels is one of the most common complications of LTC, particularly during pregnancy [9]. Many authors use a tape needle to position the tape in the avascular space between the ascending and descending branches of the uterine vessels [8, 9, 15, 31]. In our two cases, the vessels were already enlarged due to the advanced pregnancy, which increased the risk of bleeding. To minimize the risk we decided against carrying out traumatic punctures. Instead, after blunt dissection and careful exposure of the uterine vessels at the transition from the cervix to the uterine body, a KELLY forceps was used to guide the tape through the avascular space and tie the tape securely.

Many authors use a uterus manipulator to manipulate the uterus and simplify the steps of the operation, especially during cerclage placement prior to conception [7, 9, 32]. We decided against using a uterus manipulator because of the limited visibility and difficulty of exposing the residual cervix in a vaginal procedure as well as the necessity of minimizing the risk of pregnancy loss. In their case series, which included five patients in the second trimester of pregnancy, Kavallaris et al. also took the decision not to use a manipulator for the same reasons [8].

An overview of the above-reported case series of laparoscopic transabdominal cerclage procedures carried out during pregnancy is given in ▶ **Table 1**.

Delivery by cesarean section is usually necessary after placement of an LTC [4, 7, 8, 14, 29]. The cerclage may be left in place if the mother wishes to have further children. Several successful pregnancies have been described in the literature in which the cerclage had been left in situ [7, 9, 29].

The literature presented here confirms that laparoscopic transabdominal cerclage is a safe, very effective and feasible alternative if, for some reason, vaginal cerclage is not possible or fails. Most of the available data are from case reports or case series which use and report on different techniques, so there is currently no standard procedure. Every technique has its own advantages and limitations. Recent studies have emphasized the effectiveness and success of LTC, not just prior to conception and in the first trimester of pregnancy but also in the second trimester. These findings are especially relevant if transvaginal cerclage cannot be carried out or it fails. Future studies in this field should focus on optimizing the techniques and on evaluating the long-term effects on mother and child to further improve current practice and increase safety.

Summary

The presented cases make it clear that laparoscopic transabdominal cerclage is a safe, very effective and feasible option not just prior to conception and in early pregnancy but also early in the second trimester of pregnancy as well, particularly if transvaginal cerclage cannot be carried out for various reason or if it fails. This method significantly improves the chances of a successful continuation of the pregnancy and should be specifically considered when other options are lacking.

▶**Table 1** Overview of studies on laparoscopic transabdominal cerclage carried out during pregnancy.

Author	Year	Patients	Pros/ Retr	No LTC	LTC prior to conception (prec.)	LTC post conception (postc.)	GW	Complications	Intraoperative bleeding (ml)	Suture material	Used meedle	Used manipulator	Operating time	GW at delivery	Birthweight (g)	Neonatal survival rate
Cho CH [25]	2003	20	Retr			20	12.1 (11–14)	1 (5%)	< 100	Mersilene	yes	yes	55 (40–75)	> 34	n/s	95%
Wolfe L [28]	2008	2	n/s			2	11 (10–12)	no	25–30	Mersilene	yes	yes	191 (149–233)	36.5 (35–38)	2664–3203	100%
Carter JF [29]	2009	19	pros	7	6	6	9 ± 2	no	n/s	Mersilene	yes	n/s	n/s	35.5 ± 2	2780 + 1479	80%
Whittle WL [9]	2009	65	pros		34	31	14	19.3%	n/s	Prolene	yes	prec.: yes postc.: sponge with forceps	n/s	35.8 ± 2.9	n/s	89%
Ades A [22]	2014	64	n/s		61	3	1 st trimester	1.6%	< 100	Prolene	yes	n/s	30–120	35.8	n/s	95.8%
Bolla D [24]	2015	18	retr		12	6	11.4 ± 1.6	no	< 20	Mersilene	Goldfinder	prec.: yes postc.: no	55 ± 10	37.3 ± 1.9	n/s	100
Shin SJ [23]	2015	80	pros			80	12.1 (11–15)	no	< 100	Dagrofil (polyfilament polyester)	yes	no	52 (25–100)	36.3 ± 2.7	2690 (1860–3750)	72 (90%)
Chen Y [17]	2015	134	n/s	33	58	43	< 14	no	n/s	Mersilene	yes	prec.: yes postc.: no	n/s	37.88 ± 0.83	3006 ± 403	96% (25/26)
Wang YY [13]	2020	24	retr		21	3	10.90 ± 2.61	1 (4.2%)	< 30 (10–50)	Mersilene	yes	prec.: yes postc.: no	35.50 ± 11.23	37.21 ± 5.05	n/s	100%
Kavallaris A [8]	2021	5	retr		0	5	14.4 (14.2–16)	no	< 100	Mersilene	yes	no	88 (80–95)	83.1 (38.0–38.5)	3190 (2980–3350)	100%
Abdel Azim S [14]	2021	11	retr		7	4	n/s	no	n/s	Mersilene	no	prec.: yes postc.: no	62 (37–126)	34 + 4 (27 + 0–38 + 1)	2640 g (700–3105)	100%
Chung H [19]	2021	299	retr			299	12.5 (10.5–17.5)	no	70.1 (0–200)	n/s	n/s	n/s	47.4 (15–100)	37 (26–40)	2678 (690–4100)	85.9%

▶Table 1 continued

Author	Year	Patients	Pros/ Retr	No LTC	LTC prior to conception (prec.)	LTC post conception (postc.)	GW	Complications	Intra-operative bleeding (ml)	Suture material	Used meedle	Used manipulator	Operating time	GW at delivery	Birth-weight (g)	Neonatal survival rate
Zhao B [27]	2022	10	n/s			10	13.5 (12–15)	no	200–400	Mersilene	no	no	15–30	37.3 (35 + 4–38 + 5)	2645 g (2150–3240)	100 %
Huang G [30]	2022	289	retr	233	47	9	8–10	no	n/s	Mersilene	yes	prec.: yes postc.: no	n/s	38.3	n/s	98.3 %
Current study		2	retr	0	0	2	14.4 (14–16)	no	< 50	Mersilene	no	no	113.5	37.5 (35 + 4–39 + 5)	(2786–4160)	100 %

g = grams; GW = week of gestation; LTC = laparoscopic transabdominal cerclage; ml = milliliters; n/s = not specified; prec. = prior to conception; prosp = prospective study; postc. = after conception; retr = retrospective study

Consent to Publication

The patients signed a form giving their consent to the publication of their data and photos.

Conflict of Interest

The authors declare that they have no conflict of interest.

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