After Radical Trachelectomy: Reproductive and Obstetrical Outcomes of Fertility-Sparing Surgery for Cervical Cancer

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Abstract

Radical trachelectomy has become an accepted fertility-sparing treatment for patients with early-stage cervical cancer. Despite its oncological safety, radical trachelectomy is associated with persistent sexual dysfunction and voiding issues, complicating long-term quality of life. Fertility outcomes demonstrate overall pregnancy rates ranging from 25.7-73%, with less radical procedures such as conization and simple trachelectomy reporting higher pregnancy rates compared with radical trachelectomy. Assisted reproductive treatments might be necessary due to complications such as cervical stenosis. During pregnancy, there is an elevated risk of miscarriage, preterm delivery, and premature rupture of membranes due to cervical shortening. However, less radical fertility-sparing procedures such as conization and simple trachelectomy demonstrate lower preterm delivery rates. Prophylactic cerclage, as well as close monitoring of cervical length during pregnancy, is essential, and cesarean section remains the recommended method of delivery. Recent studies suggest that less radical fertility-sparing procedures may provide comparable oncological safety while reducing complications, highlighting the need to reevaluate surgical approaches. This review provides an overview of reproductive and obstetrical outcomes in patients after treatment for early-stage cervical cancer with trachelectomy. This review additionally emphasizes the need for further research to refine fertility-sparing strategies.

Keywords

- cervical cancer
- fertility-sparing surgery
- pregnancy
- obstetric
- trachelectomy

Implications of human papillomavirus (HPV) vaccines and national cytological screening programs in high-income countries are expected to decrease the incidence of cervical cancer in decades to come, and decreasing trends have recently been reported in Denmark.[1] However, cervical cancer in adolescents and young adults continues to rank among the most frequent types of cancer globally.[2,3] Traditional standard treatment for patients with cervical cancer FIGO 2018 IA2 and IB1 has been radical hysterectomy, including removal of the uterus, cervix, parametria, and the upper portion of the vagina with pelvic lymphadenectomy, resulting in loss of fertility.[4] Patients with cervical cancer younger than 40 years may still have a fertility desire and radical trachelectomy has been widely accepted as a fertility-sparing option for cervical cancer FIGO 2018 stage IA2 to IB1 in the last two decades.[5] Additionally, there is a growing trend in developed countries for women to delay the time of pregnancy desire, decreasing overall fertility and increasing the risk of neoplasia requiring invasive treatment before attempting to conceive. This review aims to provide an overview of fertility and obstetrical outcomes after trachelectomy to uncover potential challenges.

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Procedure and Eligibility

Vaginal radical trachelectomy was initially introduced in 1987 by Daniel Dargent as a fertility-sparing treatment for patients with early-stage cervical cancer.[6] The procedure included a laparoscopic complete pelvic lymphadenectomy, performing a modified Schauta Stoeckel procedure by dissecting a vaginal cuff around the cervix and dividing it from the uterus, and reconstructing an anastomosis between the vagina and the isthmus with a cerclage. The patients had a Foley catheter inserted into the cervix for 2 to 6 days postoperatively. Since the introduction, the procedure has been modified several times, and currently, a robotic-assisted approach with sentinel node mapping has been accepted as the preferred choice of technique.[7]

Fertility-sparing treatment is an oncologically safe option for patients with early-stage cervical cancer and a fertility desire.[4,8] Regardless of lympho-vascular space invasion, the eligibility criteria are a tumor size of < 2 cm and tumor-negative pelvic lymph nodes. According to European guidelines, trachelectomy should not be recommended for uncommon histology types, including neuroendocrine carcinomas, HPV-independent adenocarcinomas, and carcinosarcomas.[4]

Long-Term Complications and Morbidity

One common complication following radical trachelectomy is cervical stenosis. Cervical stenosis can be asymptomatic, but symptoms may also include amenorrhea, dysmenorrhea, decreased menstrual flow, and retrograde menstruation leading to adhesions and endometriosis. A systematic review reported that the incidence of cervical stenosis was 8.6% among 1,215 patients treated with radical trachelectomy and a cerclage.[9] The highest rate of cervical stenosis was found in patients after abdominal radical trachelectomy (11.0%) and laparoscopic radical trachelectomy (9.3%). Low rates of cervical stenosis were found in patients after vaginal radical trachelectomy (8.1%) and robotic-assisted radical trachelectomy (0%). No statistical analysis was reported, comparing differences between the procedures and only 20 patients had undergone robotic-assisted trachelectomy. In another study of 149 patients, the rate of cervical stenosis was 14% after robotic-assisted radical trachelectomy. Other long-term complications included persistent vaginal bleeding (4.0%), voiding problems (2.7%), and vesico-vaginal fistula (0.7%).[10] Two studies based on patient-reported outcome measurements showed that 50% of patients after vaginal radical trachelectomy reported any grade of incomplete bladder emptying problems and tended to have persistent sexual dysfunction up to 1 year postoperatively.[11,12]

Fertility Outcomes

►**Table 1** provides an overview of fertility outcomes after fertility-sparing procedures. A systematic review from 2020 evaluated reproductive outcomes after fertility-sparing surgery in 3,044 patients. Treatments included cold knife conization/simple trachelectomy (9.3%), vaginal radical trachelectomy (45.6%), abdominal radical trachelectomy (34.8%), and laparoscopic radical trachelectomy (10.3%, 88 with robotic assistance). Among 1,218 patients (40.0%) who attempted conception, 1,047 pregnancies were achieved, 80.3% of which were spontaneous, while assisted reproductive technology (ART) accounted for 206 pregnancies (19.7%). Pregnancy rates were 65.0% after conization/simple trachelectomy and 53.6% after radical trachelectomy.[13]

A recent study, involving 149 patients who attempted to conceive after abdominal radical trachelectomy, reported a pregnancy rate of 17.4%, with 12 patients requiring ART.[14] Ekdahl et al investigated outcomes in 88 patients attempting to conceive after robotic-assisted radical trachelectomy. Among 70 successfully achieved conceptions, ART was required in 11 patients, resulting in a pregnancy rate of 79.5%. The method of ART was not defined in the study.[10] Another study reported a pregnancy rate of 72.2% in 18 patients attempting conception after simple trachelectomy; however, ART use was not reported in the study.[15] A large multicenter study of 733 patients revealed significantly higher pregnancy rates after conization/simple trachelectomy compared with radical trachelectomy (63.7% vs. 25.7%, $p < 0.001$). Details regarding fertility outcomes were reported only for 124 patients, of which a total of 166 pregnancies were achieved during a median follow-up of 72 months. A total of 77 patients (62.1%) underwent conization, 17 (13.7%) underwent simple trachelectomy, 3 (2.4%) underwent laparoscopic radical trachelectomy, 12 (9.7%) underwent radical vaginal trachelectomy, and 15 (12.1%) underwent radical abdominal trachelectomy.[16] A study including 471 patients undergoing vaginal radical trachelectomy reported a pregnancy rate of 72.6% among 270 patients attempting to conceive.[17]

Overall, the highest fertility rates were observed after conization/simple trachelectomy. However, studies with simple trachelectomy are currently based on small sample sizes. Noteworthy, in all studies, 34.8-77.4% of patients following treatment for early-stage cervical cancer did not try to conceive during the follow-up periods.

Assisted Reproductive Treatment

As cervical stenosis is a common long-term complication of radical trachelectomy, it is often necessary to perform cervical dilatation in patients experiencing subfertility or symptoms.[8] In a study of 149 patients attempting to conceive after abdominal radical trachelectomy, cervical stenosis accounted for 27.4% of the causes of infertility, which required cervical dilation with or without in vitro fertilization (IVF). Other causes of subfertility, not attributable to trachelectomy, included fallopian tube obstruction (23.3%), ovulatory dysfunction (6.3%), and ovarian endometriosis (1.0%).[14] In a systematic review from 2020, ART consisted of cervical dilation with intrauterine insemination (IUI), IUI with or without ovulation induction, or IVF. Specifically, ART accounted for eight pregnancies (6.1%) within the conization/simple trachelectomy group, 78 pregnancies (12.9%) in the vaginal radical trachelectomy group, 104 pregnancies (45.4%) in the abdominal radical trachelectomy

Table 1 Overview of fertility outcomes after fertility-sparing procedures

Procedure	Total population, *n*	Attempting conception, *n* = (%)	Pregnancies (pregnancy rate %)	Spontaneous pregnancies (%)	ART pregnancies (%)	Median follow-up, months	Reference
Conization/Simple trachelectomy	283 36	83 (29.3) 18 (50.0)	131 (65.0) 13 (72.2)	123 (93.9) –	8 (6.1) –	47.5 91.5	13 15
Vaginal radical trachelectomy	1,387 439	608 (43.8) 270 (61.5)	606 (67.5) 257 (72.6)	528 (87.1) –	78 (12.9) –	51.5 159.0	13 17
Abdominal radical trachelectomy	1,060 360	456 (43.0) 149 (41.2)	229 (41.9) 30 (17.4)	125 (54.6) 14 (46.7)	104 (45.4) 16 (53.3)	33.0 65.0	13 14
Laparoscopic radical trachelectomy[a]	314 135	71 (22.6) 88 (65.2)	81 (51.5) 103 (79.5)	65 (80.2) 59 (84.3)[b]	16 (19.8) 11 (15.7)[b]	26.6 58.0	13 10
Pooled procedures	733	364 (49.7)	166 (45.6)	111 (89.5)[b]	13 (10.5)[b]	72.0	16
Total	4,747	2,107 (44.4)	1,616 (57.0)	855 179[b]	222 24[b]		

[a]Including robotic-assisted radical trachelectomy.
[b]Women.

group, and 16 pregnancies (19.8%) in the laparoscopic radical trachelectomy group (see ►**Table 1**).[13]

Obstetrical Outcomes

►**Table 2** provides an overview of obstetrical outcomes after fertility-sparing procedures. Due to the shortening of the cervix, the risk of miscarriage, premature rupture of membranes, and preterm delivery is increased in patients after trachelectomy. In a meta-analysis from 2017, with a total of 2,479 patients undergoing any type of radical trachelectomy, a pooled analysis revealed a miscarriage rate of 24.0% and a preterm delivery rate of 26.6%.[18] When dividing fertility-sparing procedures into types, a systematic review reported a preterm delivery rate of 15.7% after conization/simple trachelectomy, 39.7% after vaginal radical trachelectomy, 56.7% after abdominal radical trachelectomy, and 50.0% after laparoscopic or robotic-assisted radical trachelectomy. The live birth rates were 73.9%, 67.0%, 68.6%, and 78.1%, respectively.[19] Similar results were confirmed in a recent systematic review from 2024, based on 162 patients undergoing conization/simple trachelectomy and 206 patients undergoing all types of radical trachelectomy. The preterm delivery rate was 18.3% in the conization/simple trachelectomy group and 33.3% in the radical trachelectomy group. The live birth rate in the conization/simple trachelectomy group was 84.4%, and 58.6% in the radical trachelectomy group. However, the obstetrical outcomes were based only on 58 pregnancies in the conization/simple trachelectomy group and 87 pregnancies in the radical trachelectomy group.[20]

When considering radicality, maintaining sufficient blood perfusion to the uterus may be essential for obstetrical outcomes. One small study compared abdominal radical trachelectomy with simple trachelectomy or radical trachelectomy with preservation of the uterine arteries in a total of 36 patients.[21] This study found that patients undergoing less radical procedures, including simple trachelectomy or preservation of the uterine arteries, had a significantly higher live birth rate with an odds ratio (OR) of 21.9 (95% CI: 1.9–1216.4) compared with more radical procedures.

Table 2 Overview of obstetrical outcomes after fertility-sparing procedures

Procedure	Total patients	Live birth rate (%)	Preterm delivery rate (%)	Reference
Conization/Simple trachelectomy	212 162 283 94	73.9 84.4 86.4 86.2	15.7 18.3 25.1 57.7	19 20 13 16
Vaginal radical trachelectomy	1,355 1,387	67.0 63.4	39.7 34.6	19 13
Abdominal radical trachelectomy	735 1,060	68.6 65.7	56.7 30.5	19 13
Laparoscopic radical trachelectomy[a]	314 314	78.1 56.5	50.0 31.4	19 13
Any type of radical trachelectomy	2,479 206 30	– 58.6 83.3	26.6 33.3 76.5	18 20 16

[a]Including robotic-assisted radical trachelectomy.

Thus, current studies suggest better obstetrical outcomes after less radical procedures. In comparison, the preterm delivery rate was previously reported to be 6.6% following a loop electrosurgical excision procedure, while the preterm delivery rate among women with no previous history of cervical intervention was 3.5%, adjusted OR of 1.8 (95% CI: 1.1–2.9).[22]

Obstetrical Management and Delivery

In 2021, a review was published for the management of pregnancy following radical trachelectomy. The following recommendations were suggested in the review[23]:

- A prophylactic cerclage is mandatory for preventing miscarriage.
- Currently, there is no evidence of positive effects of using mifepristone and/or misoprostol for miscarriages before 12 weeks of gestation.
- For miscarriage after 12 weeks of gestation, a cesarean section is recommended to prevent cervical laceration.
- Avoiding heavy lifting during specific gestational weeks, as well as refraining from sports and physically demanding work, to reduce the risk of premature rupture of membranes.
- Refraining from sexual intercourse between 14 and 34 weeks of gestation.
- Perinatal management should consist of prenatal visits every 2 weeks after the 18th gestational week with an ultrasound screening of the cervical length.
- Hospital admittance is recommended when patients present with short cervical length ($<$13 mm) and bleeding.
- Routine administration of antibiotics is not recommended.
- If the prophylactic cerclage proves to be ineffective, another cerclage is recommended depending on the gestational age.
- Vaginal progesterone has not yet been proven helpful for preventing preterm delivery in patients with a history of previous radical trachelectomy.
- If variceal bleeding from the anastomosis occurs during pregnancy, a gaze tamponade is the first method of choice and blood transfusion or delivery may be considered.
- Cesarean section is recommended as the preferred method of delivery.
- Awareness of postpartum endometritis as the cervical canal might be narrowed due to the prophylactic cerclage.

Future of Trachelectomy

In recent years, studies have been published investigating eligibility and optimal treatment for early-stage cervical cancer, questioning the need for radical trachelectomy. A multicenter prospective study reported oncological results for fertility-sparing treatment for FIGO 2009 IA1 and IB1 cervical cancer. A total of 44 patients underwent fertility-sparing conization followed by lymph node assessment and 40 patients underwent conization followed by simple hysterectomy and lymph node assessment. Lymph node assessment consisted of sentinel lymph node biopsy and/or full pelvic lymph node dissection and none of the patients had lymph vascular space invasion. During a median follow-up of 36.3 months, the overall recurrence rate was 2.4% ($n = 1$) in the fertility-sparing group, 0% in the conization followed by simple hysterectomy group. The authors concluded that a conservative approach for early-stage cervical cancer is safe and feasible, but further studies are needed to define the optimal pathology criteria for patients eligible for conservative treatment.[24]

In 2024, a randomized multicenter study was published investigating recurrence rates during a 3-year follow-up after simple versus radical hysterectomy with lymph node assessment for cervical cancer FIGO 2009 stage IA2 and IB1 with a tumor $<$2 cm with and without lymph vascular space invasion. A total of 700 patients were randomized, and the study concluded that simple hysterectomy without resection of the parametria was as oncologically safe as radical hysterectomy. Additionally, the incidence of urinary incontinence and urinary retention was significantly lower for patients after simple hysterectomy.[25]

The abovementioned studies question the future need for radical trachelectomy, as the majority of patients with early-stage cervical cancer eligible for radical trachelectomy might be sufficiently treated with less radical surgery. However, the precise eligibility criteria and the optimal procedure for less radical treatment are yet to be established.

Conclusion

Radical trachelectomy as a fertility-sparing treatment for early-stage cervical cancer has proven to be a widely acceptable oncological treatment. In addition to common causes of subfertility, patients with a previous history of trachelectomy may also have persisting sexual dysfunction and cervical stenosis requiring cervical dilation. Less radical procedures such as conization and simple trachelectomy seem to have a positive impact on pregnancy rates and preterm delivery rates compared with radical trachelectomy. The risk of preterm delivery is low with an effective cervical cerclage but higher compared with conization, and pregnant women with a history of previous radical trachelectomy should be closely monitered for cervical length shortening during their pregnancy. The preferred method of delivery is cesarean section. Lastly, it is expected that the future indication of trachelectomy would be decreased due to emerging evidence of the oncological safety of less radical procedures.

Conflict of Interest
The authors declare that there are no conflicts of interest. All authors were departmentally funded.

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