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## Single layer versus double layer closure in cesarean section

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### Abstract

**Objective:** This study evaluated the impact of single-layer versus double-layer uterine closure techniques on the healing of uterine scars following cesarean section.

**Materials and Methods:** In this prospective, randomized trial, women aged 18 to 45 years with singleton pregnancies between 24 and 41 weeks of gestation were enrolled. None had a history of previous uterine surgery. A total of 146 participants were included, with 78 undergoing single-layer closure and 68 receiving double-layer closure.

**Results:** Baseline characteristics, including the incidence of emergency cesarean deliveries, were comparable between the two groups. The median distance from the niche to the external cervical os was similar in both groups. There were no significant differences in the rates of postmenstrual bleeding or pelvic pain/dysmenorrhea between the single-layer and double-layer closure groups.

**Conclusion:** Single-layer and double-layer uterine closure techniques showed no significant difference in their effects on uterine scar niche development.

**Keywords:** Cesarean delivery, uterine scar, single-layer and double-layer closure techniques

### Introduction

As cesarean deliveries (CD) become increasingly common worldwide, more women are experiencing related complications. In addition to short-term risks such as bleeding and infection, cesarean sections are linked to serious long-term issues, including abnormal placental attachment, cesarean scar defects, uterine rupture, dehiscence, and pregnancies complicated by cesarean scar tissue.

Researchers have explored how different uterine closure techniques might reduce the risk of uterine rupture. Historically, a two-layer closure has been the standard approach. However, a single-layer closure, which is typically quicker and not associated with increased infection or transfusion rates, has recently gained popularity. Imaging studies have shown that single-layer closure may lead to fewer abnormalities in the lower uterine segment. It is thought to minimize local ischemia, reduce hematoma formation, and lower infection risk. On the other hand, some studies suggest that single-layer closure may increase the risk of uterine rupture by four to six times.

The double-layer, unlocked closure technique is generally considered safe and does not appear to pose an elevated short-term risk<sup>[1-3]</sup>. Additionally, this method is associated with a thicker remaining myometrial layer, particularly when unlocked sutures are used<sup>[4, 5]</sup>. Dysmenorrhea has been reported more frequently after single-layer closure; however, this finding is based on only two randomized controlled trials (RCTs) and has not consistently correlated with ultrasound assessments of myometrial thickness or niche formation<sup>[5]</sup>. While the rate of uterine rupture appears similar between single- and double-layer closures, its low incidence makes it challenging to detect statistically significant differences, and these findings are not always linked to ultrasound observations. Long-term outcomes, such as gynecological symptoms, fertility, and subsequent pregnancy results, have been insufficiently studied, highlighting the need for further research before recommending one method over another.

This article focuses on the choice of uterine closure techniques, particularly in relation to reducing the risk of uterine niche formation.

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Although several modifiable factors in these methods have been examined, no standardized protocols have been established. Consequently, there is no consensus regarding which closure technique most effectively reduces the risk of uterine rupture or scar-related complications following cesarean delivery. Further investigation is required to better understand the outcomes of single-layer (SL) versus double-layer (DL) uterine closure, particularly regarding uterine scar healing assessed 6 to 9 months after cesarean section.

### Materials and Methods

This study evaluated women who had undergone cesarean deliveries and were admitted to the Obstetrics and Gynecology department over a two-year period. The participants included women aged 18 to 45 years with singleton pregnancies between 24 and 41 weeks of gestation. None had a prior history of uterine surgeries such as cesarean sections or myomectomy. The study also included women at any stage of labor and those experiencing preterm premature rupture of membranes, provided they did not have a diagnosis of clinical chorioamnionitis. Exclusion criteria encompassed women with multiple pregnancies, more than one prior cesarean section, clinical chorioamnionitis, or chronic inflammatory conditions like systemic lupus erythematosus, rheumatoid arthritis, or insulin-dependent diabetes mellitus.

Eligible participants were randomly assigned to one of two groups based on the method of uterine closure: single-layer or double-layer sutures. Informed consent was obtained from all participants prior to their surgeries, after they were briefed about the study's objectives.

Data were collected on maternal age, gravidity, parity, body mass index, smoking habits, diabetes status, hypertensive disorders of pregnancy, and other medical histories. The study also assessed cesarean section indications, cervical dilation at the time of surgery, and whether the procedure was planned (elective) or performed on an emergency basis, regardless of the presence or absence of uterine contractions.

Postoperative follow-up was conducted on all participants, who were contacted after delivery and invited to participate in evaluations at six months postpartum. However, women

who had subsequent uterine surgeries or pregnancies after their cesarean delivery were excluded from this phase. The remaining participants underwent assessments for the presence of a niche at the scar site, including measurements of the niche itself, its shape, the distance from the niche to the external cervical os, and the thickness of both the residual and adjacent myometrium. These evaluations took place between six and nine months after the cesarean delivery. The distance from the most distant point of the niche to the external os was measured parallel to the top of the niche. Two experienced sonographers, blinded to the closure technique used, conducted these ultrasound examinations.

During follow-ups, participants were asked about their menstrual cycles, including cervical pain, menstrual cramps, postmenstrual spotting, and any other abnormal bleeding patterns. Postmenstrual bleeding was defined as spotting that occurred after menstruation and lasted two or more days. Transvaginal ultrasound was used for those who had intrauterine devices post-cesarean or were unable to tolerate a speculum exam. The primary outcome was the presence of a niche, while secondary outcomes included the measurements of the niche and the thickness of the residual and adjacent myometrium.

All data were analyzed using IBM SPSS. Continuous variables were presented as means with standard deviations, or medians with ranges when appropriate, while categorical data were shown as frequencies and percentages. Group comparisons for continuous variables were made using the Student's t-test for normally distributed data or the Mann-Whitney U test when normality assumptions were not met. Categorical variables were compared using chi-square or Fisher's exact tests. A p-value of less than 0.05 was considered statistically significant for all analyses.

### Results

Out of the 146 participants who completed the study, 78 underwent the single-layer closure technique, and 68 underwent the double-layer closure technique. Niche evaluation was performed on all women using saline infusion sonohysterography.

**Table 1:** Maternal and obstetric baseline characteristics of the participants in each study group

	Single-layer group (n = 78)	Double-layer group (n = 68)
Mean age, y	30.1±4.2	31.7±5.1
Mean body mass index, kg/m <sup>2</sup>	28.97± 4.3	30.1±4.9
Nulliparity, n (%)	72 (92.3)	61 (89.7)
Tobacco use, n (%)	3 (3.8)	3(4.4)
Diabetes mellitus, n (%)	6 (7.6)	4 (5.8)
Hypertension in pregnancy, n (%)	8 (10.2)	7 (10.2)
History of infertility, %	18 (23)	16 (23.5)
Mean gestational age at delivery, wk	38.0±2.2	38.1±2.1
Mean birthweight, g	3011.5±564	3231.4±620
Emergent cesarean, n (%)	19 (24.3)	22 (32.3)
Contractions before delivery, n (%)	22 (27)	21 (30.8)
Median duration of labor, hour, (min-max)	4 (1-16)	4 (1-18)
≥4 cm cervical dilatation, n (%)	9 (11.5)	8 (11.7)

All characteristics-such as emergent cesarean delivery, pre-delivery contractions, median labor duration, and cervical dilation of ≥4 cm-were comparable between the groups ( $P > .05$  for all variables).

**Table 2:** Procedural details of the cesarean deliveries in each group

	Single-layer group (n = 78)	Double-layer group (n = 68)
Need for additional suture, n (%)	48 (61.5)	40 (58.8)
Median duration of uterine closure, min	3.4 (1-7)	6.1 (1.5-18)
Median operation time, min (min-max)	24 (15-44)	28 (20-48)
Rate of bleeding > 1000 mL	Nil	Nil
Need for transfusion, n (%)	Nil	1 (1.4)
Return to theater, n (%)	Nil	1 (1.4) (due to rectus muscle hematoma)

Aside from shorter uterine closure times and overall operation durations observed in the single-layer closure group ( $P < 0.01$  and  $P = 0.01$ , respectively), there were no significant differences between the groups regarding the

need for additional sutures, incidence of bleeding exceeding 1000 mL, requirement for blood transfusion, or the necessity for reoperation.

**Table 3:** Primary and secondary outcomes at 6-9 months after cesarean delivery according to allocated closure type

	Single-layer group (n = 78)	Double-layer group (n = 68)	P value
Median depth of niche with saline infusion sonohysterography, mm (range)	1.5 (0-8.2)	2.3 (0-6.4)	0.10
Median length of niche with saline infusion sonohysterography, mm (range)	3.4 (0-6.8)	3.6 (0-9.4)	0.07
Median width of niche with saline infusion sonohysterography, mm (range)	3.0 (0-7.6)	3.9 (0-10.2)	0.01
Median residual myometrial thickness, mm (range)	9.7 (3.8-22)	9.5 (3-24)	0.19
Median adjacent myometrial thickness, mm (range)	12.2 (6.9-22.8)	13 (5.0-24)	0.56

The median distance from the niche to the external cervical os was comparable in both the single-layer and double-layer closure groups. There were no statistically significant differences between the groups regarding postmenstrual bleeding and rates of pelvic pain or dysmenorrhea.

### Discussion

Various techniques for performing cesarean deliveries have been developed with the goals of enhancing surgical efficiency, simplifying the procedure, reducing operation time, lowering costs, and minimizing postoperative complications, such as adverse outcomes and prolonged hospital stays. Studies have shown that the occurrence of niche formation is similar between single-layer and double-layer uterine closures. However, single-layer closure is typically associated with an easier surgical technique and a shorter operating time. Additionally, many obstetricians prefer single-layer closure, as it expedites the procedure without significantly increasing the risk of immediate complications [6, 7].

Numerous studies have investigated the differences between locked and unlocked suture methods for closing the uterus. Research by Ceci *et al.* [8] reported no significant variation in scar defects between these two techniques, while Yasmin *et al.* [9] found that the unlocked method resulted in a thicker residual myometrium. Similarly, a meta-analysis by Roberge *et al.* [10] indicated that single-layer closures and locked first-layer sutures may lead to a thinner residual myometrium. A recent randomized study compared three closure methods: a locked single-layer that included the decidua, a double-layer with a locked first layer also including the decidua, and a double-layer with an unlocked first layer that excluded the decidua. The study found no substantial differences in residual myometrial thickness between the locked single-layer and double-layer closures, although the unlocked double-layer technique (excluding the decidua) resulted in a thicker residual myometrium compared to the locked single-layer method.

These results support the theory proposed by Jelsema *et al.* [11], which suggests that locking sutures may contribute to ischemic necrosis by applying excessive pressure on the

tissue. Locked sutures might also compress scar tissue, potentially hindering proper healing. Despite these concerns, locking sutures are often favored by surgeons for their ability to provide better hemostasis. In our study, all participants who underwent double-layer closures received a locked first layer, which makes it difficult to draw definitive conclusions regarding the isolated effects of locking. While more pronounced niches were noted in the double-layer closure group, the differences were not statistically significant. This may be due to the combined impact of locking the first layer and applying a second-layer closure, which could increase tissue stress and reduce vascular supply. However, current evidence is insufficient to conclude that surgical technique alone accounts for these differences.

In our research, surgeons deliberately avoided suturing through the decidua during all procedures. Prior studies, such as that by Roberge *et al.* [10], have demonstrated that an unlocked single-layer closure excluding the decidua can promote better tissue healing, although niche formation may still occur. Completely avoiding sutures through the decidua is often impractical. It has been suggested that including the decidua in sutures less than 5 mm thick is acceptable, but full-thickness suturing through the decidua might lead to fusion and increase the risk of niche development.

Two recent retrospective studies explored how single-layer and double-layer closures in an index pregnancy affect the risk of uterine rupture in subsequent deliveries. Bujold *et al.* [12] found that single-layer closure was linked to a fourfold higher risk of uterine rupture compared to double-layer closure. Similarly, Durnwald and Mercer [13] observed that single-layer closures were associated with a fivefold higher incidence of uterine windows (dehiscence) during subsequent cesarean deliveries. Both studies recommend single-layer closure for women who do not plan to undergo labor in future pregnancies, whereas double-layer closure is advised for those considering a trial of labor. To better determine the advantages or disadvantages of single-layer closures, larger multicenter prospective studies are needed. These should focus on long-term outcomes, particularly scar integrity during labor and delivery, as well as maternal and

neonatal health, using standardized protocols for suture materials and techniques.

Furthermore, previous research has mainly assessed cesarean scar defects within three months post-surgery using transabdominal or transvaginal ultrasound. These studies often concentrated solely on residual myometrial thickness or niche formation. In contrast, the current study evaluated both niche formation and myometrial thickness in multiple planes after a minimum of six months, adhering to guidelines from the European Society for Gynecological Endoscopy. Unlike earlier studies that defined a niche as a defect with a depth of at least 1 mm, this study used a threshold of 2 mm, leading to more accurate and specific results.

### Conclusion

This study found no significant differences between single-layer and double-layer uterine closure techniques following cesarean section in terms of the development of uterine niches, their size (depth and length), or myometrial thickness. Both groups displayed similar outcomes regarding postmenstrual bleeding, pelvic pain, and dysmenorrhea. However, a noteworthy finding was the increased median width of the niche in the double-layer closure group. While the results did not show a significant clinical difference in the long-term scar healing, the observed wider niche in the double-layer group warrants further investigation to better understand its implications.

The findings suggest that both techniques can be safely used in cesarean deliveries, with single-layer closure offering advantages in terms of shorter operation times and procedural simplicity, making it a practical choice in many clinical settings. On the other hand, double-layer closure, although slightly more time-consuming, may still offer benefits that could be relevant in specific patient populations, especially those who may require a more robust uterine closure in future pregnancies.

Despite the lack of clear evidence favoring one technique over the other, this study contributes valuable insights into cesarean section techniques and uterine scar healing. Future studies should focus on larger cohorts with longer follow-up periods to assess the long-term outcomes, including the risk of uterine rupture in subsequent pregnancies and the overall impact on maternal health. Standardization of the surgical techniques and protocols for closure could further enhance clinical practices and outcomes in cesarean deliveries.

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