

Original Research

Comparison of Uterine Closure Techniques and Their Association With Cesarean Scar Defect Development: A Randomized Controlled Trial

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Academic Editor: Rong Li

Submitted: 12 April 2026 Revised: 2 July 2026 Accepted: 13 July 2026 Published: 20 October 2026

Abstract

Background: To compare three uterine closure techniques regarding postoperative residual myometrial thickness (RMT) and their association with cesarean scar defect (CSD) formation. **Methods:** A prospective, assessor-blinded, randomized controlled trial (RCT) was conducted in 48 nulliparous women undergoing primary cesarean delivery. Participants were randomly assigned to one of three groups: Group 1, double-layer continuous non-locking suturing with endometrial inclusion and an imbricating second layer; Group 2, double-layer continuous non-locking suturing without endometrial inclusion and an imbricating second layer; Group 3, double-layer continuous suturing with the first layer incorporating the endometrium and deep myometrium and the second layer including the remaining myometrium. Transvaginal ultrasonography was performed 6 months postoperatively to measure RMT and evaluate the presence of CSDs. The study was powered to detect differences in RMT rather than CSD incidence. **Results:** No significant differences in preoperative and postoperative changes in visual analog scale (VAS) scores were observed among the groups. Mean RMT was comparable across the three groups (7.1 ± 2.2 mm, 7.3 ± 1.6 mm, and 7.4 ± 1.8 mm, respectively; $p = 0.920$). CSD was identified in 7.1%, 21.4%, and 6.7% of patients in Groups 1, 2, and 3, respectively (overall incidence, 11.6%; $p = 0.404$). **Conclusion:** No significant differences in postoperative RMT were observed among the uterine closure techniques evaluated. Larger prospective studies powered to detect differences in CSD outcomes are warranted. **Clinical Trial Registration:** The study was registered to <https://clinicaltrials.gov/> with an ID of NCT05100147 (<https://clinicaltrials.gov/study/NCT05100147?cond=NCT05100147%20&rank=1>).

Keywords: cesarean scar defect; residual myometrial thickness; uterine closure technique

1. Introduction

Cesarean delivery is one of the most commonly performed surgical procedures worldwide and is indicated when vaginal delivery poses risks to maternal and fetal safety. The range of indications prompting cesarean delivery has expanded beyond strictly medical reasons, leading to an increasing frequency of this procedure [1]. This rise in cesarean delivery rates correlates with an uptick in both short-term and long-term surgery-related complications. Among these complications lies the cesarean scar defect (CSD), which arises from inadequate or impaired healing of the uterine incision site during the cesarean delivery [2]. In the literature, this defect has been described using various terms such as niche, diverticulum, isthmocele, pouch, and uteroperitoneal fistula.

The clinical significance of CSD is its potential to cause gynecologic and obstetric complications associated with high morbidity and mortality. CSD is closely associated with gynecologic complications, including abnormal uterine bleeding, chronic pelvic pain, and secondary infertility [3,4,5]. In subsequent pregnancies, the cesarean scar may contribute to serious obstetric complications with considerable mortality, including scar ectopic pregnancy, abnormal placental attachment, and uterine rupture [6]. Al-

though the precise prevalence of CSD remains uncertain, reported rates range broadly from 19.4% to 84% in symptomatic patients [7].

Given its high prevalence and the complications it may cause, recognizing risk factors, particularly preventable ones, is essential. Ongoing research aims to clarify its preventability and incidence, and numerous patient-related and surgery-related factors have been identified in CSD development. Several risk categories have emerged, including surgical technique, systemic factors that may adversely affect wound healing, advanced maternal age, a retroflexed uterus, low-lying placenta, multiple pregnancies, elevated fetal weight, and previous cesarean deliveries [8]. Among these factors, surgical technique is particularly important due to its potential for prevention or prediction. Recognizing surgery-related risk factors is crucial for preempting potential complications. Previous studies have scrutinized surgical factors like uterine incision location, single-layer versus double-layer suturing for uterine closure, and the use of endometrial inclusion in the suture line, and whether the closure is locked [8,9,10]. However, no consensus has yet been reached regarding the optimal uterine closure method.

Vervoort et al. [9] categorized surgery-related risk factors into three groups: uterine incision on the cervical canal;



inadequate closure of the uterine incision, including single-layer closure, exclusion of endometrial tissue during uterine closure, and use of a locking suturing technique; and factors associated with adhesion formation, including non-closure of the visceral peritoneum, inadequate hemostasis, and the need for additional suture. When single-layer and double-layer uterine closure techniques were compared, the risk of uterine rupture in a subsequent pregnancy was reported to be fourfold higher following single-layer closure [10]. Residual myometrial thickness (RMT) was greater in the double-layer closure group. However, no difference in the incidence of CSDs was observed between the two groups [7,10]. Additionally, single-layer closure and a locked first-layer suture have been associated with thinner RMT [11]. As such, a double-layer continuous non-locking suturing technique is considered a safe approach.

Based on the existing literature, this randomized controlled trial (RCT) primarily aimed to compare three distinct double-layer continuous non-locking uterine closure techniques with respect to postoperative RMT. CSD occurrence was prospectively evaluated as an exploratory outcome, and its incidence was assessed among patients undergoing a primary cesarean delivery without known risk factors for CSD development.

2. Materials and Methods

2.1 Study Design

This prospective, assessor-blinded, RCT was conducted at the Department of Obstetrics and Gynecology, Mersin University Faculty of Medicine Hospital, between November 2021 and May 2022. The study was approved by the Mersin University Clinical Research Ethics Committee (Approval No.: 473/08.07.2020) and registered at [ClinicalTrials.gov](https://www.clinicaltrials.gov) (NCT05100147).

2.2 Study Population and Eligibility Criteria

Patients presenting for elective cesarean delivery due to obstetric indications were consecutively recruited.

The inclusion criteria included patient informed consent, age between 18 and 40 years, nulliparity, elective primary cesarean delivery, singleton pregnancy, no history of uterine surgery, absence of active labor during cesarean delivery, and body mass index (BMI) below 35 kg/m².

The exclusion criteria comprised multiparity, diabetes mellitus, hypertension, abnormal placentation, chronic systemic inflammatory disease, intrauterine infection, and Müllerian anomalies. Patients who did not meet these eligibility criteria or declined participation after informed consent was obtained were excluded (Fig. 1).

Gestational age was determined based on the last menstrual period and confirmed by first-trimester ultrasonography. Baseline demographic and clinical characteristics were recorded preoperatively.

2.3 Sample Size Calculation

The sample size was calculated using G*Power version 3.1.9.2 (Heinrich-Heine-Universität Düsseldorf, Düsseldorf, Germany) based on the primary outcome, RMT, using data from previous studies [12]. Assuming a two-sided alpha level of 0.05, a 95% statistical power, and an effect size of 0.768, a minimum of 14 participants per group was required. To account for potential loss to follow-up, planned sample size was increased to 16 participants per group. Given the sample size calculation was based on RMT, the study was not designed to detect statistically significant differences in the CSD incidence.

Initially, a total of 55 patients were assessed for eligibility. 7 patients were excluded due to abnormal placentation (n = 5) or intraoperative chorioamnionitis (n = 2). 48 patients underwent subsequent randomization, and 43 completed the 6-month follow-up (Fig. 1).

2.4 Randomization and Blinding

Patients were randomly assigned in a 1:1:1 ratio using a computer-generated randomization sequence. Group allocation was concealed in sequentially numbered, sealed, opaque envelopes. Immediately before surgery, the operating surgeon opened the assigned envelope to determine the allocated uterine suturing technique.

Outcome assessors remained blinded throughout the study. During follow-up, 2 patients in Group 1, 2 patients in Group 2, and 1 patient in Group 3 were lost to follow-up because of missed postpartum visits.

2.5 Surgical Procedure

Preoperative evaluation included a complete blood count, fasting blood glucose, renal and liver function tests, and assessment of menstrual history. Premenstrual pain and sexual intercourse before pregnancy was evaluated using the visual analog scale (VAS).

All patients received intravenous cefazolin (2 g) 30 minutes before surgery and tranexamic acid (1 g) before skin incision. Cesarean delivery was performed through a Pfannenstiel abdominal incision and a Kerr uterine incision. Following fetal delivery, oxytocin infusion was initiated.

The uterine closure techniques were as follows:

Group 1: Double-layer continuous non-locking closure with endometrial inclusion in the first layer and an imbricating second layer.

Group 2: Double-layer continuous non-locking closure with endometrial exclusion in the first layer and an imbricating second layer.

Group 3: Double-layer continuous non-locking closure with the first layer including the endometrium and deep myometrium and the second layer incorporating the remaining myometrium.

Polyglactin 910 (Vicryl®, Ethicon Inc., Somerville, NJ, USA) was used as the suture material in all patients (Fig. 2).

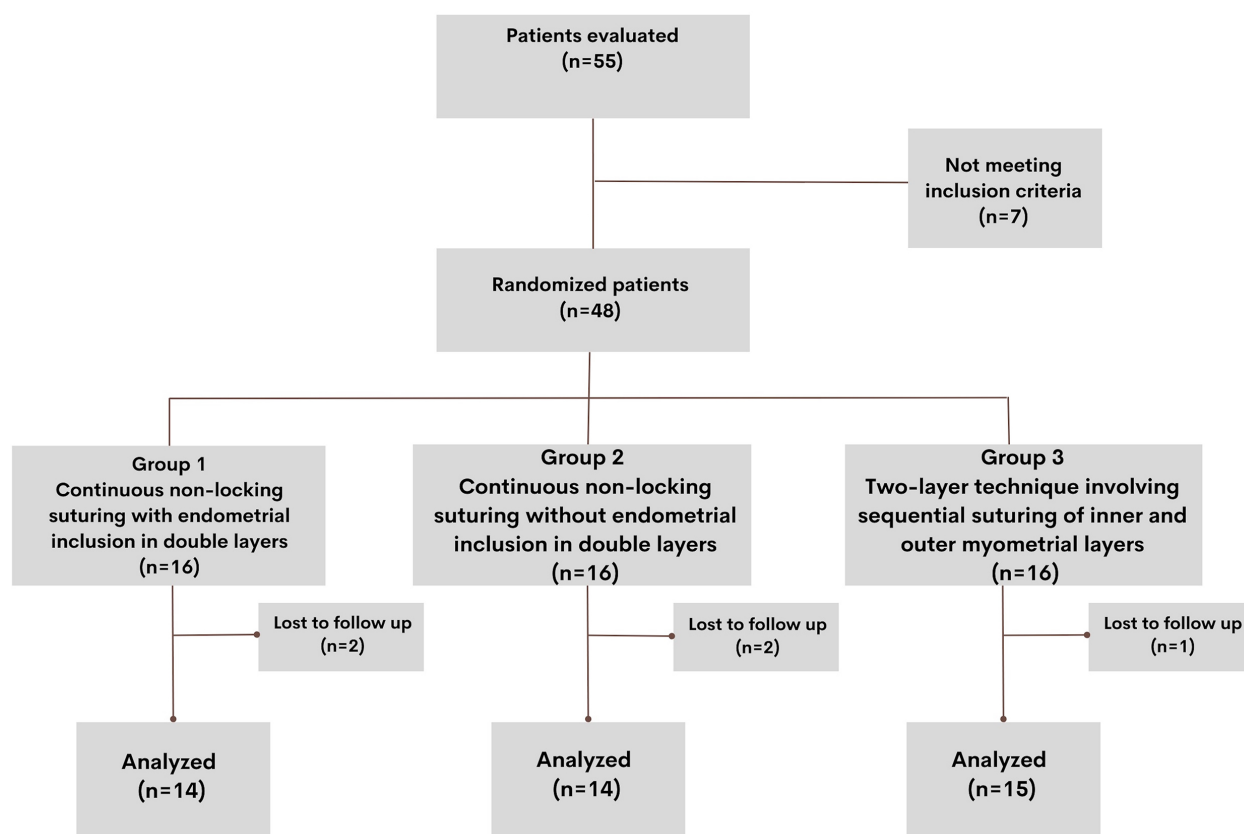


Fig. 1. Study flow diagram.

2.6 Perioperative Assessment

During cesarean delivery, the upper and lower myometrial thickness at the uterine incision site was measured using a sterile ruler. The estimated uterine wall thickness was calculated as the mean of these measurements. Uterine closure time, the need for additional hemostatic sutures, total operative time, decrease in hemoglobin level, and postoperative hemoglobin decline were recorded. All patients received routine postoperative care, including prophylactic antibiotics, and were discharged within 48 hours after surgery. Follow-up visits were scheduled at 1 week, 6 weeks, and 6 months after surgery.

2.7 Follow-up and Ultrasonographic Evaluation

At 6 months postoperatively, all patients underwent clinical evaluation, as uterine scar healing is considered complete by this time [13]. Transvaginal ultrasonography was performed by the same blinded investigator using a Toshiba Aplio 500 ultrasound system equipped with a PMW-621VT 6-MHz transvaginal probe. The primary outcome was RMT at 6 months after cesarean delivery. Secondary outcomes included CSD occurrence at 6 months after cesarean delivery, defect depth, defect width, healing ratio, menstrual duration, dysmenorrhea, dyspareunia, and routine ultrasonographic findings. The cesarean scar was identified according to previously published definitions

[14]. RMT was measured 3 times, and the mean value was recorded. In patients with CSD, the residual myometrial thickness overlying the defect, defect depth, defect width, and healing ratio were measured according to previously described methods [15] (Fig. 3).

2.8 Statistical Analysis

Statistical analyses were performed using SPSS version 22.0 (IBM Corp., Armonk, NY, USA). Data distribution was assessed using the Shapiro–Wilk test. Normally distributed variables are presented as mean $\pm$ standard deviation (SD), whereas non-normally distributed variables are presented as median (minimum–maximum). Categorical variables are expressed as frequencies (n) and percentages (%).

Between-group comparisons were performed using one-way analysis of variance (ANOVA), Kruskal–Wallis test, Chi-square test, Fisher’s exact test, or Mann–Whitney U test, as appropriate. Paired-samples *t*-test and Wilcoxon signed-rank test were used for preoperative and postoperative comparisons. Continuous variables between patients with and without CSD were compared using the independent-samples *t*-test or Mann–Whitney U test, according to data distribution. A *p*-value < 0.05 was considered statistically significant.

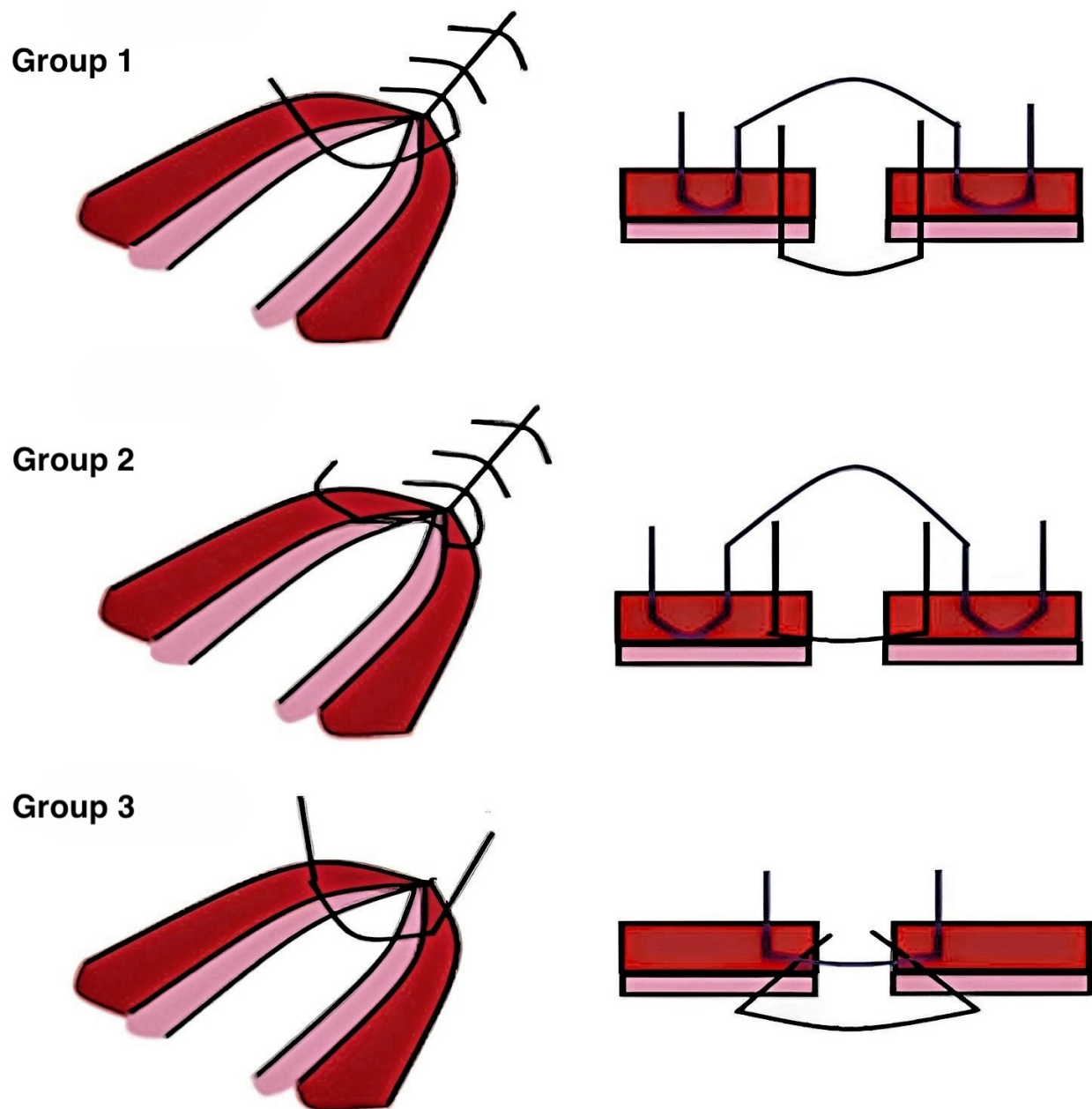


Fig. 2. Uterine suturing techniques. Red layer: myometrium; pink layer: endometrium; black line: first suture layer; blue line: second suture layer. Group 1: Double-layer continuous non-locking closure with endometrial inclusion in the first layer and an imbricating second layer. Group 2: Double-layer continuous non-locking closure with endometrial exclusion in the first layer and an imbricating second layer. Group 3: Double-layer continuous non-locking closure with the first layer including the endometrium and deep myometrium and the second layer incorporating the remaining myometrium.

This RCT was reported in accordance with the CONSORT statement. The CONSORT checklist and flow diagram are provided as supplementary material.

3. Results

3.1 Study Population

A total of 43 patients completed the 6-month follow-up and were included in the final analysis. No perioperative or postpartum complications were observed.

3.2 Baseline Characteristics

Baseline demographic, preoperative, perioperative, and postoperative characteristics are summarized in Table 1.

The three groups were comparable with respect to age, BMI, menstrual duration before and after surgery, and VAS scores for dysmenorrhea and dyspareunia. Changes in menstrual duration and pain scores did not differ significantly among the groups.

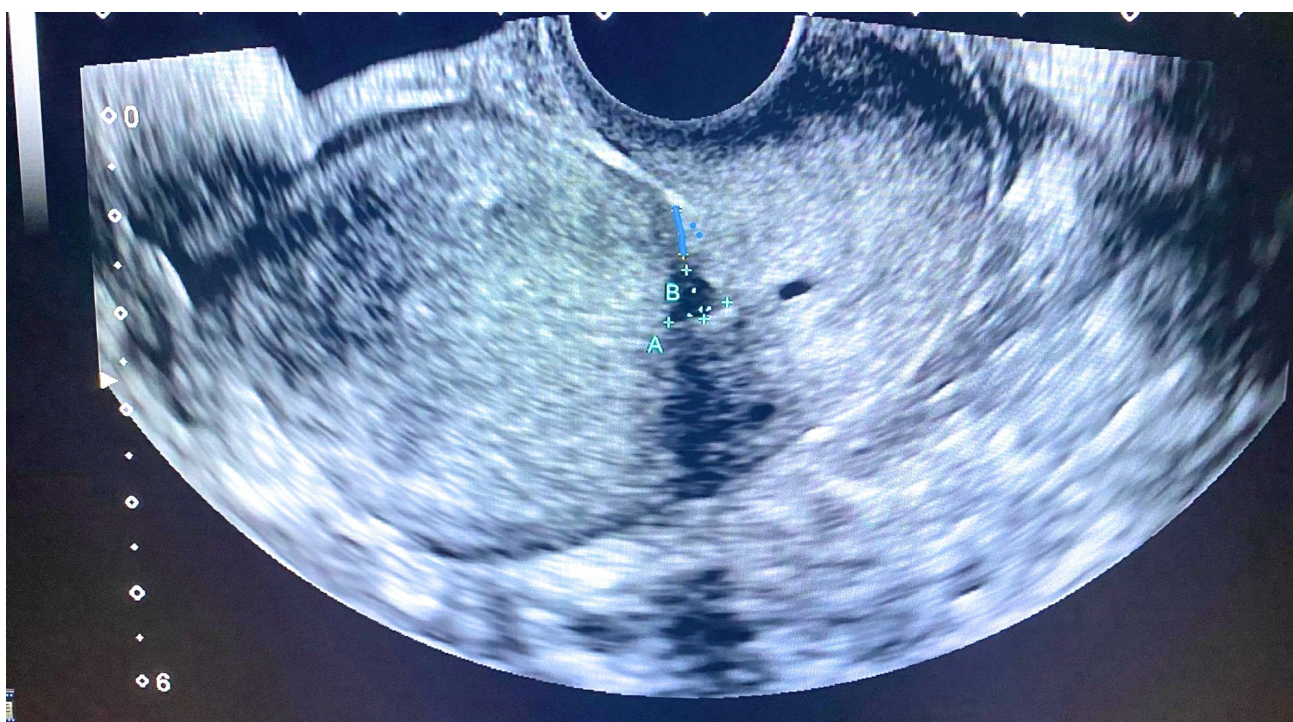


Fig. 3. Transvaginal ultrasonographic image of the CSD. A: defect width; B: defect depth; blue line: RMT. CSD, cesarean scar defect; RMT, residual myometrial thickness.

3.3 Intraoperative Outcomes

The thickness of the upper and lower uterine incision edges, uterine closure time, total operative duration, decrease in hemoglobin level, and postoperative hemoglobin decline were similar among the three groups.

The requirement for additional hemostatic sutures after uterine closure was significantly greater in Group 3 than in Groups 1 and 2 (Group 1 vs. Group 2, $p = 0.482$; Group 1 vs. Group 3, $p = 0.033$; Group 2 vs. Group 3, $p = 0.002$) (Table 1).

3.4 Primary Outcome: RMT

Postoperative RMT was comparable among the three uterine closure techniques. The mean RMT values were 7.1 ± 2.2 mm in Group 1, 7.3 ± 1.6 mm in Group 2, and 7.4 ± 1.8 mm in Group 3 ($p = 0.920$) (Table 1).

3.5 Secondary Outcomes

5 patients (11.6%) developed CSD during the 6-month follow-up. The incidence of CSD was 7.1% (1/14) in Group 1, 21.4% (3/14) in Group 2, and 6.7% (1/15) in Group 3 (Table 2). The upper and lower uterine incision thicknesses did not differ significantly between patients with and without CSD. In all three groups, the estimated intraoperative uterine wall thickness was significantly greater than the postoperative RMT measured at 6 months (Group 1, $p < 0.001$; Groups 2 and 3, $p = 0.03$). However, the magnitude of this reduction did not differ significantly among the three groups ($p = 0.804$).

3.6 Ultrasonographic Findings in Patients With CSD

Detailed ultrasonographic measurements of patients who developed CSD are presented in Table 3. Among these patients, the median RMT was 4.3 mm (range, 2.8–8.4 mm), the median defect depth was 3.0 mm (range, 2.0–3.5 mm), the median defect width was 3.0 mm (range, 2.5–5.0 mm), and the median healing ratio was 0.58 (range, 0.52–0.77).

4. Discussion

The primary finding of this RCT is that RMT was comparable among the three double-layer continuous non-locking uterine closure techniques evaluated. As the study was prospectively powered for this primary outcome, these findings indicate that none of the evaluated techniques confers a measurable advantage in terms of postoperative myometrial thickness, suggesting that endometrial inclusion or exclusion during double-layer closure does not substantially influence RMT. Regarding the secondary outcomes, no significant differences were observed among the groups in the CSD incidence or CSD-related symptoms, including menstrual duration, dysmenorrhea, and dyspareunia, at 6 months postpartum. Another important finding of this study is the reported incidence of CSD following a primary cesarean delivery in women without known risk factors for CSD development.

The global cesarean delivery rate is reported to be 21% and is projected to rise to 30% by the end of 2030 [16]. Turkey has one of the highest cesarean delivery rates world-

Table 1. Comparison of demographic and preoperative, perioperative, and postoperative characteristics between groups.

	Group 1	Group 2	Group 3	<i>p</i> -value
Age (years)	29.36 ± 7.2	27.79 ± 5.7	29.57 ± 5.4	0.708
BMI (kg/m ²)	30.71 ± 3.9	31.86 ± 3.9	28.87 ± 4.7	0.168
Preoperative menstrual duration (days)	6 (3–8)	5 (4–8)	5 (3–8)	0.436
Postoperative menstrual duration (days)	5.5 (3–8)	5 (3–8)	5 (3–7)	0.988
Change in menstrual duration (days)	0 (–3 – 1)	0 (–2 – 3)	0 (–1 – 4)	0.444
Preoperative menstrual VAS score (cm)	4.39 ± 2.8	4.31 ± 3	4.28 ± 2.6	0.995
Postoperative menstrual VAS score (cm)	4.42 ± 2.6	3.14 ± 2.7	4.19 ± 2.1	0.366
Change in menstrual VAS score (cm)	0.15 (–4.3 – 1.5)	–0.2 (–5.7 – 0.3)	0.2 (–6.3 – 6.5)	0.068
Preoperative dyspareunia VAS score (cm)	2.1 (0–8)	2.3 (0–8.5)	2 (0–8.4)	0.677
Postoperative dyspareunia VAS score (cm)	1.65 (0–8.1)	2.7 (0–8.7)	2.5 (0–8.6)	0.588
Change in dyspareunia VAS score (cm)	0.15 (–2 – 1.1)	0.1 (–2.7 – 6.5)	0.3 (–0.1 – 5.2)	0.508
Upper uterine wall incision thickness (mm)	14.7 ± 4.8	14.1 ± 5.1	15.1 ± 6.1	0.876
Lower uterine wall incision thickness (mm)	11.5 ± 3.7	10.7 ± 4.1	10.7 ± 4.8	0.841
Mean uterine wall thickness [(upper + lower thickness)/2] (mm)	13.1 ± 3.9	12.4 ± 4.4	12.9 ± 5.1	0.914
Duration of uterine incision closure (minutes)	4.71 ± 1.6	4.43 ± 1.8	4.7 ± 2.1	0.899
Total operation time (minutes)	35.93 ± 7.7	36.93 ± 8.7	35.13 ± 4.9	0.801
Number of additional sutures on the uterine incision	0 (0–3)	0 (0–2)	1 (0–5)	0.002*
Residual myometrial thickness (mm)	7.1 ± 2.2	7.3 ± 1.6	7.4 ± 1.8	0.920
Decrease in hemoglobin level (g/dL)	1.27 ± 0.7	1.81 ± 0.9	1.41 ± 0.7	0.140

* group 1 vs. 2: *p* = 0.482; group 1 vs. 3: *p* = 0.033; and group 2 vs. 3: *p* = 0.002. VAS, visual analog scale; BMI, body mass index.

Table 2. CSD rates among the groups.

	Without CSD	With CSD	<i>p</i> -value
Group 1 (n = 14)	13 (92.9 %)	1 (7.1 %)	0.404
Group 2 (n = 14)	11 (78.6 %)	3 (21.4 %)	
Group 3 (n = 15)	14 (93.3 %)	1 (6.7 %)	

CSD, cesarean scar defect.

wide. In 2020, the cesarean delivery rate in Turkey was 57%, ranking second only to Mexico (58%) among member countries of the Organization for Economic Co-operation and Development (OECD) [17]. The most recent data, from 2022, reported a cesarean delivery rate of 60.5% in Turkey, with a primary cesarean rate of 51%, notably exceeding the reference range of 10–19% [17,18]. As cesarean delivery rates continue to increase worldwide, the incidence of CSD, a delayed complication of cesarean delivery, is also expected to rise, highlighting the need for effective preventive strategies to decrease its occurrence.

Several reported risk factors for CSD, such as advanced maternal age, multiple gestation, low-lying placenta, a retroflexed uterus, multiple previous cesarean deliveries, systemic factors that impair wound healing, and

genetic predisposition to poor hemostasis and early uterine wall adhesions, are not modifiable [8,19]. In contrast, surgical technique is considered the most important modifiable factor [9]. However, there is still no consensus on the optimal uterine closure technique during a cesarean delivery.

The ideal uterine closure technique should provide adequate hemostasis with a minimum amount of sutures, minimize operative time, reduce adhesion, provide sufficient strength to prevent uterine rupture in the following pregnancies, and minimize the risk of CSD [20]. Numerous uterine closure techniques have been described, including interrupted sutures, single-layer continuous closure, either locking or non-locking; and double-layer continuous closure with a first-layer locking or non-locking second-layer, performed as either full-thickness closure including the decidua or split-thickness closure excluding the decidua [21]. Although these techniques have been evaluated in multiple studies, evidence concerning their effect on the development of CSD remains limited [22].

Previous research findings indicate that double-layer non-locking uterine sutures are associated with thicker remaining myometrial tissue and a lower prevalence of CSD than single-layer or locking closure techniques [11,12,23].

Table 3. Measurements of patients with CSD.

	RMT (mm)	Defect depth (mm)	Defect width (mm)	Healing ratio (%)
Group 1:				
Case 1	2.8	2.4	4.4	53
Group 2:				
Case 1	3.8	3.5	2.5	52
Case 2	8.4	3	3	73
Case 3	7	2	5	77
Group 3:				
Case 1	4.3	3	3	58

CSD, cesarean scar defect; RMT, residual myometrial thickness.

A systematic review of 20 RCTs further demonstrated that long-term evaluation of uterine closure methods for CSD prevalence revealed that single-layer and locking sutures lead to significantly thinner residual myometrial tissue compared to double-layer sutures [11]. These findings suggest that locking sutures may hinder healing by causing tissue ischemia. Furthermore, incorporating the endometrium into the suture line has also been associated with a reduced occurrence of CSD [24,25]. In their systematic review and meta-analysis, Stegwee et al. [26] showed that exclusion of the decidua during uterine closure was associated with a higher prevalence of CSD (risk ratio (RR) 1.71, 95% confidence interval (CI): 1.11–2.62). They reported that double-layer non-locking sutures are preferable to single-layer locking sutures concerning RMT, healing ratio, and dysmenorrhea [26]. However, other studies have reported contrasting results, suggesting that non-locking sutures with exclusion of the decidua provide optimal tissue approximation [12,27,28,29]. In our study, all three groups underwent non-locking double-layer uterine closure. The rate of CSD was 6.9% (2/29) among patients in whom the decidua was included in the suture line (Groups 1 and 3) and 21.4% among patients in whom the decidua was excluded (Group 2). The observed differences in CSD incidence should be interpreted with caution, as the study was not powered to detect differences in this outcome. Therefore, these findings should be considered exploratory and hypothesis-generating until they are confirmed by adequately powered prospective studies.

During study planning, the aim was to isolate surgical technique as the only variable. Factors known to negatively affect wound healing, such as advanced maternal age, higher BMI, and chronic systemic conditions, were considered [30]. The similarity in baseline demographic characteristics among patients shows that the intended population homogenization was achieved. The incidence of CSD after primary cesarean delivery among patients without known risk factors for CSD development was 11.6%. Although CSD diagnosis has been reported to be more frequent with saline contrast sonohysterography (SCSH) than with conventional ultrasonography in the same patients [31], SCSH is associated with potential risks, including vasovagal re-

actions, severe pain, and infection. Therefore, its routine use for CSD evaluation remains limited. The exact prevalence of CSDs varies widely, largely due to differences in diagnostic methods and study population heterogeneity. In our study, all patients underwent non-contrast transvaginal ultrasonography at the 6-month postoperative follow-up appointment, revealing a CSD frequency of 11.6% (5/43). These findings provide valuable data regarding the occurrence of CSD in low-risk patients undergoing a primary cesarean delivery. This study shows that CSD is a relatively common complication even among patients without known associated risk factors who undergo their first cesarean delivery.

An observational prospective cohort study assessing gynecological symptoms in patients with CSD found that 34% experienced postmenstrual bleeding [32]. Another case-control study reported that abnormal uterine bleeding was more frequent among those with a niche, although the difference lacked statistical significance [33]. Our study found no significant differences in menstrual patterns, dyspareunia, and dysmenorrhea VAS scores between patients operated with three different uterine closure techniques. Subanalysis revealed that symptom profiles did not differ between patients with and without CSDs (data not shown). When comparing all patients, only dyspareunia VAS scores showed a significant increase in the postoperative period compared with the preoperative phase, irrespective of CSD development (data not shown). It is worth noting that the primary aim of our study was not to evaluate the clinical symptoms associated with CSD. Although our follow-up period was limited to 6 months, which may have been insufficient to capture the full spectrum of CSD-related symptoms, future studies with longer follow-up are warranted to better characterize the progression of these symptoms.

The main strengths of this study include its prospective, randomized, controlled design, in which known risk factors for CSD were carefully controlled, allowing the uterine closure technique to be the primary variable of interest. In addition, all surgeries were performed at a single center by the same experienced surgical team, and all postoperative ultrasonographic assessments were conducted by the same blinded investigator using the same ultrasound de-

vice, thereby minimizing procedural and measurement variability.

Limitations

The study also presents several limitations. First, although the sample size was prospectively calculated and adequately powered for the primary outcome of RMT, it was not specifically powered to detect differences in the less frequent outcome of CSD incidence. Therefore, the absence of a statistically significant difference in the CSD rates should not be interpreted as evidence of equivalence among the uterine closure techniques, as a type II error cannot be excluded. Accordingly, the observed numerical differences in CSD incidence should be considered exploratory and hypothesis-generating in nature. Lastly, the relatively short follow-up period may have limited the assessment of longer-term scar remodeling and the development of CSD-related symptoms.

5. Conclusion

No significant differences in postoperative RMT were observed among the three double-layer continuous non-locking uterine closure techniques. As CSD incidence was evaluated as a secondary outcome, these findings should be considered exploratory. Larger prospective studies are warranted to clarify the effect of uterine closure techniques on the development of CSD.

Availability of Data and Materials

The datasets used or analyzed during the current study are available from the corresponding author on reasonable request.

Author Contributions

EO, HD, and HA designed the study. EO and HA performed the surgeries and collected the data. EO performed the ultrasonographic evaluations. HA analyzed the data. All authors contributed to manuscript preparation and critical revision. All authors read and approved the final manuscript. All authors agree to be accountable for all aspects of the work.

Ethics Approval and Consent to Participate

The study received approval from the Mersin University Clinical Research Ethics Committee (473/08.07.2020). This study was performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments. All participants included in the study were given detailed information about the study design and informed consent was obtained from each participant.

Acknowledgment

Not applicable.

Funding

This research received no external funding.

Conflicts of Interest

The authors declare no conflicts of interest.

Supplementary Material

Supplementary material associated with this article can be found, in the online version, at <https://doi.org/10.31083/CEOG52842>.

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