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The Effect of Uterine Closure Methods During Cesarean Section on Isthmocele Development

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Abstract

Objective: Isthmocele is frequently encountered due to the increasing rates of cesarean deliveries nowadays. This study aims to evaluate the effectiveness of uni-layer and dual-layer uterine closure techniques in preventing isthmocele formation 6 months post-cesarean delivery.

Methods: This retrospective study involved 57 women aged 18-35 who had planned cesarean sections after 38 gestational weeks with singleton pregnancies at our hospital between 2019 and 2020. Patients were categorized into 2 groups based on the uterine closure method used during the cesarean sections: uni-layer technique vs. dual-layer technique. The main outcome was the incidence of isthmocele formation at the post-operative 6th month. Secondary outcomes included the remaining myometrial thickness and posterior uterine wall thickness at the 6-month follow-up.

Results: At the 6-month post-cesarean section follow-up, ultrasound revealed isthmocele formation in 17 patients (60.7%) in the uni-layer group and 6 patients (20.6%) in the dual-layer group. The remaining myometrial thickness (RMT) was 5.7 ± 1.4 mm in the uni-layer group and 6.5 ± 1.4 mm in the dual-layer group (P = .04). Remaining myometrial thickness and posterior uterine wall thickness were positively correlated.

Conclusion: The isthmocele development was significantly affected by the uterine closure method. The dual-layer closure method can be used to reduce the risk of isthmocele development.

Keywords: Isthmocele, dual-layer uterine closure, cesarean scar defect, niche, remaining myometrial thickness

Introduction

The global increase in cesarean deliveries has brought about short- and long-term complications.[1] Among these long-term complications is the cesarean scar defect (niche or isthmocele), which occurs due to insufficient healing of the isthmic myometrium at the previous uterine scar. An isthmocele manifests as a triangular indentation in the anterior uterine wall, typically forming after previous cesarean section surgery.[2] It has also been described as indentations within the myometrium at least 2 mm in depth, with a base associated with the endometrial cavity.[3] The real prevalence of isthmocele is unknown due to the lack of standardization in definition and evaluation methods.[2] In fact, the prevalence varies between 6.9% and 69%.[4] The most common complaint is abnormal uterine bleeding, especially postmenstrual spotting, while most of the cases remain asymptomatic. Also, other gynecological problems such as pelvic discomfort, dysmenorrhea, and secondary infertility may be linked to the presence of isthmocele.[5]

Isthmocele development and remaining myometrial thickness in the uterine scar are critical risk factors for serious complications in subsequent pregnancies, including uterine scar dehiscence, uterine rupture, placental adhesion disorders, and cesarean scar pregnancies.[6] While investigations into potential risk factors for isthmocele formation continue, associations have been found with uterine closure techniques, the number of cesarean deliveries, and labor preceding cesarean delivery.[5] The healing of the uterine scar and remaining myometrial thickness may be influenced by the surgical technique employed during uterine closure in a cesarean section. Despite many comparative studies, the optimal closure technique has not been clarified yet.[7-9] Even though isthmocele can be repaired by hysteroscopy and laparoscopy with a high success rate, prevention of isthmocele formation should be the main goal.[10]

The present study aims to compare the uni-layer technique with the dual-layer method regarding their impact on isthmocele development assessed through transvaginal ultrasound 6 months after cesarean delivery.

Methods

This retrospective study enrolled 60 women aged 18-35 who had planned cesarean sections after 38 gestational weeks with singleton pregnancies at our hospital between 2019 and 2020. The Institutional Ethics Committee of İstanbul University-Cerrahpaşa, Cerrahpaşa Faculty of Medicine approved our study (Approval no: 39675, Date: March 11, 2019), and ethical principles outlined in the Declaration of Helsinki were strictly followed. All patients gave informed consent.

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We included women aged 18-35 years who underwent planned cesarean delivery after 38 weeks of gestation with singleton pregnancies. Cesarean delivery indications were maternal preference, cephalopelvic disproportion, macrosomia, and abnormal presentation. Exclusion criteria comprised multiple pregnancies, body-mass index (BMI) >35, gestational diabetes, gestational hypertension/preeclampsia, thrombophilia, prior cesarean or uterine scar, myoma uteri, uterine anomalies, active labor before cesarean section, failure to progress during labor, unsuccessful induction of labor, cesarean delivery before 38 weeks of gestation, placental abruption, or placenta previa. The 60 patients were divided into 2 groups according to the uterine closure technique during cesarean section. Our main outcome was the isthmocele development rate at the post-operative 6th month, comparing uni-layer and dual-layer uterine closure techniques. Secondary outcomes included remaining myometrial thickness and posterior uterine wall thickness at the post-operative 6th-month follow-up.

Baseline characteristics included maternal age, BMI, gestational age, and fetal weight. The uterus was checked using an ultrasound at the post-operative 6th month in our clinic, taking into account that uterine wound healing completes after this timeframe.[11] The presence and size of isthmocele, along with remaining myometrial thickness above the isthmocele and posterior uterine wall thickness, were measured using transvaginal ultrasound (GE Voluson S6 device, frequency range: 7-9 MHz) and recorded. Isthmocele depth was determined as the shortest perpendicular distance between the apex of the isthmocele and the endometrial line.

Surgical Technique

The skin was cleansed using povidone-iodine prior to surgery. Patients received 1 g of cefazolin sodium intravenously 1 hour before the skin incision was made. A Pfannenstiel incision was utilized for the cesarean section, and a Kerr incision was performed on the lower uterine segment. The low transverse uterine incision was sutured using either a uni-layer or a dual-layer closure method. In the second layer of the dual-layer closure method, continuous running sutures were also employed to approximate the myometrium, while simultaneously imbricating the wound lips to ensure hemostasis. Synthetic absorbable No. 1 Polyglactin (Coated VICRYL® [polyglactin 910] Sutures, Ethicon, NJ, USA) was used for uterine incision repair in all cesarean section procedures conducted in this study.

Statistical Analysis

The statistical analyses were done using the Statistical Package for Social Sciences version 20.0 software (IBM Corp.; Armonk, NY, USA). The post hoc power analysis of the collected cohort was conducted using the E-PICOS online post-hoc power calculator, comparing the rate of isthmocele development between the 2 groups. The power calculation yielded 88.9%, suggesting a robust sample size.[12] Kolmogorov–Smirnov test was conducted for normal distribution control. Normally distributed values were compared using the Student's *t*-test, and non-normally distributed values were compared using the Mann–Whitney *U* test. The categorical variables were presented as numbers and percentages. The normally distributed variables were expressed as mean (±) standard deviation (SD), while non-normally distributed variables were presented as median (minimum–maximum). Pearson's correlation analysis was employed to assess correlations. $P < .05$ was considered statistically significant.

Results

The study comprised 57 patients, with 28 patients in the uni-layer group and 29 patients in the dual-layer group. General parameters of the patients are shown in Table 1. There were no significant differences regarding age, BMI, gestational week at delivery, and fetal weight between the 2 groups (Table 1).

Postoperative evaluations revealed that remaining myometrial thickness and posterior uterine wall thickness were found to be significantly lower, while the rates of isthmocele development were notably higher in the uni-layer group. During the 6th-month outpatient clinic visit, 17 patients (60.7%) in the uni-layer group and 6 patients (20.6%) in the dual-layer group were diagnosed with isthmocele based on their sonography reports. The remaining myometrial thickness in the uni-layer group was 5.7 ± 1.4 mm, significantly thinner than the value in the dual-layer group (6.5 ± 1.4 mm) ($P = .04$) (Figure 1).

A positive correlation was identified between remaining myometrial thickness and posterior wall thickness (Figure 2).

Discussion

In this study investigating the impact of uni- vs. dual-layer uterine closure methods during cesarean delivery on the uterine scar, it was demonstrated that employing a dual-layer closure technique resulted in lower rates of isthmocele development, as well as higher remaining myometrial thickness and posterior uterine wall thickness. These findings, consistent with prior research,

Table 1. Comparison of Cases with Uni-layer and Dual-layer Closure Technique

	Uni-layer Closure (N: 28)	Dual-layer Closure (N: 29)	*P*
Age, mean ± SD	26.6 ± 4.1	27.6 ± 5.0	.388
BMI, mean ± SD	26.2 ± 2.0	27.3 ± 2.0	**.06**
Gestational age at delivery, mean ± SD	38.2 ± 0.8	38.1 ± 1.1	.653
Fetal weight, mean ± SD (g)	3366.8 ± 287.0	3438.9 ± 352.5	.483
Remaining myometrial thickness, mean ± SD (mm)	5.7 ± 1.4	6.5 ± 1.4	**.04**
Posterior uterine wall, mean ± SD (mm)	11.2 ± 1.6	12.1 ± 1.7	**.046**
Formation of isthmocele, n/N (%)	17/28 (60.71%)	6/29 (20.68%)	**.002**

BMI, body mass index; n, number of cases that developed isthmocele in each group; N, total number of patients in each group; SD, standard deviation.

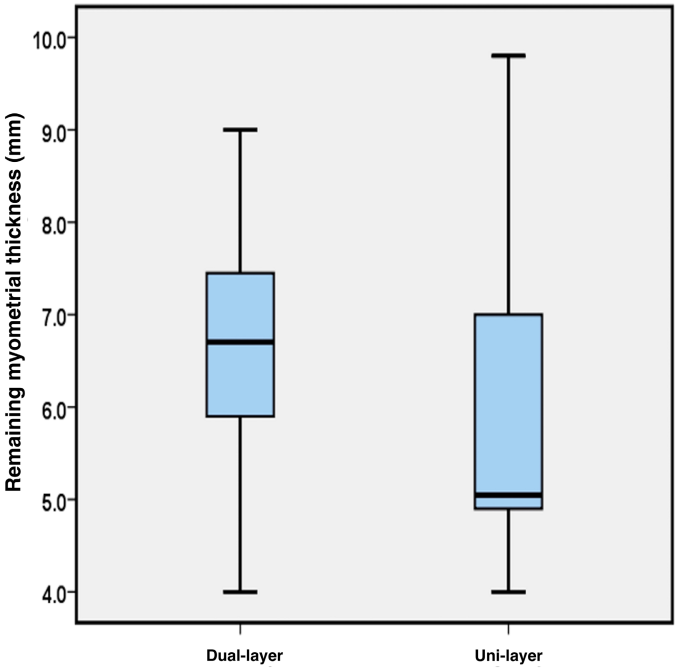

Figure 1. Remaining myometrial thickness in cases with uni- and dual-layer closure.

emphasize the significance of the uterine closure technique as a determinant of myometrial scar healing and subsequent complications, such as isthmocele development.[9]

As previously mentioned, isthmocele often remains asymptomatic, and its prevalence in symptomatic patients remains unknown.[13] However, it is foreseeable that as the number of cesarean deliveries increases, the incidence of isthmocele will rise steadily. In our study, the incidence of isthmocele was 20.6% in the dual-layer closure group and 60.7% in the uni-layer closure group. Variations in diagnostic methods, criteria, and timing of postoperative evaluations contribute to the wide range of reported isthmocele prevalence. The debate in the literature regarding the superiority of uni- versus dual-layer uterine closure persists.[14] Studies of CORONIS and CAESAR have reported that surgical technique does not significantly impact isthmocele development at the 6-week follow-up for patients receiving uni- and dual-layer sutures.[15] Despite differences in surgical techniques, meta-analyses, such as one by Di Spiezio et al, have found similar niche depth and scar defect incidence.[7] Nevertheless, numerous studies suggest a preventive role for the dual-layer closure method in isthmocele formation.[16] In our study, the dual-layer technique showed a reduced rate of isthmocele development. We propose that the meticulous approximation of uterine wound lips with the dual-layer technique enables superior anatomical restoration and uterine integrity.

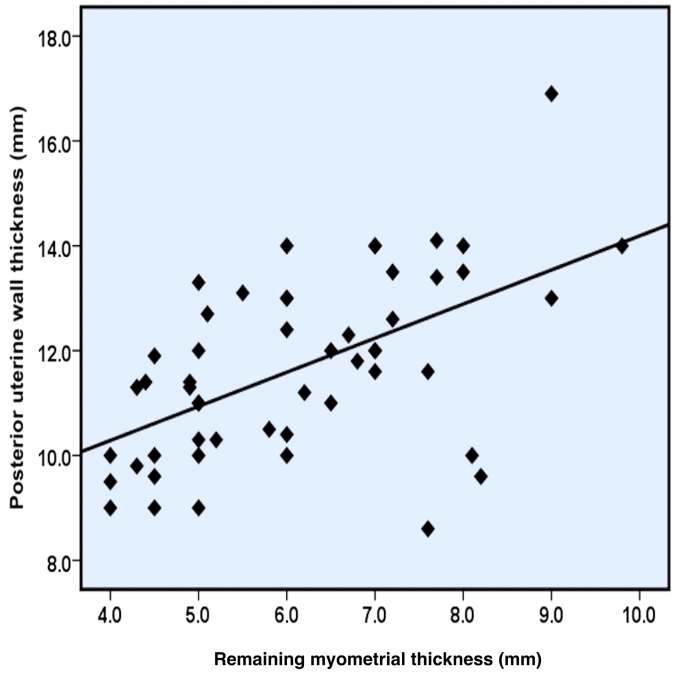

Figure 2. Correlation between remaining myometrium thickness and uterine posterior wall thickness.

Hamar et al[17] reported that 6 weeks after cesarean delivery, there was no notable difference between the single layer vs. double layer closure groups in terms of isthmocele formation. However, the scar remodeling process has been shown to be incomplete by magnetic resonance imaging before 6 months in other studies.[18] Considering this information, we preferred to perform the follow-up of our patients at the 6th month after cesarean section. Accordingly, the incompatible results of our study may be due to the variance in the follow-up timing.

The decision to perform single or dual-layer suturing is crucial for reducing the likelihood of complications such as uterine rupture and scar pregnancy in future pregnancies, as well as maintaining the integrity of the uterine scar. Remaining myometrial thickness and isthmocele formation indirectly reflect poor scar healing and subsequently serve as predictors of adverse outcomes. Consequently, numerous studies have examined the relationship between RMT and suture technique.[19,20] In Roberge et al's study, patients who underwent dual-layer suturing exhibited significantly thicker remaining myometrium thickness compared to those with uni-layer suturing at the 6th month after cesarean section.[21] Similarly, Hayakawa et al.[22] compared uni-layer closure and dual-layer closure techniques and demonstrated that RMT was notably greater in the dual-layer closure group. Bamberg et al. conducted evaluations 6 months after primary cesarean section and reported no significant difference in isthmocele formation based on suturing technique; however, remaining myometrium thickness was notably greater in the dual-layer group.[23] While our study demonstrated a correlation between the dual-layer suture technique and thicker RMT, we lack clinical data for the subsequent pregnancies in our patients.

Tissue oxygenation and mechanical tension between wound edges are 2 critical factors influencing tissue healing. Increased mechanical stress in the myometrium leads to reduced blood flow and tissue oxygen supply, thereby adversely affecting tissue healing and resulting in incomplete myometrial repair with scar formation.[24] Consequently, our primary objective in evaluating the impact of uni- vs. dual-layer closure techniques on isthmocele formation was to address the question of how we can minimize ischemia in the myometrium. Insufficient closure of the uterine wall and subsequent tissue eversion or inversion can hinder wound healing in the uterus.[25] The pursuit of preserving the endometrium may inadvertently lead to neglecting closure of the deeper myometrial layer, resulting in disrupted myometrium. Eversion of the myometrium into the serosa may lead to pathological adhesions in the peritoneum, while inversion may cause endometrial defects in the uterine cavity.[3] The infiltration of the endometrium into the myometrium can induce the

onset of adenomyosis formation and exacerbate isthmocele development.[26]

In the studies investigating the impact of uni- and dual-layer closure techniques on wound healing, the thickness of the posterior uterine wall has not yet been explored. In our study, we tried to reveal the relationship between suturing technique and posterior wall thickness by measuring myometrial thickness at the 6th month follow-up. Our findings revealed that the posterior myometrium was notably thicker in the dual-layer technique group and positively correlated with the remaining myometrial thickness. We hypothesize that patients undergoing the dual-layer closure technique experience less impairment of smooth muscle nutrition, leading to improved uterine integrity and recovery.

The strength of our study is the adequate sample size, which included women who underwent primary cesarean deliveries without any previous uterine scars and experienced active labor, with an appropriate monitoring duration of 6 months for evaluating isthmocele presence. Moreover, to mitigate potential biases stemming from variations in surgical techniques among different surgical teams, all operations were performed by the authors. Nonetheless, our study is subject to limitations. These include the lack of short- and long-term monitoring for conditions such as endometritis, chorioamnionitis, secondary infertility, and complications arising in future pregnancies. Isthmocele is frequently encountered due to the rising rates of cesarean deliveries. We have demonstrated that the closure technique employed during cesarean section significantly influences isthmocele formation. Furthermore, we observed that the dual-layer technique was associated with thicker remaining myometrium and posterior uterine wall thickness, both indicative of better uterine recovery. Based on the significant findings from our study and supporting evidence from the literature, we recommend the adoption of the dual-layer closure method during cesarean section.

Availability of Data and Materials: The data that support the findings of this study are available on request from the corresponding author.

Ethics Committee Approval: Ethics committee approval was received for this study from the Ethics Committee of İstanbul University-Cerrahpaşa, Cerrahpaşa Faculty of Medicine (Approval no: 39675, Date: March 11, 2019).

Informed Consent: Written informed consent was obtained from patients who participated in this study.

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Declaration of Interests: The authors have no conflict of interest to declare.

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