ORIGINAL RESEARCH

The Effects of Uterine Closure Techniques Single Layer Locking, Modified Lembert, and Laterally Continuing Suture on Uterine Scar Development: A Cohort Research

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ABSTRACT Objective: Incomplete healing of a cesarean scar is a mid-term complication of cesarean section and is widely known to be associated with many gynecological symptoms. In this study, we evaluated the correlation between uterine closure suture techniques in the development of uterine scar defect after cesarean section. **Material and Methods:** The study was conducted prospectively with 131 patients who applied to single center between April 2022 and September 2022, who had an emergency or elective cesarean section indication and had their first cesarean section. Three types of suture techniques were applied to the cesarean section: 42 with single-layer locking (Group 1), 44 with modified Lembert (Group 2), and 45 with sutures continuing from the lateral to the medial (Group 3). Scar thickness-hyperechogenicity, myometrial thickness-vascularization, operating time and number of sutures used for closure of the uterus evaluated by transvaginal ultrasonography (TVUSG) in patients who were called for control at the postoperative 6th week after cesarean section were compared between the groups. **Results:** The scar thickness detected by TVUSG at postoperative 6th week; in the modified Lembert suture technique, it was found to be less than the other two suture types (p=0.001). Myometrial thickness was also observed to be less in the modified Lembert suture technique compared to the other two groups (p=0.019). **Conclusion:** In this study, it was shown that the uterine scar and myometrium thickness were thinner and the scar hypercogeneity was less in the modified Lembert closure suture technique in the evaluation performed with TVUSG at the 6th week.

Keywords: Cesarean section; locking suture technique; Lembert suture technique; lateral to medial suture technique and scar

Cesarean section is a life-saving operation for mother and baby, and the number of cesarean deliveries has been increasing due to various reasons by physicians and expectant mothers all over the world in recent years compared to normal vaginal delivery. Cesarean section is also the most common major surgical operation performed in women. This rate has increased from 20.7% (1996) to 32.9% (2012) worldwide.[1] The etiology of this increase in the frequency of cesarean section includes fetal monitoring, the shift of the first pregnancies to advanced ages, the increase in socioeconomic level, the more widespread use of ultrasonography, the career anxiety of physicians due to medicolegal reasons, and the fear of normal birth in the expectant mother.[2-5] It is expected that the complications associated with this process will increase with the increasing rates of cesarean section in the world every year.[6,7]

Uterine rupture, scar pregnancy, placental insertion anomalies, and hospital stay also increased with the increase in cesarean delivery rates.[8] The severity of these complications necessitated the examination of cesarean section techniques and the search for the most accurate method to preserve maternal and fetal well-being.[9]

Although little is known about the long-term complications of cesarean section, it is seen that the most common complications are related to the cesarean scar line.[10,11] Various techniques have been described and evaluated for cesarean delivery, especially regarding uterine closure.[12,13] Therefore, myometrial closure methods should be evaluated by considering maternal complications in subsequent pregnancies.

It causes gynecological disorders such as abnormal uterine bleeding, postmenstrual spotting, dysmenorrhea, dyspareunia, chronic pelvic pain, and secondary infertility that affect the quality of life due to cesarean section-related scar defects. Rare complications from scars resulting from hysterotomy incision can develop. It is caused by inadequate healing of the myometrium at the incision site. Its thinning is known as cesarean scar defect. This situation is also known as niche or isthmocele.[14-16] Incomplete healing of the cesarean scar is a well-known sequelae of cesarean section and may be associated with complications in later pregnancies.[17]

In recent years, there has been an increase in studies using ultrasound to describe scar defects as incomplete, weak, and inadequate to correlate the functional integrity of the lower uterine segment with the morphology of the scar.[18] Considering the relationship between uterine scar defect and gynecological symptoms, obstetric complications and potential subfertility, it is important to elucidate the etiology of scar development after cesarean section and to develop preventive strategies.[19] Inadequate surgical techniques applied when closing the uterus, down-located uterine incision extending to the cervical tissue, surgical interventions that increase adhesion development, patient-related factors that impair wound healing and increase the development of inflammation are possible factors that play a role in scar development.[19]

Although the optimal duration of uterine scar healing is not exactly known, some studies have stated that it may be between 6 weeks and 6 months. Although it is appropriate to perform postoperative control at both the 6th week and the 6th month, this makes it difficult to reach patients for control, and it would be appropriate to perform any of these periods. It should also be kept in mind that the statistical calculation will be more complicated this time.[20,21]

Transvaginal ultrasound examination is a reliable method to detect cesarean scar defects. Transvaginal ultrasound provides information about the thinness of the residual myometrium, which increases the risk of uterine rupture. Any problem associated with the presence of a cesarean scar is significant both at the individual and societal level.[22]

The continuous suture locking technique is performed by placing friction points on the suture along the length of the wound to reduce the suture's tendency to loosen as the remainder of the suture is placed. It turns the lips of the wound inward and never passes through the mucosa, so contamination is unlikely. The Lembert suture is the simplest model that can be used for internal organs, performed relatively quickly. In addition to the locking suture technique, the suture technique that continues from the laterals to the medial is starting with separate sutures from both sides of the incision lips and connecting the sutures in the middle.[23]

In this study, we compared the single-layer locking, modified Lembert, and lateral to medial suture techniques. Our aim is to evaluate the effect of uterine closure techniques on the development of uterine scar defect after cesarean section.

MATERIAL AND METHODS

This study was conducted in a prospective plan with a total of 131 female patients who were admitted to the Denizli State Hospital Gynecology and Obstetrics Clinic between April 2022 and September 2022 and had an emergency or elective cesarean section indication. All procedures in this research were applied in compliance with the principles of the Helsinki Declaration 2008. The cesarean section was closed using single-layer locking in 42 patients, modified Lembert in 44 patients, and continuous suture from lateral to medial in 45 patients. These closure techniques are depicted in Figure 1, Figure 2, and Figure 3.

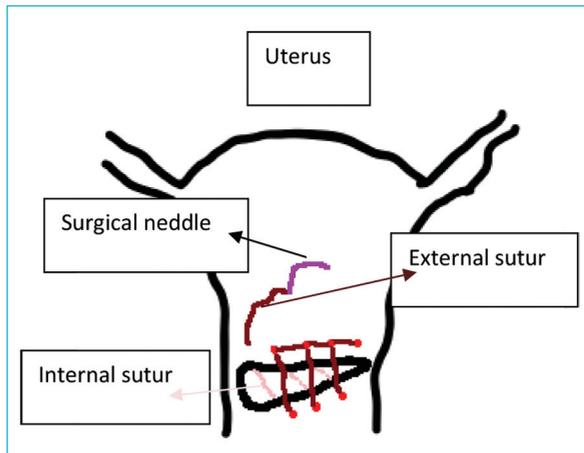The women included in the study were between the ages of 18-38 and had no comorbid diseases.

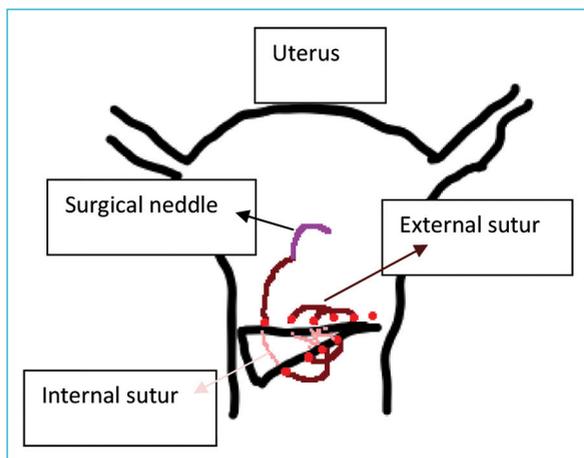**FIGURE 1:** Single-layer locking suture technique.

FIGURE 2: Modified Lembert suture technique.
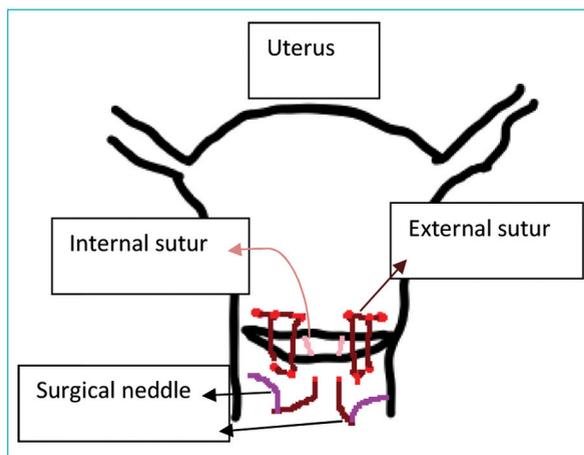

FIGURE 3: Suture technique from lateral to medial.

Pregnant women with a history of uterine surgery including previous cesarean section, bleeding diathesis, preeclampsia, non-progressive labor, gestational diabetes mellitus, multiple pregnancies, preterm pregnancies (before 37 weeks of gestation and pregnant women) with placental location-invasion anomaly (placenta previa, placenta accreta, placenta increta, placenta percreta) were not included. The study was approved by the Ethics Committee of Pamukkale University with date: March 18, 2022, no: E.184944. All patients gave their informed consent.

A 14-16 F Foley catheter was placed in the bladder in all cases. For surgical prophylaxis before cesarean section, 1 g of cefazolin sodium was administered to all patients. The anesthesia method to be applied to the patient was determined by the anesthesiologist just before the operation. 93 of 131 patients were given general anesthesia and 38 of them spinal anesthesia. Skin cleansing was performed with povidone iodine before the operation. The abdomen was entered with a Pfannenstiel incision made two cm above the symphysis pubis, and a lower segment transverse incision was made into the uterus. After the baby was removed, the uterus was taken outside the abdomen in each case and sutured externally. During the operation, the incision line of the lower segment of the uterus was removed as a complete layer with the myometrium and endometrium structure superior. As a locking stitch; this was accomplished by placing friction points on the suture along the length of the wound to reduce the tendency of the suture to loosen while placing the remainder of the suture. The continuing suture was passed through the previous suture and continued. It was accomplished with the locking technique, by threading the suture through the previous stitching cycle. Thus, as the process was completed, the interlocking stitches helped keep each previously thrown stitch tight. It was turned the lips of the wound inward and never was passed through the mucous membrane. The modified Lembert wound was sutured continuously without locking by turning the lips of the wound inward and turning back a certain amount from the middle of the previous suture. Separate sutures were started from both sides of the incision lips with the suture continuing from the laterals to the medial, and the sutures were connected in the middle by locking them together (Figure 1, single-layer locking; Figure 2, modified Lembert; and Figure 3, continuing from lateral to medial, are attached.) Uterine wound

lips were closed with number one vicryl suture (1/0 polyglactin 910). If there were bleeding sites after closure of the uterus, additional sutures were placed with number one or No: 1/0 vicryl (1/0 polyglactin 910) in patients in both groups. Visceral and parietal peritonees were closed with No: 2/0 vicryl (2/0 polyglactin 910) in all patients. The fascia was sutured continuously with vicryl number one (1/0 polyglactin 910) at 10 mm width and 10 mm apart from the wound edges. The skin was closed subcuticularly with No: 2/0 sharp vicryl (2/0 polyglactin 910). After the operation was completed, the skin-to-skin operating time was recorded.

While in the hospital, the patients were treated with IV 1 g cefazolin sodium for a total of 4 doses, and on discharge, the patients were treated with 200 mg cefpodoxime proxetil orally for 1 week. If necessary, pain treatments were arranged with diclofenac sodium both in the hospital and on discharge. In the postoperative period, uterine anterior wall myometrial thickness measurement was performed with transvaginal ultrasonography (TVUSG). "eSaote My Lab Six" and "4-9MHz" frequency vaginal probe was used as ultrasound device. All ultrasound controls were performed by the same brand device and the same experienced surgeon, while the bladder was empty, transvaginally, in two dimensions. Patients who were called for control at the postoperative 6th week were evaluated by TVUSG in the uterus transverse and midsagittal longitudinal axis. By evaluating the presence of scar at the incision line in the uterus, the depth of the scar area and the thickness of the anterior wall residual myometrium tissue were measured. Scar echogenicity and scar vasculization were also evaluated. Uterine images of each patient in the midsagittal longitudinal axis were recorded on the device. The distance between the scar tissue and the serosa of the uterus is called scar thickness. The so-called myometrial thickness is the entire thickness of the uterus where the scar tissue is. The brightness in the scar area on ultrasound is called scar hyperechogenicity. The appearance of vascular structures in ultrasound dopes is called scar vascularization (Figure 4, Figure 5, Figure 6, and Figure 7).

In addition, groups were compared with regard to myometrial thickness, scar hyperechogenicity, vas-
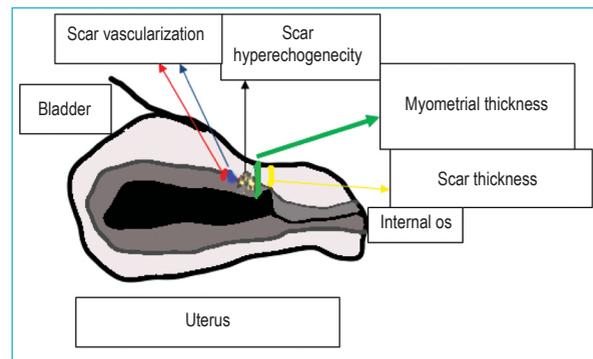

FIGURE 4: Illustration of transvaginal ultrasound measurements.

FIGURE 5: Transvaginal ultrasound illustrating measurements of scar **(A)** and myometrial thickness **(B)**.

FIGURE 6: Scar hyperechogenicity.

cularization, and operating time at the postoperative 6th week, the number of patients, postoperative erythrocyte replacement requirement, development of intra-abdominal hematoma, age, gravida, parity, and body mass index (BMI).

STATISTICAL ANALYSIS

Statistical analysis was done using IBM SPSS Statistics version 20 (SPSS Inc, Chicago, IL, USA). De-
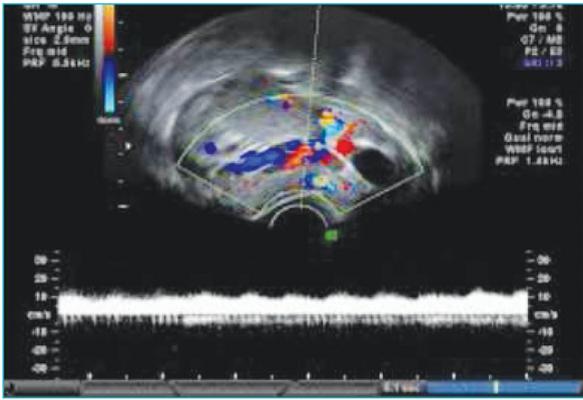
FIGURE 7: Scar vascularisation.

scriptive statistics were given as numbers and percentages for categorical variables, mean and standard deviations for numeric variables. One-way analysis of variance test, K-independent-samples test or chi-square test were used for three-group comparisons. Those with a probability level of $p<0.05$ were considered statistically significant. But since there were 3 groups in our study, using Bonferroni adjustment for multiple comparisons, a p value <0.025 was considered significant (as in most studies).

RESULTS

A total of 142 women were screened and 131 agreed to participate and were randomized. In our study, the data of a total of 131 patients were evaluated, including 42 patients with single-layer locking, 44 patients with modified Lembert, and 45 patients who were sutured from the lateral to the medial (Figure 8). The characteristics of the patients for all three groups are shown in Table 1. The mean age of patients with single-layer locking was 26.71±4.62, modified Lembert was 25.55±4.62, and 25.6±4.36 from with lateral to medial. There was no significant difference between the groups in terms of age, gravida, parity, gestational week, and BMI (p=0.414, p=0.881, p=0.309, p=0.27, p=0.175) (Table 1).

The scar thickness at the 6th postoperative week was 7.96±2.57 mm in the single-layer locking group, 6.23±1.97 mm in the modified Lembert group, and 6.45±2.34 mm in the group that continued from the lateral to the medial. Myometrial thickness at postoperative 6th week was 27.2±5.63 mm in the single-layer locking group, 24.07±4.5 mm in the modified
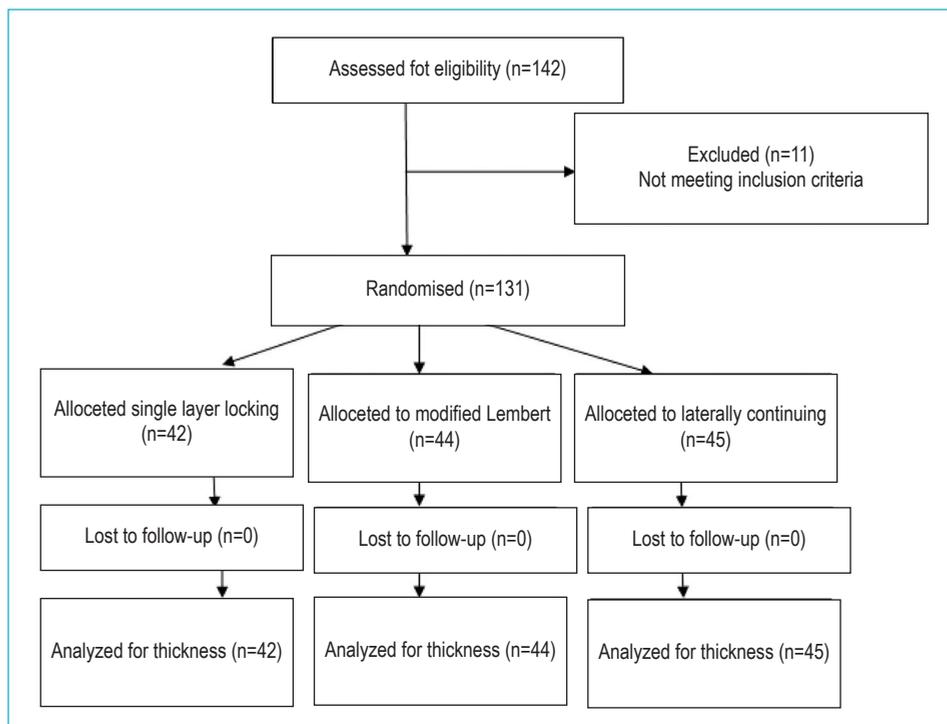

FIGURE 8: Flow chart.

TABLE 1: The comparison of patient and technical characteristics between groups.					
	Total patients (n=131)	Group 1 Single-layer lock (n=42)	Group 2 Modified Lembert (n=44)	Group 3 From lateral to medial (n=45)	p value
Age	25.94±4.53	26.71±4.62	25.55±4.62	25.6±4.36	p=0.414
Gravida	2 (1-6)	2 (1-5)	2 (1-6)	2 (1-6)	p=0.881
Parity	1 (0-4)	1 (0-4)	1 (0-5)	1 (0-4)	p=0.309
Gestational week	39 (37-42)	40 (37-42)	39 (37-42)	39 (37-41)	p=0.27
Body mass index (kg/m²)	26.64±6.23	26.96±4.73	26.47±6.93	26.5±6.84	p=0.175
Scar thickness at 6 weeks postoperatively (mm)	6.86±2.41	7.96±2.57	6.23±1.97	6.45±2.34	**p=0.001**
Myometrial thickness (mm) at 6 weeks postoperatively	25.66±6.15	27.2±5.63	24.07±4.5	25.45±7.5	**p=0.019**
Scar vascularization at 6 weeks postoperatively	9.92%	16.67%	4.54%	8.89%	p=0.164
Scar hyperechogenicity at 6 weeks postoperatively	51.14%	69.04%	45.45%	40%	**p=0.017**
Operating time (min)	41.6±8.39	38.57±8.71	40.68±8.18	45.33±6.94	**p=0.001**
Number of sutures used in uterus	2.24±1.5	1.48±0.69	2.48±1.35	2.73±1.78	**p=0.001**
Postop erythocyte suspension need	5.34%	7.14%	4.54%	4.44%	p=0.82
Presence of postoperative intra-abdominal hematoma	2.29%	2.38%	0%	4.44%	p=0.374

Lembert group, and 25.45±7.5 mm in the group that continued from the lateral to the medial. The presence of scar echogenicity at postoperative 6th week was 69.94% in the single-layer locking group, 45.45% in the modified Lembert group, and 40% in the group that continued from the lateral to the medial. The duration of the operation was 38.57±8.71 minutes in the single-layer locking group, 40.68±8.18 minutes in the modified Lembert group, and 45.33±6.94 minutes in the group that continued from the lateral to the medial. The number of sutures used when closing the uterus was 1.48±0.69 in the single-layer locking group, 2.48±1.35 in the modified Lembert group, and 2.73±1.78 in the group that continued from the lateral to the medial (Table 1).

It was found that both the scar thickness and myometrial thickness were less in the modified Lembert and lateral to medial suture techniques determined by TVUSG for anterior wall myometrium thickness at the 6th postoperative week compared to the single-layer locking suture technique (p=0.001). The presence of scar hyperechogenicity was more common in the single-layer locking group (p=0.017). In addition, the operating time and the number of sutures used when closing the uterus were significantly less in the single-layer locking group than in the other two groups (p=0.001 and p=0.001) (Table 1).

There was no significant difference between the groups in terms of scar vascularization, need for postoperative erythocyte suspension, and the presence of postoperative intra-abdominal hematoma at postoperative 6 weeks (p=0.164, p=0.82, and p=0.374) (Table 1).

DISCUSSION

This single-center study, which we conducted in Denizli State Hospital Gynecology and Obstetrics Clinic in a period of approximately six months, a single layer was applied to 42 of 131 patients who had an emergency or elective cesarean section indication and had their first cesarean section. Three types of suture techniques were applied, 42 with locking, 44 with modified Lembert and 45 with sutures continuing from the laterals to the medial. As the primary results of this study, while the presence of scar and myometrial thicknesses and scar hypergenicity in TVUSG at postoperative 6th week were less common in the modified Lembert group, the operating time and the number of sutures used in the operation were found to be less in the single-layer locking group. As secondary results, each different suture technique used affects the patient's recovery time, complaints such as postoperative menorrhagia, the cost of the operation, the duration of anesthesia, and the rates of cesarean scar in subsequent pregnancies. Myometrial

and scar thickness of uteruses sutured with modified Lembert and locking suture from lateral to medial means that myometrial healing may be better in future rotations. However, it has also been understood that the operating time may be shorter and cost may be more affordable when using a single-layer interlocking suture.

Although cesarean section is a widely performed operation worldwide, there is limited information about the most appropriate surgical technique. There is increasing evidence that short-term maternal outcomes are equivalent for many techniques. Until the long-term effects on health are known, surgeons should continue to use the technique they currently use and prefer.[24] In most randomized controlled studies, positive or negative results could not be found in terms of surgical technique, and long-term follow-up of these patients could not be performed.[25] TVUSG offers a non-invasive approach to the visualization of the scar defect and is extremely sensitive in identifying defects. The liberal use of TVUSG has increased the detection of cesarean scar defects. In our study, the patients were followed up with TVUSG for a period of six weeks; the patients included in our study consist of patients with lower segment incision who had their first cesarean section. Comparison of single-fold locking, modified Lembert and lateral to medial sutures were performed with transvaginal ultrasound.

For the closure of the uterus, single layer or double layer, various methods, intermittent and either permanently locked or unlocked have been defined.[26] Some studies suggest that single-layer locking modification may increase the risk of uterine rupture by causing an increase in tissue hypoxia and insufficient healing.[27,28] In a study by Yasmin et al. comparing locked and non-locking suturing, it was shown that locked suturing of the first layer resulted in decreased myometrial thickness and increased blood loss.[29] In our study, both the scar and myometrial thickness were found to be higher than the single-layer locking suture technique, other modified Lembert and lateral to medial suture techniques.

In the study by Ceci et al. in which interrupted non-locking single-layer sutures and continuous-locked single-layer closure were compared, no difference was reported in the rate of scar defect on ultrasound 6-12 months after cesarean section. However, a larger scar defect was shown in the continuous locking single-layer closure sonographic evaluation.[30] Uterine closure with unlocked sutures, a thicker myometrium potentially may result in a lower prevalence of scars.[30] Double-layer closure with unlocked first layer is associated with better uterine scar healing than locked single layer.[20] Even when scar prevalence decreases, scar echogenicity increase is not observed.[29] In our study, scar hyperechogenicity was found to be less in modified Lembert and lateral to medial suture techniques compared to single layer locking technique.

In addition, uterine healing is examined in the 6th postoperative month, while uterine healing is examined in the 6th-8th week. Studies in the following week showed that scar tissue was more visible. In addition, although there is no significant difference in the uterine scar tissue examined after the 6th month in the literature, it has been found that the differences in uterine closure techniques are more evident in uterine surgeries performed after the 6th week. Finally, it has been determined that reaching patients will become more difficult as time goes by.[20,21] That's why we thought it would be more appropriate to evaluate our patients at the 6th week postoperatively, in order to have easier access to patients and to make our study meaningful.

The purpose of locking sutures is to increase the pressure and tension force at the suture and tissue interface and to provide support to the continued sutures. Monolayer, locked sutures not only reduce operating time, blood loss, but also reduce the amount of foreign body exposure of the tissue and offer less suture requirement.[29] In the systematic review and meta-analysis study conducted by Stegwee et al., the operating time (0.8-1.5 minutes) was shorter in single-layer closure.[31] In our study, the operating time was shorter and the number of sutures used in the operation was found to be less in the single-layer locking technique.

The most important limitations of our study are the fact that it examines the period of 6 weeks in the

postoperative period, covers a relatively short time in terms of symptom formation in patients, and the limited number of patients. In this context, there is a need for studies to be conducted with a larger number of patients and to cover longer periods.

CONCLUSION

In conclusion, our study showed that the scar and myometrial thickness after cesarean section, the number of sutures used in the operation and the duration of the operation may vary according to the uterine closure suture techniques. In the modified Lembert suture technique performed instead of the lower uterine cesarean section, the 6th week scar and myometrial thickness with TVUSG is thinner and the scar hypercogeneity is less. In addition, the duration of the operation and the number of sutures used when closing the uterus are less in the single layer locking suture technique.

Source of Finance

During this study, no financial or spiritual support was received neither from any pharmaceutical company that has a direct connection with the research subject, nor from a company that provides or produces medical instruments and materials which may negatively affect the evaluation process of this study.

Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

All authors contributed equally while this study preparing.

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