# Transvaginal Ultrasound Evaluation Of Cesarean Section Niche Scar During Pregnancy: A Prospective Longitudinal Study

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**Abstract:** Background and Objectives: To determine the prevalence of a CS scar niche during pregnancy using transvaginal ultrasound imaging, and to determine the relationship between the evolution of the CS scar niche and the ultimate pregnancy result. Materials and Methods: Transvaginal sonography was used in this prospective observational research to look at the uterine scars of 100 women at $11^{+0}$-$13^{+6}$, $18^{+0}$-$20^{+6}$ and $32^{+0}$-$35^{+6}$ weeks of pregnancy. When the region of hypoechogenic myometrial discontinuity of the lower uterine section was discovered, a scar was discernible while pregnant. An indentation at the location of the CS scar with a depth of at least 2 mm in the sagittal axis was designated as the CS scar niche (or "defect"). Myometrial thickness next to the niche and the remaining myometrial thickness were used to quantify the hypoechogenic portion of the CS niche in two dimensions. (RMT). The entire lower uterine segment (LUS) thickness and the myometrial layer thickness were measured during the second and third trimesters of pregnancy at the thinnest portion of the scar area. In a non-selected subset of patients (n=20), CS scars were measured by two separate examiners. Scar visibility was evaluated using descriptive analysis, and the intraclass correlation coefficient (ICC) was computed to demonstrate the degree of absolute agreement between two observers for measuring scars. Maternal age, BMI, smoking status, prior vaginal deliveries, obstetric complications, and a history of uterine curettage were among the factors looked into as potential contributors to the CS scar niche. The hospital's computerized medical database provided clinical statistics on pregnancy outcomes and complications. Results: 80.9% of the ladies could see the scar. A CS scar niche was prevalent in 53.6% of people with a noticeable CS scar. Excellent intra- and interobserver agreement was observed for CS scar niche readings. There was no statistically significant correlation between maternal age, BMI, gestational diabetes, smoking status, previous vaginal delivery after CS, and niche development when subgroups of women were compared in terms of CS scar niche and non-niche. In contrast to 34.4 % of the women who did not have uterine curettage, 56.3% of the women who had done uterine curettage had uterine scar niches. Conclusions: The CS scar niche could be reproducibly measured by a transvaginal scan in half of the cases with a visible CS scar at the first trimester of pregnancy, according to an ultrasonography evaluation. An increased chance of uterine niche formation in a subsequent pregnancy was linked to prior uterine curettage. The CS scar area may be connected to uterine scar dehiscence.

**Keywords:** Cesarean Scar Niche, Cesarean Scar, And Transvaginal Ultrasonography.

## 1. Introduction

Defects of the uterine scar seem to be a rapidly increasing problem caused by increasing Cesarean delivery rates worldwide. In recent decades, there has been an increasing number of studies that describe Cesarean section (CS) scars, but it is not known how the CS scar niche is associated with an increased risk of uterine dehiscence or rupture in labor. Ultrasonographic evaluation of the uterine scar has become an important element of obstetric and gynecologic practice, especially in further pregnancies. However, there is still limited evidence relating the CS scar niche to pregnancy outcome, yet the visibility and measurement of a CS scar on ultrasound examination may be clinically relevant. Many studies describing CS scars using ultrasonography have been conducted on non-pregnant and pregnant subjects **[1–5].**

A CS scar niche is described as a triangular, hypoechoic area defect at the site of a previous CS. It comprises two components: the hypoechoic part and the tissue contained within the residual myometrium **[1,5].** A large niche is defined as an incision of a depth of at least 50% or 80% of the anterior myometrium, or the remaining myometrial thickness ≤ 2.2 mm evaluated by TVS **[6].**

Previous studies proposed a standardized approach for assessing the hypoechoic component of the scar as the RMT measurement **[5].** The reported prevalence of CS niche varies within −24–70% using transvaginal scans (TVS) **[3,5,7].** There is a lack of evidence about potential risk factors of the CS scar niche. According to the literature, gestational diabetes, previous Cesarean delivery, and advanced body mass index are independent risk factors for niche development **[8].**

Few methods have been used to correlate lower uterine segment (LUS) measurements on pregnant status with the risk of uterine dehiscence or rupture **[9].** The LUS was measured by transabdominal ultrasoundin ; other studies, the muscular layer was measured by TVS [**10].** Unfortunately, no cut-off values have been tested. It is unknown whether the CS niche influences the type of delivery and pregnancy outcomes. Previous studies showed that TVS could reproducibly measure the CS scar niche, RMT, and LUS thickness, with good agreement between two observers [**10**]. Nevertheless, there is a lack of studies describing CS scars during pregnancy.

### Aim of the Study

The present study will investigate the prevalence of a Cesarean section (CS) scar niche during pregnancy, assessed by transvaginal ultrasound imaging, and relates scar measurements, demographic and obstetric variables to the niche evolution and final pregnancy outcome.

### Patient and Methods

The study will be conducted between April 2023 and July 2023 at the obstetrics and gynecology department of Damanhur Medical National Institute. In this prospective study, we will use transvaginal sonography to examine the uterine scars of 100 women at $11^{+0}$-$13^{+6}$, $18^{+0}$-$20^{+6}$ and $32^{+0}$-$35^{+6}$ weeks of gestation. A scar was defined as visible on pregnant status when the area of hypoechogenic myometrial discontinuity of the lower uterine segment was identified. The CS scar niche (“defect”) was defined as an indentation at the site of the CS scar with a depth of at least 2 mm in the sagittal plane. We will measure the hypoechogenic part of the CS niche in two dimensions, myometrial thickness adjacent to the niche and the residual myometrial thickness (RMT). In the second and third trimesters of pregnancy, the full lower uterine segment (LUS) and myometrial layer thickness will be measured at the thinnest part of the scar area. Two independent examiners measured CS scars in a non-selected subset of patients (n= 20). Descriptive analysis will be used to assess scar visibility. The intraclass correlation coefficient (ICC) will be calculated to show the strength of absolute agreement between two examiners for scar measurements. Factors associated with the CS scar niche were investigated, including maternal age, BMI, smoking status, previous vaginal delivery, obstetrics complications, and a history of previous uterine curettage. Clinical information about pregnancy outcomes and complications will be obtained from the hospital’s electronic medical database.

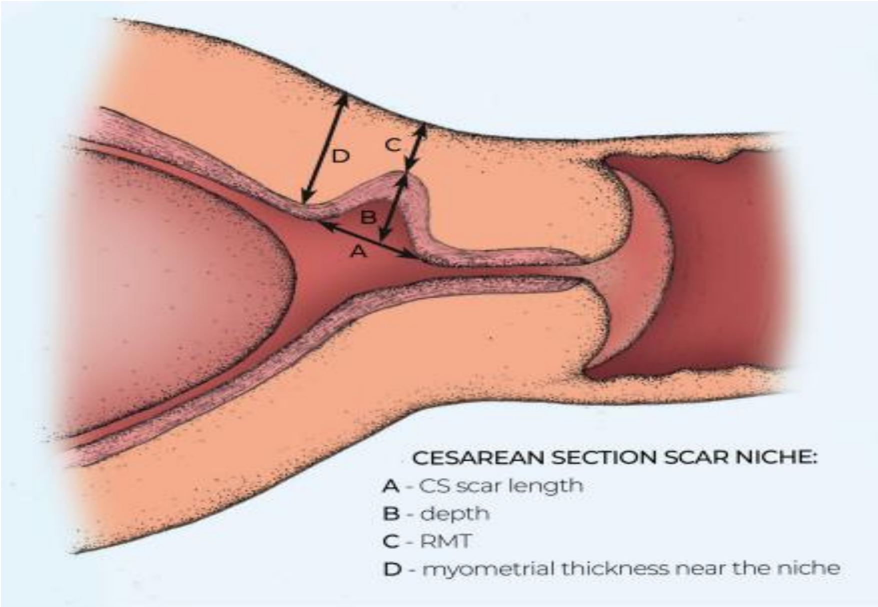


**Figure 1. Schematic diagram showing Cesarean scar niche dimensions in the sagittal plane. A;** niche length—the length of a hypoechoic part of the niche**; B;** depth of the hypoechogenic part of the niche**, C;** residual myometrial thickness**; D;** the thickness of the myometrium adjacent to the niche

### Inclusion Criteria

Pregnant women between the ages of 11 and 40 weeks of gestation coinciding with routine first-trimester screening, fetal anomaly screening, and growth assessment scans. Previous one or more CS. Absence of congenital anomalies. Normal position of the placenta

### Exclusion Criteria

Primigravida (PG), Structural uterine abnormality or large uterine fibroids distorting the anatomy, Multiple pregnancies, Intrauterine growth restriction, Polyhydramnios and Placenta previa or accreta.

**Informed consent:** All the patients will give written informed consent after being counseled regarding the study's objectives and procedure.

The first researcher will perform all ultrasound examinations in the lithotomy position, with an empty bladder at the first-trimester scan and a filled bladder at the second and third trimesters. All participating patients will undergo TVS at 11–14, 18–21, and 32–36 weeks of gestation, coinciding with routine first-trimester screening, fetal anomaly screening, and growth assessment scans. Ultrasound images of a CS scar will be classified subjectively as (1) a non-visible scar, (2) a visible scar without a niche, and (3) a CS scar niche when the depth of the hypoechoic part is 2 mm or more. When a CS scar is not visible or is without a scar niche, the myometrial thickness of the isthmus uteri at the level of the internal cervical os will be measured. When a CS scar is visible, measurements will be taken in the sagittal plane, the length (widest gap along the cervical canal), the depth of the hypoechoic scar part (the vertical distance between the base and apex of the visible defect), and RMT over the niche (defined as the distance from the bottom of the niche to the ureterovesical fold). The ratio (expressed as a percentage) between the thickness of the remaining myometrium over the niche and the thickness of the myometrium adjacent to and fundal to the defect will be calculated.

LUS and myometrial thickness at the area likely containing a CS scar will be assessed in the second and third trimesters of pregnancy, as previously described [**11**]. The local hospital image storage system (DICOM) will store all representative images. Data will be recorded prospectively on an SPSS spreadsheet. The second part of the study focused on the inter- and intraobserver variability for measuring CS scars. Overall, twenty consecutive cases are assessed by real-time scanning to evaluate the visibility of CS and measurements of CS scar niche as LUS and myometrial thickness by two independent investigators at every trimester of pregnancy. At each examination episode, the first researcher assessed the lower uterine segment in the sagittal plane to identify the CS scar area. The measurements then will be taken scar length, depth, RMT, and myometrial thickness adjacent to the niche. The second researcher talks about the examination of the same patient. He will be blinded to the findings of the first operator and repeat all the measurements twice. For intraobserver variability, the first researcher measured each scar dimension twice, and the results were recorded in a database. Patient management and pregnancy delivery will follow the hospital's policy. Obstetricians were blinded to the results of the CS scar ultrasound evaluation. All data about pregnancy outcomes and complications were retrieved from hospital records after delivery.

### Ethical Aspects

The study protocol will be approved by the Ethics Committee of the GOTHI research center. Written informed consent will be obtained from the patients or their legal representatives according to the patient's condition before enrollment.

### Statistical Analysis

Statistical analyses will be performed using SPSS Statistics v 27.0 (IBM Corp., Armonk, NY, USA). The median and 25th–75th percentile for the length and depth of the scar niche as RMT will be calculated in the first trimester of pregnancy, and LUS and myometrial thickness in the second and third trimesters. The statistical significance of the difference in categorical data will be determined using the Chi-square test or Fisher's exact test. Continuous variables were compared between groups (after one CS versus after two or more CS; CS scar niche group versus non-niche group) using the Mann–Whitney U-test. $p<0.05$ will be considered statistically significant. To determine systematic bias in uterine scar measurements between two researchers, the mean of differences and its standard error (SEM) are calculated. The limits of agreement between the two investigators will be calculated for each measurement as the mean ± (1.96×SD). For inter- and intraobserver agreement, the intraclass correlation coefficient (ICC) will be calculated. High absolute agreement corresponds to a high ICC (close to 1), with values > 0.75 indicative of a test with good agreement **[12]**.

## RESULTS

A total of 100 women were included to evaluate the appearance of CS scars. The uterine scar niche was discovered in 49/100 (40.2%) instances, whereas the CS scar was visible in 75/100 (75%) cases. 49/100 (49% of the women) of those with visible CS scars had a CS specialty. Each CS scar niche had a triangular form, and 33 of 50 (66%) of them were large (having an incision that extended at least half the depth of the anterior myometrium). Only two patients (2%) had a retroverted uterus during the first trimester of pregnancy; both had a uterine scar from a prior CS that was not evident. Between the two studies, there was complete agreement regarding scar niche visibility at the 11–13-week scan. Table 1 displays baseline demographic information.

Table 2 displays the size of the CS scar niche and the measurements of a low uterine segment during each stage of pregnancy. Only during the first month of pregnancy were CS scar niches visible. The two witnesses' systematic bias was evaluated. We discovered that during measurements in all three trimesters, there were no systematic biases between experts. Table 3 displays the boundaries of agreement as well as the means of differences between the two observers. The boundaries of agreement for CS scar niche measurements were small throughout all trimesters of pregnancy.

**Table 1: Demographic and obstetric history of the study population (*n* = 100)**

| Characteristic | Median (IQR) |
|---|---|
| Maternal age (years) | 33 (29–34) |
| BMI (kg/m$^2$) | 26 (21–28) |
| Gestational diabetes | 16 |
| Hypertension | 11 |
| Smoking during pregnancy | 17 |
| Previous uterine curettage | 31 |
| Previous VBAC | 7 |
| Previous postpartum infection | 4 |

BMI, body mass index at first trimester; VBAC, vaginal birth after Cesarean section; IQR, interquartile range.

**Table 2 : Size of scar niche and dimensions of LUS and myometrial thickness**

| Scar Characteristic (mm) | First Trimester Median (IQR) | Second Trimester Median (IQR) | Third Trimester Median (IQR) |
|---|---|---|---|
| **CS scar niche length** | 5.4 (3.9–7.0) | - | - |
| **CS scar niche depth** | 7.1 (4.8–9.7) | - | - |
| **RMT** | 4.8 (3.3–5.9) | - | - |
| **Myometrial thickness in the isthmus uteri** | 12.9 (10.8-14.5) | - | - |
| **LUS thickness** | - | 6.9 (5.2–9.1) | 4.2 (0.9–5.5) |
| **Myometrial thickness** | - | 3.9 (2.5–5.3) | 2.3 (1.7–2.7) |

CS, Cesarean section; RMT, residual myometrial thickness; LUS, low uterine full segment thickness; IQR, interquartile range.

We determined that a difference of 1 mm in the CS scar niche measurements taken by two observers was adequate for intra-observer comparisons. In 91% of the instances, the scar measurements differed by less than 1 mm because RMT over the scar niche was 100%. In 84% of cases, the change in myometrial thickness at the internal cervical os was less than 1 mm.

All scar measurements had flawless intra-observer agreement throughout the entire course of the pregnancy, with an ICC ranging from 0.73 to 0.95 for all scar measurements (Table 4). In the first trimester, there was 83.6% interobserver agreement for the length, depth, and RMT of the CS scar niche between two separate observers.

Overall, the ICC for all metrics across all trimesters of pregnancy and for the length of the CS scar niche was greater than 0.75. (Table 4).

**Table 3 Mean (±SEM) of differences between and 95% limits of agreement (LoA) for CS scar niche and low uterine segment measurements by two researchers across all three trimesters (n=20)**

| Scar Characteristic (mm) | First Trimester Mean ± SEM of Difference (95% LoA) | Second Trimester Mean ± SEM of Difference (95% LoA) | Third Trimester Mean ± SEM of Difference (95% LoA) |
|---|---|---|---|
| **CS scar niche length** | −0.320 ± 0.45 (+3.723 to 3.123) | - | - |
| **CS scar depth** | −0015 ± 0.2 (−1.565 to 1.536) | - | - |
| **RMT** | −0.117 ± 0.15 (−1.142 to 0.914) | - | - |
| **Myometrial thickness in the isthmus uteri** | −0.135 ± 0.16 (−1.761 to 1.494) | - | - |
| **LUS thickness** | - | −0.108 ± 0.17 (−1.725 to 1.517) | 0.024 ± 0.078 (−0.717 to 0.759) |
| **Myometrial thickness** | - | −0.085 ± 0.2 (−2.158 to 1.999) | 0.005 ± 0.037 (−0.340 to 0.348) |

CS, Cesarean section; RMT, residual myometrial thickness; LUS, low uterine segment.

Only two cases (2% of all participants) had undergone three CS, while the majority (77/100) had done just one. Women with one prior CS were just as likely to have an obvious CS scar niche as those with two or more prior CS (39% (39/100 vs. 16.3% (8/28), p=0.228). Nevertheless, individuals with one prior CS were more likely to have non-visible CS scars than those with two or more (63% (17/94) vs. 37% (10/28), p=0.049). After two or more prior CS, the LUS and myometrial layer were thinner in the second trimester than they were in the first (p=0.012). However, the third trimester of pregnancy showed no changes (p=0.503) (Table 5).

A statistical study was performed to determine the impact of the mother's and the doctor's medical history on the development of a CS scar niche during a subsequent pregnancy. We discovered that uterine scar niche development was substantially influenced (p=0.049) by prior uterine curettage. On the other hand, there was no connection between the CS niche and the mother's age, BMI, gestational diabetes, smoking status, or prior vaginal birth (Table 6).

**Table 4 Intraobserver (obtained by one researcher, with a short interval between measurements) and interobserver agreement for CS scar niche measurements and RMT in the first trimester, LUS and myometrial thickness in the second and third trimesters (*n* = 20)**

| | **Percentage of Difference ≤ 1 mm** | **Intraclass Correlation Coefficient (95% CI)** |
|---|---|---|
| | **Intraobserver Agreement** | |
| **CS scar niche length** | 94.1 | 0.991 (0.95–0.995) |
| **CS scar niche depth** | 92.9 | 0.979 (0.968–0.997) |
| **RMT** | 99.1 | 0.990 (0.971–0.991) |
| **Myometrial thickness at internal os** | 84.5 | 0.965 (0.91–0.983) |
| **LUS second trimester** | 96.9 | 0.991 (0.982–0.997) |
| **Myometrial thickness second trimester** | 95.8 | 0.98 (0.953–0.991) |
| **LUS third trimester** | 92 | 0.92 (0.811–0.962) |
| **Myometrial thickness third trimester** | 92.1 | 0.91 (0.796–0.958) |
| | **Percentage of difference ≤ 1 mm** | **Intraclass correlation coefficient (95% CI)** |
| | **Interobserver Agreement** | |
| **CS scar niche length** | 85.71 | 0.759 (0.399–0.915) |
| **CS scar niche depth** | 84.7 | 0.971 (0.916–0.991) |
| **RMT** | 85.72 | 0.97 (0.906–0.995) |
| **Myometrial thickness at internal os** | 87.52 | 0.967 (0.924–0.985) |
| **LUS second trimester** | 87.53 | 0.968 (0.925–0.986) |
| **Myometrial thickness second trimester** | 91.72 | 0.855 (0.692–0.934) |
| **LUS third trimester** | 100 | 0.97 (0.929–0.986) |
| **Myometrial thickness third trimester** | 100 | 0.92 (0.824–0.964) |

CS, Cesarean section; RMT, residual myometrial thickness; LUS, low uterine segment.

**Table 5 Ultrasound findings in women after one (*n*= 80) or two or more (*n* =20) previous CS**

| Finding | One CS Median (IQR) or *n* (%) | Two and More CS Median (IQR) or *n* (%) | *p* Value |
|---|---|---|---|
| **Visible CS scar** | 76.9 (81.1) | 18.1 (18.9) | 0.049 |
| **Non-visible CS scar** | 17.1 (63) | 10.1 (37) | 0.049 |
| **CS scar niche** | 41.1 (43.6) | 8.2 (28.5) | 0.228 |
| **RMT** | 4.7 (3.6–6.6) | 3.5 (1.9–5.3) | 0.09 |
| **RMT ≤ 2 mm** | 3.1 (60.0) | 1.9 (40.0) | 0.323 |
| **Ratio (%)** | 35.3 (25.7–51.34) | 31.3 (24.9–47.7) | 0.532 |
| **≤50** | 29.9 (73.2) | 6.1 (75) | 0.645 |
| **LUS thickness in second trimester** | 7.5 (5.4–9.5) | 6.1 (4.6–7.9) | 0.012 |
| **Myometrial thickness in second trimester** | 4.1 (2.77–5.4) | 2.4 (2.0–5.3) | 0.022 |
| **LUS thickness in third trimester** | 4.1 (2.7–5.4) | 4.2 (2.8–5.1) | 0.503 |
| **Myometrial thickness in third trimester** | 2.2 (1.6–2.8) | 2.4 (1.7–2.6) | 0.97 |

CS, Cesarean section; RMT, residual myometrial thickness; LUS, low uterine segment. Ratio between the RMT and the thickness of the myometrium adjacent to the defect.

**Table 6 Influence of demographic and obstetric variables on CS niche development in a subsequent pregnancy.**

| Parameter | CS Scar Niche Median (IQR) or *n* (%) | Without CS Scar Niche Median (IQR) or *n* (%) | *p* Value |
|---|---|---|---|
| **Age (years)** | 34.2 (27.9–36.0) | 35.1 (26.0–37.0) | 0.486 |
| **BMI (kg/m$^2$)** | 24.8 (21.6–28.5) | 25.4 (21.9–28.5) | 0.529 |
| **Gestational diabetes** | 5.9 (12.2) | 8.9 (12.3) | 1 |
| **Smoker** | 4.9 (10.4) | 10.9 (14.9) | 0.662 |
| **Previous VBAC** | 3.1 (6.25) | 5.1 (6.8) | 1 |
| **Uterine curettage** | 17.9 (56.3) | 30.9 (34.4) | 0.049 |

BMI, body mass index; VBAC, previous vaginal delivery after Cesarean section.

39 (58.0%) of the 52 women who experienced a labor trial after a prior CS had a successful vaginal delivery. A vacuum evacuation was done on one of these women (2%) cases. 14 (54.5%) of the 25 (41.8%) women who underwent labor induction following a prior CS delivered vaginally. 22 (35.5%) women had emergency repeat CS after trial of labor; 12 had labor stop and 9 had non-reassuring fetal status. Seven deliveries through natural routes occurred in the patient group with visible CS scars during the first trimester of pregnancy, and the same number of deliveries occurred in the group with non-visible CS scars (54.7% vs. 57.3%, p=1.000). There were no statistical variations in the method of delivery between the patient group with CS scar niches (n=47) and the non-niche group (n=45). In the non-niche group, 21 women and 18 women, respectively, had effective labor trials (39.7% vs. 48.8%, p = 0.802). In contrast to 34 women in the non-niche group, 15 women in the niche group experienced an elective repeat caesarean delivery for different clinical reasons (32.9% vs. 45.6% p=0.337). In the niche group, 12 women needed intrapartum emergency CS due to unsuccessful labor attempts, compared to 18 women in the non-niche group (41.6% vs. 45.3% p=0.802).

The research population's average gestational age at delivery was 38.8±1.17 weeks, and the average neonatal weight was 3494.7±595.0 g. According to the CS scar niche and the Apgar score, there were no differences in the median newborn weight between the groups. In the women's group without CS scars, the median birth weight was 3519.0 (IQR 3262.0-3688.0) g, while in the CS scar subgroup group, it was 3693.0 (IQR 3187.7-3926.0) g (p=0.340). The median Apgar score after 5 minutes was 10.0 (IQR 8.9-10.0) in both groups (p=0.95). In the women's group with CS scars, there were two (4.4%) instances with neonatal Apgar scores lower than 6.9 after one minute, as opposed to just one (1.5%) in the non-niche group. Following a trial vaginal delivery, uterine dehiscence was verified in two women (4.6%), both of whom had CS niches in the first trimester. There were no uterine ruptures in the study group.

## DISCUSSION

Due to the worldwide rise in Cesarean deliveries, defects in the uterine scar appear to be an issue that is getting worse very quickly. There have been more studies in recent years that describe Cesarean section (CS) scars, but it is unclear how the presence of a CS scar increases the chance of uterine rupture or dehiscence during labour. Particularly in subsequent pregnancies, ultrasound assessment of the uterine scar has emerged as a crucial component of obstetric and gynecologic practise. The visibility and measurement of a CS scar on an ultrasound examination, however, may be clinically pertinent despite the paucity of research linking CS scar niche to pregnancy outcomes. Numerous studies using ultrasound to describe CS scars have been conducted on both pregnant and non-pregnant individuals **[13].**

The objective of the research was to estimate the prevalence of the CS scar niche and evaluate the sensitivity of transvaginal ultrasonography in detecting CS scars. Additionally, during pregnancy, we examined the repeatability of the CS scar readings. We looked into some of the obstetric and demographic factors that were connected to CS scar niche development during a subsequent pregnancy and linked pregnancy outcomes.

In a subsequent pregnancy, the development of uterine scar niche was linked to prior uterine curettage, according to our research. Additionally, we report that TVS can reliably identify CS scars in all pregnancy trimesters with a high degree of interobserver agreement.

The prospective design of the research and the fact that the reproducibility of the CS scar measurements was assessed throughout all three trimesters of pregnancy are its two main advantages. The first author conducted all of the TVS scans, with assistance from two witnesses with knowledge of CS scar evaluation for a portion of the scans. A standardised process was followed to conduct each scan in the sagittal plane. **[14].** In comparison to earlier studies, which ranged in size from 7 to 89%, our research found a CS scar visibility rate of 77.9% **[15].**

In our study group, large niches were prevalent in 73.4% of cases, compared to 10-42% in the two prior studies**[16]**. Population differences may account for this discrepancy, as measurements of the CS scar "defect" in earlier studies were obtained while the subjects were not pregnant **[17]**. They asserted that the retroverted uterus frequently exhibits the CS scar pocket. **[18]**. Only two patients with non-visible CS scars had a retroverted uterus in the first trimester in our prospective analysis. In a prior study, **Naji et al.** discovered that when the uterus was retroverted in 36 cases, a CS scar was not visible to the operators. **[19].**

In comparison to other studies reporting good agreement between two observers regarding uterine scar measurements at the first trimester and moderate for the second and third trimesters, our results of inter- and intraobserver variability analysis for scar measurements during the first, second, and third trimesters were excellent.**[15].** This could be a result of prior studies conducting the scar assessment offline using stored images. In our research, the CS scar was scanned in real-time by two operators sequentially. Our analysis was carried out as part of routine ultrasound screening at the first and second trimesters, lacking time for extra TVS scans, so there was some systematic bias. The study's main drawback is the tiny number of patients who were enrolled in the subgroup for reproducibility.

In the current research, 22.1% of pregnant women had CS scars that were not visible during the first trimester and that were not visibly visible during the second or third trimester. This might be as a result of ultrasound's poor ability to identify anatomical changes related to pregnancy in the scar region. **[20**]. As a result, we measured the thinnest portion of the myometrium at the internal cervical os in patients with non-visible CS scars, as was done in earlier studies. **[21].** An worldwide consensus statement regarding the CS scar niche in non-pregnant status was released by Jordan et al. on page 22. To the best of our understanding, there is no agreement on the CS scar niche measurements in pregnant status. The precise causes of niche formation are still unknown, but there have been numerous studies on the risk factors for CS scar niche development **[23].**

It appears to be dependent on a variety of patient, pregnancy, and prior surgery factors, including the number of previous CS, the location of the hysterotomy, the suturing technique, and maternal conditions such as gestational diabetes, smoking, or BMI. **[23]**. We did not discover a link between prior CS deliveries, the patient's BMI, smoking status, gestational diabetes, and the development of uterine scar niches. This disparity with previous studies could be attributed to the small number of patients in our study group who had numerous CS scars. Nonetheless, a link between multiple CS and scar niche has previously been documented. [24]. It is well known that a uterine scar following CS has a detrimental impact on new scar healing due to repetitive trauma to the isthmic wall and decreased vascular perfusion in the surrounding uterine scar **[25]**.

For the first time, we demonstrate that previous uterine surgery such as curettage increases the chance of CS scar niche in a subsequent pregnancy. Based on the literature and our findings, we think that there are similarities between multiple CS scars in the lower uterine segment and prior uterine curettage as a risk factor for incomplete scar tissue healing or myometrial damage. A link has been proposed between large scar defects in non-pregnant women and uterine rupture/dehiscence of scars in a later delivery. **[26]**. First-trimester CS scar assessment was considered to be a promising tool for identifying high-risk patients for uterine dehiscence/rupture or placenta accreta spectrum disorders early in pregnancy **[27]**.

Previous researchers, however, were unable to infer that a single evaluation of the CS scar in the first trimester could be used to predict uterine rupture/dehiscence. **[28]**. Kim Paquette et al. previously assessed uterine scars in 166 women using transvaginal ultrasound in the first trimester and then again in the third trimester, concluding that evaluation of the CS scar in the first trimester could not be used to predict uterine rupture in a subsequent pregnancy. **[28]**. Our results indicate that there is no such link. Our study's main limitation is the small amount of patients. Many women were referred, and prior caesareans had been performed by various obstetricians in various institutions; however, in Lithuania, we have a uniform Cesarean delivery technique that includes single-layer suturing of the uterine incision.

## CONCLUSIONS

Our findings show that the CS scar niche is a myometrial defect that can be identified by TVS during the first trimester of pregnancy and is associated with prior uterine curettage, but it is not always associated with poor pregnancy outcomes. The research findings cannot provide recommendations for routine ultrasound examinations of CS scars in pregnant women in order to manage subsequent deliveries appropriately. However, we believe that women who have a uterine scar niche identified during a first-trimester scan are at a higher risk of uterine dehiscence or rupture during delivery. Women should avoid CS unless medically indicated, as well as repeated abortions with uterine curettage. More prospective high-quality studies are required, however, to determine the clinical significance of the CS scar niche and to define guidelines for the possible prevention of the CS scar niche in a subsequent pregnancy.

### Declarations

### Ethics approval and consent to Participate

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### Consent for publication

Not applicable.

### Availability of data and materials

All data and materials are fully presented in the manuscript.

### Competing Interests

The authors declare that they have no competing interests.

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## Author Contributions

Dr Ahmed will write the protocol, and Dr Tamer will collect specimens, follow up on the cases, take the history, and fulfill inclusion and exclusion criteria. We will analyze the results together.


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We would like to acknowledge staff members of -----------------


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