Research Article

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Sonographic Study of Scar Thickness in Post Caesarean Pregnancy and Its Obstetrical Outcome

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Received Date: Month 00, 2025 **Published Date:** Month 08, 2025

Abstract:

Background: The rising incidence of caesarean deliveries has increased the need to assess scar integrity during subsequent labours. Ultrasonographic evaluation of lower uterine segment (LUS) thickness provides a non-invasive tool for predicting scar outcomes.

Objectives: To assess LUS scar thickness by ultrasonography in labouring post-caesarean women and correlate it with maternal and neonatal outcomes.

Methods: A prospective observational study was conducted on 110 term pregnant women with previous caesarean sections who presented with pain lower abdomen, at SRMS Institute of Medical Sciences, Bareilly, over a period of 1 ½ years from May 1, 2023, to October 31, 2024. Transabdominal sonography was used to measure LUS thickness, and obstetrical outcomes were compared across the three groups based on number of prior caesareans, i.e. previous 1 LSCS (Group A), previous 2 LSCS (Group B), previous 3 LSCS (Group C). Intra-operative findings, maternal recovery, and neonatal health were recorded.

Results: Scar thickness ≤2.5 mm was significantly associated with higher rates of scar dehiscence, rupture, postpartum haemorrhage, delayed recovery, and adverse neonatal outcomes such as NICU admission and respiratory distress ($p < 0.05$).

Conclusion: Sonographic LUS thickness is a reliable predictor of obstetrical outcomes and can aid clinical decision-making in post-caesarean term pregnant women, presenting with pain lower abdomen.

Keywords: Caesarean Section; Ultrasonography; Labour; LUS Scar Thickness.

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How to Cite: Yadav M, Baghel J, Agarwal V. Sonographic Study of Scar Thickness in Post Caesarean Pregnancy and Its Obstetrical Outcome. J. Comprehensive Obs. & Gynec Care. 2025; 1(1): 1-5

ISSN: 3105-8507

Introduction

With the increasing global and national trend of caesarean sections, reported at 21.5% in India according to National Family Health Survey-5 (2019-21), the number of women presenting in labour with a previous caesarean scar has risen significantly.[1] In such cases, assessing the integrity of the uterine scar is vital, as uterine dehiscence or rupture, though uncommon, can lead to severe maternal and fetal morbidity.[2] Traditionally, the decision for a trial of labour after caesarean (TOLAC) has relied on clinical predictors such as inter-delivery interval, fetal size, prior vaginal delivery, scar tenderness, maternal pulse and fetal heart rate i.e. NST.[3] However, these parameters do not provide direct insight into scar quality. Transabdominal and transvaginal sonography are both used for this purpose, however among both of these transvaginal scans offers better resolution, especially for identifying thinner segments and scar defects. A thinner LUS during labour may indicate a compromised scar and increased risk of dehiscence or rupture, particularly as fetal head descent further stretches the segment.[4] Yet, a clear consensus on cutoff values and correlation with obstetrical outcome remains lacking.

This study aimed to evaluate LUS scar thickness in labouring post-caesarean women using ultrasonography and correlate the findings with maternal and neonatal outcomes. By doing so, it intends to provide evidence-based guidance for safer delivery decisions in such high-risk pregnancies.

Materials and Methods

This prospective observational study was conducted in the Department of Obstetrics and Gynaecology, SRMS Institute of Medical Sciences, Bareilly, over 18 months i.e. from May 1, 2023, to October 31, 2024. It included post-caesarean pregnant women at term (37–42 weeks gestation) who presented with lower abdominal pain to the outpatient department, emergency unit, or labour room. Eligibility criteria required a history of previous caesarean done for non-recurrent indications, singleton

pregnancy, longitudinal lie, and cephalic presentation. Women with complications such as placenta previa/accreta, other uterine scars like myomectomy or hysterotomy, multiple pregnancies, polyhydramnios, oligohydramnios, malpresentations, uterine anomalies, or unknown scar etiology were excluded.

A total of 110 participants were recruited through simple random sampling after screening based on the inclusion and exclusion criteria. A preliminary pilot study involving 8 patients (10% of the calculated sample size) was conducted to test the feasibility of the protocol and refine the methodology. These cases were not included in the final analysis. Written informed consent was obtained from all participants, and ethical clearance was obtained from the institutional ethics committee.

Proper history taking in terms of age, socioeconomic status, gravida, parity, number of previous caesarean section, gestational age were taken. Each participant underwent clinical assessment for scar tenderness using superficial palpation over the lower uterine segment, with a distraction technique to minimize response bias. A wince on palpation was noted as a positive sign. Ultrasonographic evaluation was performed by experienced sonographers using Siemens Acuson Juniper and S2000 machines with 2–5 MHz convex transducers. With an adequately filled bladder, transabdominal sonography was conducted in the sagittal view to identify and measure the thinnest point of the lower uterine segment. Three measurements were taken, and the lowest value recorded. Then the whole study population was divided into 3 groups – Group A (with previous 1 LSCS), B (with previous 2 LSCS) and C (with previous 3 LSCS), according to the number of previous caesarean section and their feto-maternal outcome were compared.

Patients taken for caesarean delivery were evaluated intraoperatively for scar condition—intact, thin, dehiscent, or ruptured as well as for intra-abdominal adhesions. Maternal outcomes included postpartum hemorrhage, need for blood transfusion, infection, and hospital stay duration. Neonatal outcomes recorded were APGAR scores, NICU admission, respiratory complications, hypoxic encephalopathy, seizures, sepsis, and neonatal mortality. Uterine rupture was defined as complete dehiscence of all the layers of uterus, with fetal parts in the abdominal cavity; dehiscence as a partial defect with intact membranes; and a thinned scar as an intact scar with <2.5 mm thickness.

Data were entered into Microsoft Excel 2019 and analyzed using SPSS version 21.0. Descriptive statistics summarized clinical data; continuous variables were reported as means with standard deviations, and categorical variables as frequencies and percentages. Chi-square test was applied to assess associations, with a p-value < 0.05 considered statistically significant.

Results

The study assessed *scar thickness in labouring post-caesarean pregnancy by ultrasonography and its obstetrical outcome*. The present study revealed significant demographic and clinical trends among the participants. Most women (58%) were aged 27–33 years, highlighting that labouring post-caesarean pregnancies predominantly occur in the prime reproductive age group. The mean age was 28.67 ± 4.28 years. Notably, the majority were housewives (98%) and belonged to the upper middle or middle socio-economic class. Regarding obstetric status, 37% were third gravida, and 45% had one previous LSCS followed by 32% with previous 2 LSCS and 23% with previous 3 LSCS. This reflects that the study population was largely from reproductive, middle-income backgrounds with prior caesarean deliveries (Table 1).

A remarkable association was observed between ultrasonographic lower uterine scar thickness and intra-operative findings. Women with scar thickness ≤ 2.5 mm exhibited significantly higher rates of scar dehiscence and rupture ($p < 0.05$), whereas no clear cut association can be made between sonographic lower uterine scar thickness with intra-operative adhesions. In contrast, none of the women with scar thickness > 2.6 mm experienced scar rupture. Additionally, postpartum haemorrhage was significantly more common in cases with thinner scars (≤ 2.0 mm). These findings strongly indicate that reduced scar thickness predisposes women to poor intra-operative scar condition and increased maternal morbidity (Table 2).

The study findings underscore a clear correlation between scar thickness and both maternal recovery and neonatal outcomes. A thinner scar (≤ 2.0 mm) was significantly

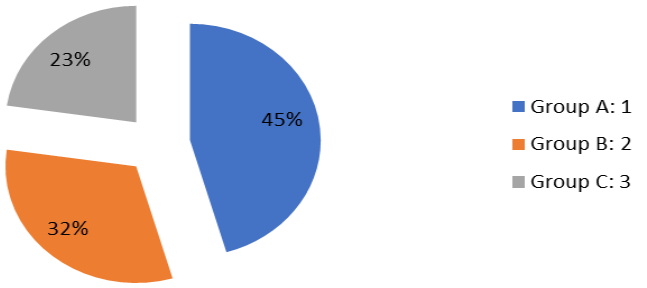

Figure 1: Distribution of study population according to number of previous LSCS

Table 1: Demographic and Clinical Characteristics of Study Population (N = 110)

S. No.		*Parameter*	*Frequency*	*Percentage (%)*
1	Age Group (years)	20 – 26	32	29%
		27 – 33	64	58%
		34 – 40	12	11%
		41 – 47	2	2%
		Mean Age ± SD	28.67 ± 4.28	-
2	Occupation	Housewife	108	98%
		Working	2	2%
3	Socio-economic Status	Upper Class (₹9098 and above)	20	18%
		Upper Middle Class (₹4549 - 9097)	30	27%
		Middle Class (₹2729 - 4548)	25	23%
		Lower Middle Class (₹1365 - 2728)	20	18%
		Lower Class (Below ₹1365)	15	14%
4	Gravida	2	34	31%
		3	41	37%
		4	24	22%
		≥ 5	11	10%
5	Number of Previous LSCS	1	50	45%
		2	35	32%
		3	25	23%

LSCS- Lower Segment Caesarean Section, Gravida - No. of Pregnancies, SD - (standard deviation)

Table 2: Correlation of sonographic lower uterine scar thickness with intra-operative scar condition

Variable scar intact		*Scar Condition N (%)*				*Intra-abdominal Adhesions N (%)*			*Postpartum Hemorrhage N (%)*	
		scar thinned out	*scar dehiscence*	*scar rupture*	*Absent*	*Thick Adhesions +*	*Thin Adhesions +*	*Absent*	*Present*	
Sonographic scar thickness (mm)	1.5-2.0	0	3(3)	5(4)	3(3)	0	5(5)	6(5)	9(8)	2(2)
	2.1-2.5	12(11)	30(26)	1(1)	0	10(9)	16(14)	17(16)	43(39)	0
	2.6-3.0	37(34)	14(13)	0	0	8(7)	23(21)	9(8)	51(46)	0
	3.1-3.5	5(5)	0	0	0	15(14)	0	1(1)	5(5)	0
p-value[#]		0.00				0.007			0.000	

LSCS – Lower Segment Caesarean Section; LUS – Lower Uterine Segment, mm – millimetre.

associated with prolonged maternal recovery (8–10 days) and lower neonatal APGAR scores, indicating increased risks for both mother and child ($p < 0.001$). Conversely, women with scar thickness ≥ 2.6 mm showed favourable outcomes, including shorter recovery periods (3–4 days) and higher APGAR scores. This emphasises the importance of antenatal sonographic scar assessment in predicting post-delivery outcomes (Table 3).

The present study demonstrated a striking relationship between lower uterine scar thickness and neonatal health parameters. Neonatal complications, including NICU admission, meconium aspiration syndrome (MAS), and respiratory distress syndrome (RDS), were significantly higher among women with scar thickness ≤ 2.5 mm ($p < 0.05$). In contrast, no adverse neonatal outcomes were reported in those with scar thickness ≥ 3.1 mm. These findings suggest that reduced scar thickness is a reliable predictor of neonatal morbidity, reinforcing the role of

Table 3: Correlation of maternal lower uterine scar thickness with post-operative maternal recovery period and APGAR Score

Variable		*Recovery Period*			*APGAR score*					
		Short (3-4 days) N (%)	*Medium (5-7 days) N (%)*	*Long (8-10 days) N (%)*	*0 N (%)*	*4 N (%)*	*7 N (%)*	*8 N (%)*	*9 N (%)*	*10 N (%)*
Sonographic scar thickness (mm)	1.5-2.0	4(4)	3(3)	4(4)	5(4)	1(1)	1(1)	1(1)	1(1)	2(2)
	2.1-2.5	33(30)	10(9)	0	0	0	0	2(2)	5(4)	36(33)
	2.6-3.0	45(41)	6(5)	0	0	0	0	1(1)	2(2)	48(44)
	3.1-3.5	5(4)	0	0	0	0	0	0	0	5(4)
p-value[#]		0.000			<0.001					

mm – millimetre, LUS – Lower Uterine Segment, APGAR Score – Appearance, Pulse, Grimace, Activity, Respiration Score (standard measure of newborn health at birth)

Table 4: Sonographic Lower Uterine Segment Scar Thickness with Neonatal Outcomes (NICU Admission, Meconium Aspiration Syndrome, and Respiratory Distress Syndrome)

LUS Scar Thickness (mm)	*NICU Admission*		*MAS*		*RDS*	
	Absent N (%)	*Present N (%)*	*Absent N (%)*	*Present N (%)*	*Absent N (%)*	*Present N (%)*
1.5–2.0	7(6)	4(4)	2(2)	9(8)	7(6)	4(4)
2.1–2.5	36(33)	7(6)	32(29)	11(10)	37(34)	6(5)
2.6–3.0	49(44)	2(2)	47(42)	4(4)	49(44)	2(2)
3.1–3.5	5(5)	0	5(5)	0	5(5)	0
p-value	0.012		0.000		0.001	

NICU – Neonatal Intensive Care Unit, MAS – Meconium Aspiration Syndrome, RDS – Respiratory Distress Syndrome

sonographic scar evaluation in guiding obstetric decision-making (Table 4).

Discussion

In our study, the majority of participants were aged 27–33 years (58%), with a mean age of 28.67 ± 4.28 years. Similar findings were reported by Ghayath Janoudi et al.[5], where 76% of women were aged above 25 years. However, Vandana Dhama et al.[6] observed a lower mean age of 24.23 ± 2.62 years, possibly due to inclusion of only primary LSCS cases, whereas our study included women with up to three previous LSCS. Regarding occupation, 98% of participants were housewives, likely reflecting the rural background of the study population. This contrasts with the study by Elisabeth Simoes et al.[7], where occupation influenced the risk of primary caesarean, but not repeat caesarean sections. Socio-economically, half of the participants belonged to upper middle or middle class, similar to other studies that found no significant association between socio-economic status and post-caesarean outcomes. Gravida-wise, most women were in their second or third pregnancy (68%), with declining numbers in higher-order pregnancies, consistent with literature suggesting reduced family size due to complications associated with multiple caesarean sections. The study population was further categorised into three groups based on the number of previous LSCS for outcome comparison.

Scar thickness ranged predominantly between 2.1–3.0 mm across all groups, showing no significant association with the number of previous caesarean sections. Anusha Leelapalli et al.[8] reported comparable findings but did not correlate scar thickness with number of LSCS. Our study found a significant association between reduced LUS thickness and intra-operative scar dehiscence or rupture, supporting findings by Suzuki et al.[9] who emphasized a threshold of ≤2.0 mm as high-risk for scar complications. Intra-abdominal adhesions were more common with increasing number of caesareans, although not found statistically significant in our study, which may be due to small sample size. Mercy Nuamah et al.[10] and Kiruthika et al.[11] reported higher adhesion prevalence with repeat CS. Postpartum hemorrhage was significantly more frequent in patients with scar thickness <2.0 mm, correlating with findings by Kiruthika et al.[11], who linked adhesions and PPH.

Maternal recovery was significantly delayed in women with lower scar thickness, likely due to increased operative complexity, similar to findings by Sunanda Gupta et al.[12] using Enhanced Recovery After Caesarean protocol (ERAC).

Neonatal APGAR scores and birth weights were statistically similar across groups. However, lower LUS thickness (<2.5 mm) was significantly associated with poor neonatal outcomes including low APGAR scores, NICU admissions, MAS, and RDS. Comparable findings were observed in studies by Dinesh et al.[13], Gupta & Sinha[14], and Sereesha et al.[15].

While the number of previous caesareans showed limited predictive value, sonographic measurement of LUS thickness was a strong predictor of adverse maternal and neonatal outcomes. Our results align with studies by Singh et al.[16], supporting the use of LUS thickness >2.5 mm as a threshold for safer trial of labour in post-CS pregnancies.

SWOT Analysis-Strengths of the study

The strengths of the study include its prospective design, direct intraoperative correlation, and use of standardized ultrasound measurement. It comprehensively evaluated both maternal and neonatal outcomes, providing practical evidence to support research work.

Weakness or Limitations of the Study

The weakness of the study are limited sample size for multiple prior caesarean groups, reliance on transabdominal ultrasound only, potential inter-observer variability, single centred study and short term follow up. Lack of long-term neonatal outcome assessment may also restrict broader applicability of results.

Opportunities

Sonographic LUS thickness may act as a decision-making tool in post-caesarean labour management, especially with respect to giving Trial Of Labour After Caesarean.

Threats

Threat is regarding cost effectiveness, as its not available in most of Community and Primary Health Centres, where majority of deliveries take place. Besides, it needs training to identify the LSCS scar in LUS.

Conclusion

LUS scar thickness measured by ultrasonography is a significant predictor of maternal and neonatal outcomes in labouring post-caesarean women. A scar thickness ≤2.5 mm was linked with higher risks of scar complications and adverse neonatal outcomes. Therefore, LUS assessment can aid in clinical decision-making regarding trial of labour after caesarean.

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