Original Article

Scar Tenderness in Previous Cesarean Section: Correlation with Ultrasonographic Scar Thickness and Intraoperative Scar Integrity

Syeda Afreen Sultan[1], Prachi Singh[2]

[1]Junior Resident, Department of Obstetrics & Gynaecology, Rohilkhand Medical College & Hospital, Bareilly, Uttar Pradesh, India. [2]Professor, Department of Obstetrics & Gynaecology, Rohilkhand Medical College & Hospital, Bareilly, Uttar Pradesh, India.

Abstract

Background: Cesarean section is one of the most commonly performed obstetric surgeries worldwide. Rising cesarean rates have led to an increasing number of pregnancies complicated by previous uterine scars. Scar-related complications such as scar thinning, dehiscence, and uterine rupture contribute significantly to maternal and fetal morbidity. The aim is to evaluate the relationship between clinical scar tenderness, ultrasonographic lower uterine segment (LUS) scar thickness, and intraoperative scar integrity in women undergoing cesarean section after a previous lower segment cesarean section (LSCS). **Material and Methods:** A prospective observational study was conducted on 50 pregnant women with previous one LSCS, singleton pregnancy, gestational age >36 weeks, and clinically detectable scar tenderness at Rohilkhand Medical College & Hospital, Bareilly. LUS thickness was measured by ultrasonography. Intraoperative findings (scar thinning, adhesions, dehiscence) and maternal–fetal outcomes were recorded. Associations were analysed using Fisher's exact test. **Results:** Mean LUS thickness was 3.1 ± 0.6 mm. Thickness <2.5 mm was found in 11 (22%) women. Intraoperative thin scar was observed in 11 (22%) cases and scar dehiscence in 3 (6%) cases; all dehiscences occurred in the <2.5 mm group. No complete uterine rupture occurred. Women with LUS thickness <2.5 mm had significantly higher rates of thin scar ($p < 0.001$) and scar dehiscence ($p = 0.008$) compared with those with thickness ≥2.5 mm. Most women (90%) had an uneventful recovery. **Conclusion:** In women with previous LSCS and scar tenderness, ultrasonographic LUS thickness <2.5 mm is strongly associated with intraoperative thin scar and dehiscence. Scar tenderness alone does not reliably indicate impending rupture. Combined clinical and ultrasonographic assessment improves prediction of true scar integrity and supports safer obstetric decision-making.

Keywords: Cesarean Section, Cesarean Scar Tenderness, Ultrasonographic Scar Thickness, Lower Uterine Segment, Scar Integrity, Intraoperative Findings, Repeat Cesarean Delivery.

Received: 02 August 2026 **Revised: 20 August 2026** **Accepted: 05 September 2026** **Published: 02 November 2026**

Introduction

Cesarean section is one of the most commonly performed obstetric surgeries worldwide.[1] Over the last few decades there has been a significant rise in cesarean section rates owing to improved fetal monitoring, increasing numbers of repeat cesarean sections, medico-legal concerns, and changing obstetric practices.[2] Consequently, pregnancies complicated by previous uterine scars have become increasingly common.

Women with a previous lower segment cesarean section are at increased risk of scar thinning, scar dehiscence, and uterine rupture.[3] Uterine rupture is a serious obstetric emergency associated with severe maternal and fetal morbidity and mortality.[4-9]

Scar tenderness has traditionally been regarded as an important clinical sign suggestive of impending scar rupture. However, tenderness alone may not accurately indicate actual scar rupture or dehiscence; many patients with tenderness demonstrate intact scar integrity at surgery. Ultrasonographic measurement of lower uterine segment thickness has emerged as a useful non-invasive method for evaluating scar healing and predicting scar-related complications.[4]

Several studies have shown that LUS thickness less than 2.5 mm is associated with an increased risk of scar dehiscence and rupture,[5,6] whereas thickness greater than 3.5 mm is generally associated with safer maternal and fetal outcomes.[7] Combined clinical and ultrasonographic assessment may therefore improve prediction of scar integrity and aid obstetric decision-making.[8]

Aim: To study the correlation between clinical scar tenderness, ultrasonographic lower uterine segment scar thickness, and intraoperative scar integrity in women undergoing cesarean section after previous one lower segment cesarean section.

Objectives

- To assess scar tenderness clinically.
- To measure lower uterine segment scar thickness using ultrasonography.
- To correlate ultrasonographic findings with intraoperative

Address for correspondence: Dr. Prachi Singh, Professor, Department of Obstetrics & Gynaecology, Rohilkhand Medical College & Hospital, Bareilly, Uttar Pradesh, India.
E-mail: singh.prachi.dr@gmail.com

DOI:
10.21276/amit.2026.v13.i3.1158

How to cite this article: Sultan SA, Singh P. Scar Tenderness in Previous Cesarean Section: Correlation with Ultrasonographic Scar Thickness and Intraoperative Scar Integrity. Acta Med Int. 2026;13(2):842-847.

scar integrity.
- To evaluate maternal and fetal outcomes.

Materials and Methods

Study Design: Prospective observational study.
Sample Size: Fifty consecutive eligible patients.
Inclusion Criteria
- Previous one lower segment cesarean section
- Singleton pregnancy
- Gestational age >36 weeks
- Presence of clinical scar tenderness

Exclusion Criteria
- Multiple pregnancy
- Placenta previa
- Patients unwilling to participate

Methodology: Detailed obstetric history and clinical examination were performed. Scar tenderness was assessed by gentle palpation of the lower uterine segment through the abdominal wall. Obstetric ultrasonography was performed to measure lower uterine segment scar thickness. In patients undergoing cesarean section, intraoperative findings including scar thinning, adhesions, and scar dehiscence were recorded by the operating surgeon. Maternal and neonatal outcomes were noted.

Statistical Analysis: Data were entered in Microsoft Excel and analysed using SPSS version 25.0. Quantitative variables are expressed as mean ± standard deviation; qualitative variables as frequency and percentage. Association between lower uterine segment scar thickness categories and intraoperative findings was assessed using Fisher's exact test because of small expected cell counts. A p-value <0.05 was considered statistically significant.

Results

Table 1: Demographic Profile of Patients (n = 50)

Category	Number	Percentage
Age (years)		
18–21	5	10%
22–28	13	26%
29–34	20	40%
>35	12	24%
Socioeconomic status (Modified Kuppuswamy)		
I	3	6%
II	6	12%
III	17	34%
IV	15	30%
V	9	18%
Educational status		
Illiterate	8	16%
Primary	22	44%
Secondary	14	28%
Graduate	6	12%
Occupational status		
Homemaker	32	64%
Working	18	36%

The majority of patients belonged to the age group 22–28 years (26%), followed by 29–34 years (40%). The mean age was 29.4 years. Most patients had completed primary education (44%). The largest socioeconomic groups were Class III (34%) and Class IV (30%) according to the Modified Kuppuswamy Scale. The majority were homemakers (64%).

Table 2: Distribution According to Gestational Age

Gestational Age	Number	Percentage
36 – <37 weeks	8	16%
37–40 weeks	25	50%
>40 weeks	17	34%

Half of the patients (50%) presented between 37 and 40 weeks of gestation, 34% beyond 40 weeks, and 16% between 36 and 37 weeks.

Table 3: Indications for Previous Cesarean Section

Indication	Number	Percentage
Fetal distress	19	38%
Non-progress of labor	8	16%
Breech presentation	6	12%
Oligohydramnios	4	8%
Cephalopelvic disproportion	5	10%
Meconium-stained liquor	5	10%
Others	3	6%

Fetal distress was the most common indication for the previous cesarean section (38%), followed by non-progress of labor (16%) and breech presentation (12%).

Table 4: Ultrasonographic Findings

USG Parameter	Findings
Mean scar thickness	3.1 ± 0.6 mm
Scar thickness <2.5 mm	11 (22%)
Scar thickness 2.5–3.5 mm	21 (42%)
Scar thickness >3.5 mm	18 (36%)

Mean lower uterine segment thickness was 3.1 ± 0.6 mm. Eleven patients (22%) had thickness <2.5 mm, 21 (42%) had thickness between 2.5 and 3.5 mm, and 18 (36%) had thickness >3.5 mm.

Table 5: Intraoperative Scar Findings

Intraoperative Finding	Frequency (%)
Adhesions present	8 (16%)
Adhesions absent	42 (84%)
Thin scar	11 (22%)
Normal scar	39 (78%)
Scar dehiscence present	3 (6%)
Complete uterine rupture	0 (0%)

A thin lower uterine segment scar was observed in 11 patients (22%), while 39 (78%) had a normal-appearing scar. Intraoperative adhesions were present in 8 cases (16%). Scar dehiscence was noted in 3 patients (6%). No complete uterine rupture occurred.

Table 6: Fetal Birth Weight

Birth Weight	Number	Percentage
<2.5 kg	8	16%
2.5–3.5 kg	34	68%
>3.5 kg	8	16%

The majority of neonates (68%) had a birth weight between 2.5 and 3.5 kg. Low birth weight (<2.5 kg) and birth weight >3.5 kg each occurred in 16% of cases.

Table 7: Maternal Outcomes

Maternal Outcome	Number	Percentage
Postpartum hemorrhage (PPH)	2	4%
Scar dehiscence	3	6%
Scar rupture (complete)	0	0%
Uneventful recovery	45	90%

Most patients (90%) had an uneventful recovery. Postpartum hemorrhage occurred in 2 patients (4%) and scar dehiscence in 3 (6%). No complete scar rupture or maternal mortality was observed.

Table 8: Fetal Outcomes

Fetal Outcome	Number	Percentage
Fetal distress without NICU admission	4	8%
NICU admission	4	8%
No fetal complications	42	84%

Forty-two neonates (84%) had no significant complications. Fetal distress without NICU admission and NICU admission each occurred in 4 cases (8%).

Table 9: Correlation Between Scar Thickness and Intraoperative Findings

Scar Thickness	Thin Scar Found Intraoperatively	Scar Dehiscence
<2.5 mm (n=11)	9	3
2.5–3.5 mm (n=21)	1	0
>3.5 mm (n=18)	1	0
Total	11	3

Women with LUS thickness <2.5 mm showed a markedly higher incidence of

thin scar and all cases of scar dehiscence. When thickness <2.5 mm was compared with thickness ≥2.5 mm, the association with thin scar was highly significant (Fisher's exact test, $p < 0.001$) and the association with scar dehiscence was also significant ($p = 0.008$).

These findings support the predictive value of ultrasonographic LUS thickness for intraoperative scar integrity in women who already have clinical scar tenderness.

Discussion

Previous cesarean section is associated with an increased risk of scar thinning, dehiscence, and uterine rupture in subsequent pregnancies. With rising global cesarean rates, evaluation of uterine scar integrity has become an important component of modern obstetric practice. The present study examined the relationship between clinical scar tenderness, ultrasonographic LUS thickness, and intraoperative scar findings in women with previous one LSCS.

All participants had clinical scar tenderness by inclusion criteria. Despite this, no patient developed complete uterine rupture, and the majority (78%) had a normal-appearing scar at surgery. This observation indicates that scar tenderness alone has limited specificity for severe scar disruption. Similar conclusions have been reported by Landon et al,[9] and Macones et al,[10] who noted that clinical signs by themselves may not accurately predict uterine rupture and should be interpreted together with other investigations.

The mean LUS thickness in the present study was 3.1 ± 0.6 mm. Thickness <2.5 mm was present in 22% of women and was strongly associated with both thin scar and dehiscence. These results are consistent with the findings of Rozenberg et al,[4] and Bujold et al,[6] who demonstrated that thinner LUS measurements are associated with a higher risk of scar defects and rupture. Kok et al,[7] also reported that increasing LUS thickness correlates with fewer scar defects and better obstetric outcomes.

Table 10: Comparison of Ultrasonographic Findings with Previous Studies

Parameter	Present Study	Rozenberg et al.[4]	Bujold et al.[6]
Study population	50	642	236
Mean/median LUS thickness	3.1 ± 0.6 mm	Not reported as mean	Median 2.8 mm
Low LUS thickness	<2.5 mm: 22%	1.6–2.5 mm: 7.9%	<2.3 mm associated with increased rupture risk
Scar abnormality	Thin scar 22%; dehiscence 6%	Defect 4.0%	9 defects / 236 (3.8%)

Thin scar was the most frequent intraoperative abnormality (22%), while scar dehiscence occurred in 6% of cases. Comparable rates of deficient scars have been reported by Ofili-Yebovi et al,[11] and Suzuki & Nakata.[12]

Table 11: Distribution of Scar Thickness and Intraoperative Findings – Comparison with Literature

Scar Thickness	Thin Scar – Present Study	Scar Dehiscence – Present Study	Relevant Finding in Bujold et al.[6]
<2.5 mm	9	3	<2.3 mm associated with increased rupture risk; rupture rate 9.1%
2.5–3.5 mm	1	0	Not directly comparable
>3.5 mm	1	0	Not directly reported
Total	11	3	—

The table demonstrates that decreasing lower uterine segment thickness was associated with increased incidence of thin scar and scar dehiscence. Women with scar thickness less than 2.5 mm had the highest incidence of intraoperative scar abnormalities, consistent with the higher rupture risk reported by Bujold et al,[6] for very thin segments.

Table 12: Comparison of Intraoperative Findings

Finding	Present Study	Ofili-Yebovi et al.[11]	Suzuki et al.[12]
Study population	50	324	—
Thin / deficient scar	11 (22%)	63/324 (19.4%)	—
Scar dehiscence	3 (6%)	Not directly reported	2.82%
Complete uterine rupture	0 (0%)	—	0%

A clear gradient was observed: decreasing LUS thickness was associated with worsening intraoperative findings. Women with thickness <2.5 mm accounted for the great majority of thin scars and all dehiscences. This association reached statistical significance and supports the clinical utility of ultrasonographic LUS assessment even in the presence of scar tenderness.

Gestational age may also influence scar integrity. Progressive stretching of the lower uterine segment with advancing gestation can contribute to thinning. Similar observations have been made by Kok et al,[7] and Cheung,[18]

Maternal and fetal outcomes were generally favorable. Postpartum hemorrhage occurred in only 4% of cases, NICU admission in 8%, and there was no maternal mortality or complete uterine rupture. These results align with reports by Landon et al,[9] Macones et al,[10] and Tahseen & Griffiths,[26] emphasizing that timely cesarean section and careful antenatal surveillance substantially reduce morbidity in women with previous cesarean scars.

Ultrasonographic measurement of LUS thickness is non-invasive, widely available, reproducible, and relatively

inexpensive. It can help identify women at higher risk of scar complications and guide decisions regarding timing and mode of delivery. Rozenberg et al,[4] first demonstrated its usefulness, and subsequent studies have validated its clinical value.

The present findings are consistent with recommendations from ACOG[3] and RCOG[13] that advocate individualized assessment and careful monitoring for scar-related complications in women with previous cesarean section. Combined clinical and sonographic evaluation may reduce unnecessary interventions while maintaining maternal and fetal safety.

Limitations of the study include the relatively small sample size, single-center design, and lack of assessment of inter-observer variability in ultrasonographic measurements. Because all participants had scar tenderness, the study cannot evaluate the predictive performance of tenderness itself in an unselected population. Larger multicentre studies with standardized ultrasound protocols are needed to establish universally accepted thickness cut-offs.

ETHICAL CLEARANCE

Ethical approval was obtained from the Institutional Ethics Committee of Rohilkhand Medical College & Hospital, Bareilly. Written informed consent was obtained from all participants.

Conclusion

In women with previous one lower segment cesarean section and clinical scar tenderness, ultrasonographic lower uterine segment thickness <2.5 mm is strongly associated with intraoperative thin scar and scar dehiscence. Scar tenderness alone does not reliably indicate impending uterine rupture.

Combined clinical assessment and ultrasonographic measurement of lower uterine segment thickness provide a more reliable method for predicting scar-related complications. Timely diagnosis, careful antenatal monitoring, and appropriate obstetric intervention can significantly reduce maternal and fetal morbidity associated with previous cesarean scars.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Cunningham FG, Leveno KJ, Bloom SL, et al. Williams Obstetrics. 26th ed. McGraw Hill Education; 2022.
2. Dutta DC. Textbook of Obstetrics. 9th ed. Jaypee Brothers Medical Publishers; 2018.
3. ACOG Practice Bulletin No. 205. Vaginal Birth After Cesarean Delivery. Obstet Gynecol. 2019;133:e110-e127.
4. Rozenberg P, Goffinet F, Phillippe HJ, Nisand I. Thickness of the lower uterine segment and risk of uterine rupture. Lancet. 1996;347:281-284.
5. Jastrow N, Roberge S, Gauthier RJ, et al. Sonographic lower uterine segment thickness and risk of uterine scar defect. J Obstet Gynaecol Can. 2010;32(4):321-327.
6. Bujold E, Jastrow N, Simoneau J, et al. Prediction of complete uterine rupture by sonographic evaluation of uterine scar defect. Obstet Gynecol. 2009;113(3):520-525.
7. Kok N, Wiersma IC, Opmeer BC, et al. Sonographic measurement of lower uterine segment thickness to predict uterine rupture during trial of labor in women with previous Cesarean section: a meta-analysis. Ultrasound Obstet Gynecol. 2013;42(2):132-139.
8. Sen S, Malik S, Salhan S. Ultrasonographic evaluation of lower uterine segment thickness in patients of previous cesarean section. Int J Gynaecol Obstet. 2004;87(3):215-219.
9. Landon MB, Hauth JC, Leveno KJ, et al. Maternal and perinatal outcomes associated with a trial of labor after prior cesarean delivery. N Engl J Med. 2004;351:2581-2589.
10. Macones GA, Cahill A, Pare E, et al. Obstetric outcomes in women with two prior cesarean deliveries: is vaginal birth after cesarean delivery a viable option? Am J Obstet Gynecol. 2005;193(3):1016-1023.
11. Ofili-Yebovi D, Ben-Nagi J, Sawyer E, et al. Deficient lower-segment cesarean section scars: prevalence and risk factors. Ultrasound Obstet Gynecol. 2008;31(1):72-77.
12. Suzuki S, Nakata M. Clinical significance of lower uterine segment thickness. J Matern Fetal Neonatal Med. 2003;13(2):96-98.
13. Royal College of Obstetricians and Gynaecologists. Birth After Previous Caesarean Birth (Green-top Guideline No. 45). London: RCOG; 2015.
14. Qureshi B, Inafuku K, Oshima K, et al. Ultrasonographic evaluation of lower uterine segment to predict uterine rupture. Int J Gynaecol Obstet. 1997;58(3):261-266.
15. Asakura H, Myers SA. More than one previous cesarean delivery: a 5-year experience with 435 patients. Obstet Gynecol. 1995;85(6):924-929.
16. Roberge S, Demers S, Girard M, et al. Impact of uterine closure on residual myometrial thickness after cesarean: a randomized controlled trial. Am J Obstet Gynecol. 2011;204(6):e1-e6.
17. Gotoh H, Masuzaki H, Yoshida A, et al. Predicting incomplete uterine rupture with vaginal sonography during pregnancy. Obstet Gynecol. 2000;95(4):596-600.
18. Cheung VY. Sonographic measurement of the lower uterine segment thickness: is it truly predictive of uterine rupture? J Obstet Gynaecol Can. 2008;30(2):148-156.
19. Uharček P, Mlynček M, Ravinger J, et al. Sonographic assessment of lower uterine segment thickness. Ceska Gynekol. 2005;70(2):92-98.
20. Basaran A, Basaran M. Diagnosis of uterine scar defects by transvaginal sonography. Arch Gynecol Obstet. 2011;284(3):567-574.
21. Michaels WH, Thompson HO, Boutt A, et al. Ultrasound diagnosis of defects in previous cesarean scars. Obstet Gynecol. 1988;71(6):859-862.
22. Rozenberg P, Senat MV. Prediction of uterine scar defects and rupture. Semin Perinatol. 1999;23(2):126-133.
23. Bujold E, Gauthier RJ. Should we allow a trial of labor after cesarean for breech presentation? Obstet Gynecol. 2001;98(4):652-655.
24. Roberge S, Boutin A, Chaillet N, et al. Systematic review of sonographic lower uterine segment thickness. Acta Obstet Gynecol Scand. 2012;91(1):5-13.
25. Tahseen S, Griffiths M. Vaginal birth after two cesarean sections (VBAC-2): a systematic review. BJOG. 2010;117(1):5-19.
26. Miller DA, Diaz FG, Paul RH. Vaginal birth after cesarean: a 10-year experience. Obstet Gynecol. 1994;84(2):255-258.
27. Flamm BL, Goings JR, Liu Y, et al. Elective repeat cesarean

delivery versus trial of labor: a comparison of birth experience and postpartum recovery. Obstet Gynecol. 1994;83(6):927-932.
28. Shipp TD, Zelop CM, Repke JT, et al. Interdelivery interval and risk of symptomatic uterine rupture. Obstet Gynecol. 2001;97(2):175-177.
29. American College of Obstetricians and Gynecologists. Vaginal birth after previous cesarean delivery. Practice Bulletin No. 184. 2017.