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Comparison of Transabdominal versus Transvaginal Ultrasound to Measure Thickness of The Lower Uterine Segment at Term

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ABSTRACT

Background: The rising global rates of cesarean sections (CS) and pregnancies with CS history necessitate the assessment of uterine scar integrity, potentially using transabdominal or transvaginal ultrasounds as a predictive tool.

Aim: To compare the accuracy and utility of transabdominal and transvaginal ultrasound in measuring lower uterine segment (LUS) thickness at term.

Materials and Methods: We conducted a thorough search on Google Scholar, PubMed, Embase, and Cochrane Library. The investigation utilized both text terms and medical subject headings, such as LUS Thickness, (CS), Transabdominal Ultrasound (TAS), Transvaginal Ultrasound (TVS), Scar Dehiscence, Rupture of uterus, Vaginal Birth following Cesarean, Vaginal Birth After Cesarean (VBAC). Also, we conducted a thorough investigation on ClinicalTrials.gov and examined the references cited in selected materials and reviews to discover any more pertinent observational research.

Results: This meta-analysis incorporated data from 9 studies involving 1,789 patients to assess the differences in lower uterine segment (LUS) thickness measured by (TAS) and (TVS). The studies included participants aged eighteen to 44 years, with a BMI range of 20.7 to 50.4 kilogram/metrer² and gestational ages from 36 to 40 weeks. Our combined analysis revealed a statistically significant variance in LUS thickness between the groups ($Z = 4.42$, $P < 0.0001$), highlighting the potential of ultrasound measurement techniques in predicting uterine scar complications.

Conclusion: The findings support the clinical use of LUS measurement, particularly via transvaginal sonography (TVS), as valuable tool in guiding delivery decisions, especially for those considering a trial of labor after cesarean (TOLAC).

Keywords: CS, TAS, TVS.

INTRODUCTION

Worldwide cesarean section rates have experienced an alarming increase in recent years [(1)]. The majority of pregnant female who visit obstetricians have a history of cesarean section. Additionally, the preceding cesarean section is now serving as a leading indicator for the subsequent CS [(2)].

The probability of rupture for a previous cesarean section scar is 0.2-1.5 percent. A non-invasive and fairly simple method for predicting dehiscence of the scar or rupture is the ultrasound evaluation of the LUS [(3)]. The favorable result of a trial of labor in female with a history of cesarean section is contingent upon the scar of the previous caesarean section, which is directly correlated with its thickness. The estimation of lower thickness of LUS has been identified as a possible indicator of scar dehiscence [(4)].

The strength of the scar, which has been demonstrated to be correlated with its girth, is the primary factor determining the result of VBAC [(5)]. Consequently, the evaluation of the thickness of the lower uterine segment at term has the possibility to be utilized as a predictive instrument for scar dehiscence [(6)]. In the third trimester, the thickness of the lower uterine segment can be determined through either a TAS or TVS examination [(7-10)].

In identification of layers and the ease of measurement, and general, image resolution, are better with transvaginal ultrasound than transabdominal ultrasound [(7)]. Despite this, the comparative efficacy of TAS and TVS in accurately measuring thickness of LUS remains a subject of ongoing debate, with limited direct evidence comparing the two approaches.

This meta-analysis aimed to fill that gap by systematically comparing the accuracy and utility of transabdominal and transvaginal ultrasound in measuring LUS thickness at term. Through this comparison, we hope to provide clearer insights into which method offers more reliable predictions for scar dehiscence and, ultimately, safer VBAC outcomes.

MATERIALS AND METHODS

Search strategy: We conducted a thorough search on Google Scholar, PubMed, Embase, and Cochrane Library. The investigation utilized both textual terms and medical subject titles, such as thickness of lower uterine segment, (CS), (TAS), (TVS), Scar dehiscence, Rupture of uterus, and Vaginal Birth After Cesarean. In addition, we conducted a thorough search on ClinicalTrials.gov and examined the references cited in selected publications and reviews to discover more relevant observational research.

Inclusion criteria: Investigations have been considered eligible if they met the following criteria: Reported original data on LUS thickness measurements using TAS, TVS, or both. Included a comparison of LUS thickness between groups with varying histories of cesarean deliveries. Provided quantitative outcomes such as mean

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LUS thickness and standard deviations, or other relevant metrics.

Exclusion criteria: We excluded studies if they: did not report LUS thickness measurements or relevant outcomes. Included populations with conditions that could confound LUS measurements, such as multiple pregnancies or significant uterine anomalies. Were not published in English or did not provide full-text access.

Data extraction: The titles and abstracts of all generated papers were assessed by the researcher. Each trial was thoroughly examined, and decisions were made on whether to include it. The researcher independently extracted the data into a standardized data extraction form. In cases of ambiguity or uncertainty regarding trial eligibility or data extraction, the researcher consulted relevant literature or sought expert opinion to resolve discrepancies.

Ethical considerations: All the procedures of the research were approved by Pediatrics Department and the Investigation Ethics Committee of Damanhour National Medical Institute. Administrative consents required were taken. This study was performed in compliance with the Declaration of Helsinki, the code of ethics of the World Medical Association

Statistical analysis

Review Manager version 5.4.1 has been utilized to conduct all data analyses (The Cochrane Collaboration, 2014, Copenhagen: The Nordic Cochrane Centre). The odds ratio for binary findings was determined using a ninety-five percent confidence interval (CI). For continuous results, we computed the mean variance with an interval of confidence of ninety-five percent. When there was no indication of heterogeneity among investigations, we utilized a fixed-effect model utilizing the Mantel-Haenszel method to compute the aggregate effect estimate with a ninety-five percent confidence interval. Alternatively, the random-effects model utilizing the method of DerSimonian and Laird has been selected. The heterogeneity of the investigations was assessed by employing the Q statistic and I^2 test, which describe the percentage of variability in the effect estimates. A p-value less than 0.05 has been regarded significant.

RESULTS

Study characterization:

A total of 8 studies have been selected for the current analysis including a total of 1789 patients. The publication year ranged from 2009 to 2024. Four studies were carried out in Egypt and one study was conducted in each of the following: Brazil, Japan, Turkey and India (Table 1).

Table 1. Study characteristics

Author	Year	Design	Country	Study Period		Sample size
				From	To	
Martins *et al.* [11]	2009	Prospective investigation	Brazil	October	December 2006	30
Mohammed *et al.* [12]	2010	Prospective investigation	Egypt	2007	2008	50
Abosrie *et al.* [13]	2015	Prospective study	Egypt	April	November 2014	
Fukuda *et al.* [14]	2016	Prospective study	Japan	August	October 2015	944
El-Badry *et al.* [4]	2022	Prospective study	Egypt	January	July 2021	147
Afifi *et al.* [8]	2022	Cross sectional study	Egypt	May	November 2020	130
Tekin *et al.* [15]	2022	Prospective study	Turkey	April	September 2019	198
Rana *et al.* [16]	2024	Cross sectional study	India	January	April 2023	120

Patient's characteristics

The mean participants' age was reported in 9 studies, ranging from 18 to 44 years. BMI was reported in three studies, ranging from 20.7 to 50.4 kg/m^2. Gestational age reported in 8 studied ranging from 36 to 40 week (Table 2).

Table 2. Patient's characteristics:

Author	Age			BMI			Gestational age		
	Mean	**SD**	**Range**	**Mean**	**SD**	**Range**	**Mean**	**SD**	**Range**
Martins *et al.* (11)	27.4	3.5	21.3 - 35.2						36 + 4 to 38 + 3
Mohammed *et al.* (12)	27.3	4.8					37.8	0.5	
Abosrie *et al.* (13)	26.34	5.1	18-40				37.77	1.14	36-40
Fukuda *et al.* (14)							36	0.2	
El-Badry *et al.* (4)	27.54	4.81	20 – 39	26.92	2.65	22 – 32	38.24	1.33	37 – 40
Afifi *et al.* (8)	25	2.5	20 -30						
Tekin *et al.* (15)	30.16	5.001	19–44	30.42	5.01	20.7–50.4	38.87	0.65	37–40
Rana *et al.* (16)	29.37	4.26	20-40				37	0.2	
Farahat *et al.* (17)	32.54	4.81	20-39	26.92	65	22-32	38.24	1.33	37-40

Nine studies reported LUS thickness. A significant heterogeneity has been observed. Therefore, a random-effect model has been used for analysis (I^2 = 91%, P<0.00001). The combined mean difference and ninety-five percent CIs was 0.59 (0.33 to 0.85). The combined result demonstrates statistically significant difference between groups regarding LUS thickness (Z = 4.42, P -value; < 0.0001) (Figure 1).

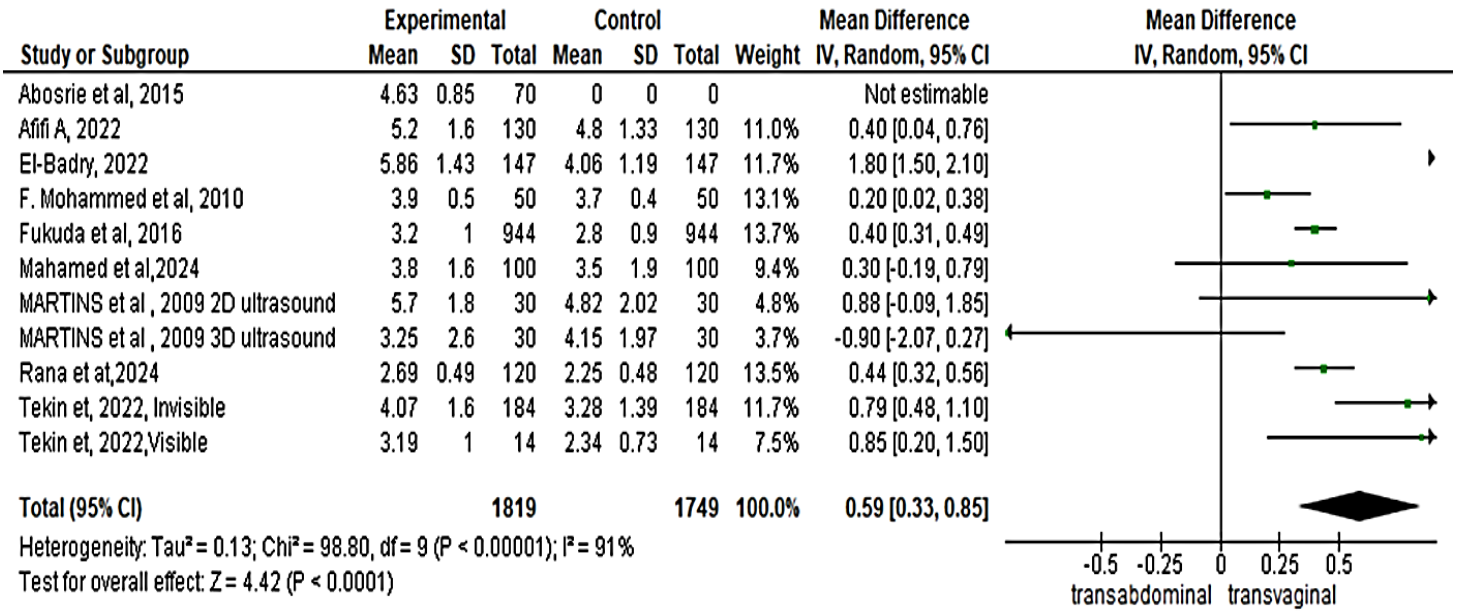

Figure (1): Forest plot of LUS thickness illustrate statistically significant variance between groups

Figure 2 illustrates potential publication bias regarding LUS thickness.

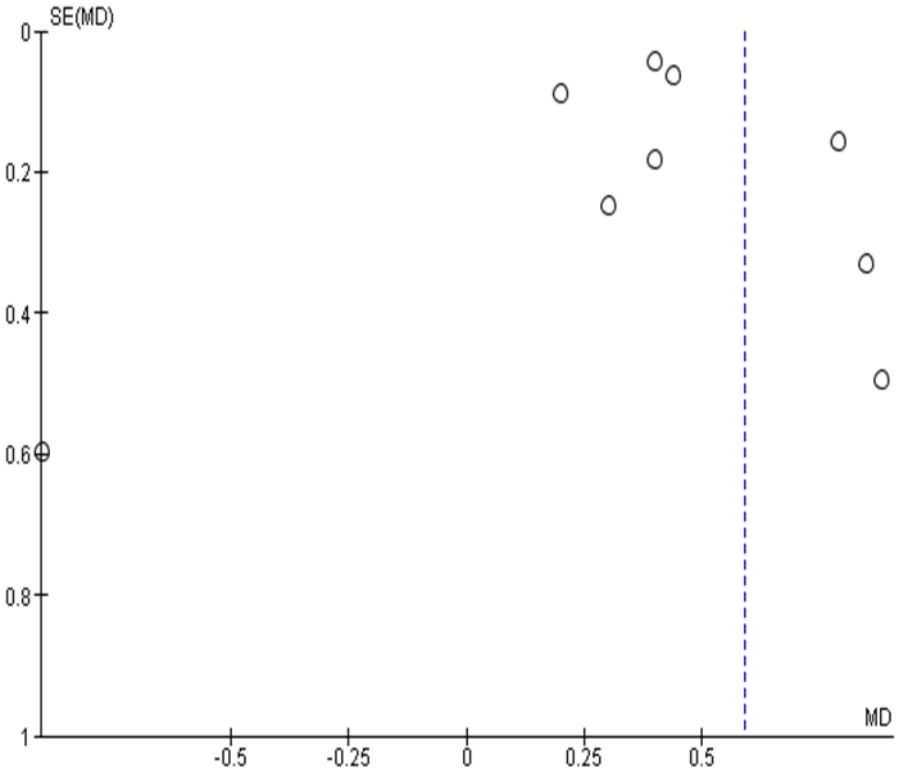

Figure (2): Funnel plot of LUS thickness

DISCUSSION

This meta-analysis aimed to consolidate the available evidence on the correlation among thickness of lower uterine segment and the possibility of uterine scar complications in females with a previous cesarean section. By synthesizing data from studies conducted across various countries, we sought to offer a comprehensive understanding of the role of LUS thickness in predicting scar dehiscence or rupture and its implications for clinical practice.

The pooled outcomes indicate a statistically significant variance in LUS thickness between the studied groups. This finding underscores the importance of LUS measurement as a predictive tool for scar dehiscence or rupture of uterus in females with a history of cesarean section. The statistically significant difference (combined mean difference: 0.59, confidence interval of ninety-five percent I: 0.33 to 0.85, Z = 4.42, P-value less than 0.0001) highlights the potential for thickness of lower uterine segment to serve as a reliable marker guiding clinical decisions on the mode of delivery, particularly for females considering a trial of labor after cesarean.

Our findings align with those of **Marasinghe *et al.* [7],** who reported that the mean LUS thickness following delivery was 7.58 ± 1.3 millimeters in unscarred uteri, 5.09 ± 1.4 millimeters for one previous cesarean, and 3.92 ± 1.1 millimeters for 2 previous cesareans (P-value less than 0.01). They also found significant correlations between LUS thickness measured by transvaginal sonography and transabdominal sonography, demonstrating that TVS offers greater accuracy in LUS assessment. **Omar El-Badry *et al.* [4]** further supported this, showing that thickness of lower uterine segment detected by transabdominal ultrasound was significantly greater than thickness of lower uterine segment detected by transvaginal ultrasound. They demonstrated that measurement of thickness of lower uterine segment scar was most accurate with transvaginal ultrasound in comparison with transabdominal ultrasound.

Ultrasonography evaluation permitted better estimation of the risk of intrapartum complications for cases attempting vaginal birth following CS, and could permit for safer management of delivery [4].

The choice of ultrasound method significantly influences LUS thickness measurements. A combination of TAS and TVS appears to offer superior detection of uterine dehiscence [18]. This is consistent with the previous meta-analysis by **Jastrow et al.** [19], which supported the use of antenatal thickness of LUS measurements to predict rupture of uterus risk during TOL in women with prior CS.

Both TAS and TVS have been widely utilized in clinical practice, but TVS is generally considered more reliable. **Sen *et al.*** demonstrated excellent association between TAS and TVS measurements [20], while a more recent investigation demonstrates better interobserver agreement with TVS [19].

CONCLUSION

The findings support the clinical use of LUS measurement, particularly via transvaginal sonography (TVS), as a valuable tool in guiding delivery decisions, especially for those considering a trial of labor after cesarean. Further research should focus on standardizing LUS measurement techniques and exploring its predictive value across diverse populations to optimize the management of VBAC and reduce the risks associated with uterine rupture.

DECLARATIONS

- **Funding:** No fund
- **Availability of data and material:** Available
- **Conflicts of interest:** No conflicts of interest.
- **Competing interests:** None

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