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ORIGINAL ARTICLE

SONOGRAPHIC EVALUATION OF POST-CESAREAN LOWER UTERINE SEGMENT IN PREGNANT NIGERIAN WOMEN

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ABSTRACT

Background: *This study was done to determine if there are significant morphological differences between a previously sectioned and non-operated lower uterine segment in a group of Nigerian women.*

Methods: *This was a prospective, descriptive, comparative study of thirty-eight pregnant women with previous Cesarean section (CS) and 45 pregnant women with no previous uterine surgery. They had transabdominal sonographic measurement of their lower uterine segment thickness between 35 and 37 weeks gestation. Mann-Whitney U test was used for comparison of means.*

Results: *The lower uterine segment (LUS) was significantly thinner in women with previous Cesarean group compared to the controls (mean of 4.9 ± 2.5 mm and 3.4 ± 2.2mm versus 6.4 ± 2.8 mm and 4.5 ± 2.2mm for full and myometrial thicknesses, respectively; P= 0.006 and 0.007, respectively). Normal lower uterine segment appearance and thicknesses were seen in the majority of previously sectioned women. The previous scar site was identified in 8 (10.7%) of women with previous scar.*

Conclusion: *The LUS is thinner in women with previous CS; the more the number of Cesarean sections, the thinner the LUS becomes. Ultrasonography of the LUS could be done to help decide for or against a trial of scar.*

Key words: *Lower uterine segment, Cesarean section, Ultrasonography, Vaginal birth after Cesarean section, Trial of labor*

INTRODUCTION

Cesarean section (emergency and elective types) is a surgical method of delivery in a pregnant woman which is often necessitated by various clinical indications. The previous thinking regarding the obstetrics management of pregnant women with previous Cesarean section (CS) is encapsulated by the old dictum: "once a Cesarean, always a Cesarean" (1). However, there is a new awareness in modern obstetrics of the possibility of safe vaginal birth in a previously Cesarean-sectioned uterus - this is referred to as "Vaginal birth after (previous) Cesarean Section (VBAC)" (2).

This new trend is further encouraged by the renewed quest to avoid or minimize the inherent morbidity and mortality associated with Cesarean sections as well as the physical, emotional, and financial costs of such a major surgery. In order to reduce the overall CS rate, methods of reducing primary and repeat CS need to be explored (3).

The lower uterine segment (LUS) in late pregnancy corresponds essentially to the isthmus of the uterus and upper portion of the anatomic cervix in the non-pregnant patient and in early pregnancy (4).

The relatively amuscular nature of the LUS in late pregnancy makes it the preferred site for Cesarean section incisions (5).

Even though about 100,000 VBACs are successful each year (1), VBAC still carries a risk of scar dehiscence and uterine rupture (6). Therefore, careful selection of patients for VBAC is mandatory. Since the risk of uterine rupture in the presence of a defective scar is reportedly related to the degree of thinning of the LUS (7-9), the integrity of the LUS of a gravid uterus can be studied in the 3rd trimester using B-mode sonography to define its layers in detail and to detect potential LUS abnormalities that may lead to adverse outcome if VBAC is attempted.

There is relative paucity of information on the antepartum state of the LUS in pregnant Nigerian women. This study was done to evaluate the LUS wall thickness of pregnant Nigerian women and to determine the effect(s) of parity and previous CS on LUS wall thickness. The findings could potentially be useful in predicting the capability of a previously scarred uterus to withstand a VBAC.

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METHODS

This prospective, observational comparative study was carried out in the Department of Radiology of our institution as approved by the Ethics and Research Committee of the hospital.

The consecutively recruited study group consisted of 38 pregnant women with 1 or more previous Cesarean deliveries (Cesarean group) and a control group of 43 pregnant women with no previous Cesarean section (Controls).

The Cesarean group/subjects comprised women aged 20 – 45 years with singleton pregnancies and were between the 35th and 37th weeks of gestation (as determined from the last menstrual period (LMP) or first trimester ultrasound evaluation, or both). The designation of 35-37 weeks as the time of sonographic examination was borne-out of previous studies affirming this period to be desirable for LUS assessment because there would have been a well-formed LUS in which thinning, if present, would have been well established.

The control group consisted of nulliparous (no previous childbirth), multiparous (2-5 previous deliveries), and grand-multiparous women (> 5 previous deliveries). Written informed consent was obtained from all the participants.

The exclusion criteria include: multiple gestations, abnormal amniotic fluid volumes, presence of placenta previa, lower uterine segment leiomyoma, previous myomectomy, previous classical or inverted 'T' hysterotomy, cervical length <3.0 cm, history of or current cervical incompetence, congenital uterine anomalies, and history of wound infection in the previous CS (10).

Clinical histories were obtained by interviewing the pregnant women and reviewing their case notes to ascertain their past obstetrics history and mode of delivery. The maternal age, weight, height, gravidity (the number of times a woman had conceived previously), and parity (the number of pregnancies carried beyond the age of viability; i.e., 28 weeks in Nigeria, 24 weeks in Europe and 22 weeks in the USA; irrespective of the outcome) were also determined. Attempts were made at blinding (to reduce observer bias) by the recruiting sonologist not being the one performing the sonographic exam, that is, the first and second authors switched roles throughout the study. However, the fact of a previous Cesarean section could not be blinded but that of the number of previous deliveries, either per vaginum or per abdomen was blinded.

All sonographic examinations were performed prior to onset of labor. The amniotic fluid index (AFI) was determined by summation of the antero-posterior extents of the deepest vertical pockets in the four quadrants of the abdomen. A range of 7.0 cm – 24.5 cm was taken as normal for the AFI (11).

Transabdominal sonographic examination was carried out with a moderately full urinary bladder (when the patient feels the first/initial urge to void). All examinations were performed on a Mindray® diagnostic ultrasound system machine (Shenzhen Mindray Bio-medical Electronics Co. Ltd, Shenzhen, China) with a 3.5 – 5.0 MHz curvilinear array transducer. Careful evaluation of the LUS was done in both longitudinal and transverse planes.

The sonographic anatomy of the LUS is depicted in Fig. 1. The LUS measurements were taken in the midsagittal plane at its thinnest portion. However, if the LUS appeared uniform along its entire length, LUS measurements were obtained at a point which is >3.0 cm to < 6.0 cm from the internal cervical os (Fig. 2). The myometrial thickness was obtained at the echogenic urinary bladder wall – myometrium interface and the myometrium – decidualized chorioamniotic membrane interface. The full thickness measurement was taken at the echogenic urinary bladder wall - myometrium interface and the decidualized chorioamniotic membrane – amniotic fluid interface**.** At least three measurements were obtained and the average taken as the LUS thickness.

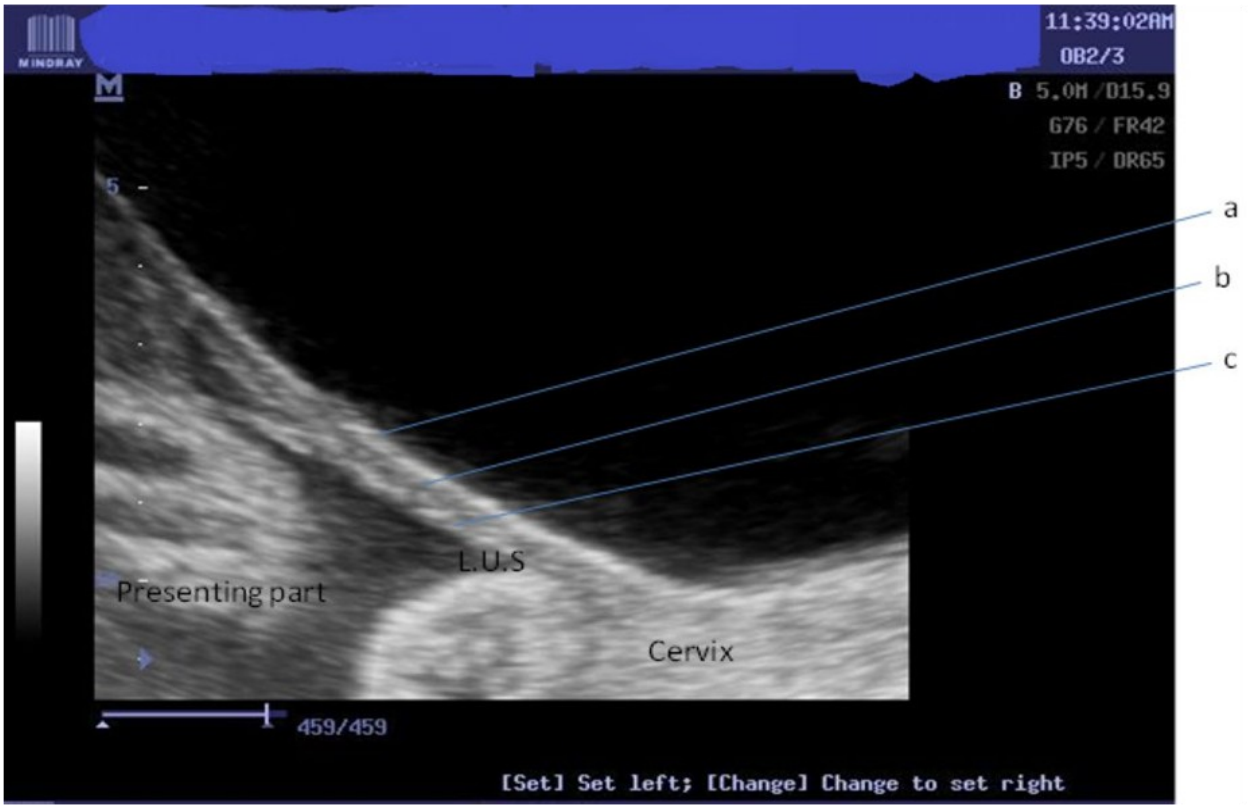


Figure 1. Transabdominal longitudinal sonogram showing the trilaminar lower uterine segment: (a) outer echogenic visceral-parietal peritoneal reflection, (b) the middle hypoechoic myometrial layer, and (c) echogenic chorioamniotic membrane and decidualized endometrial layer.

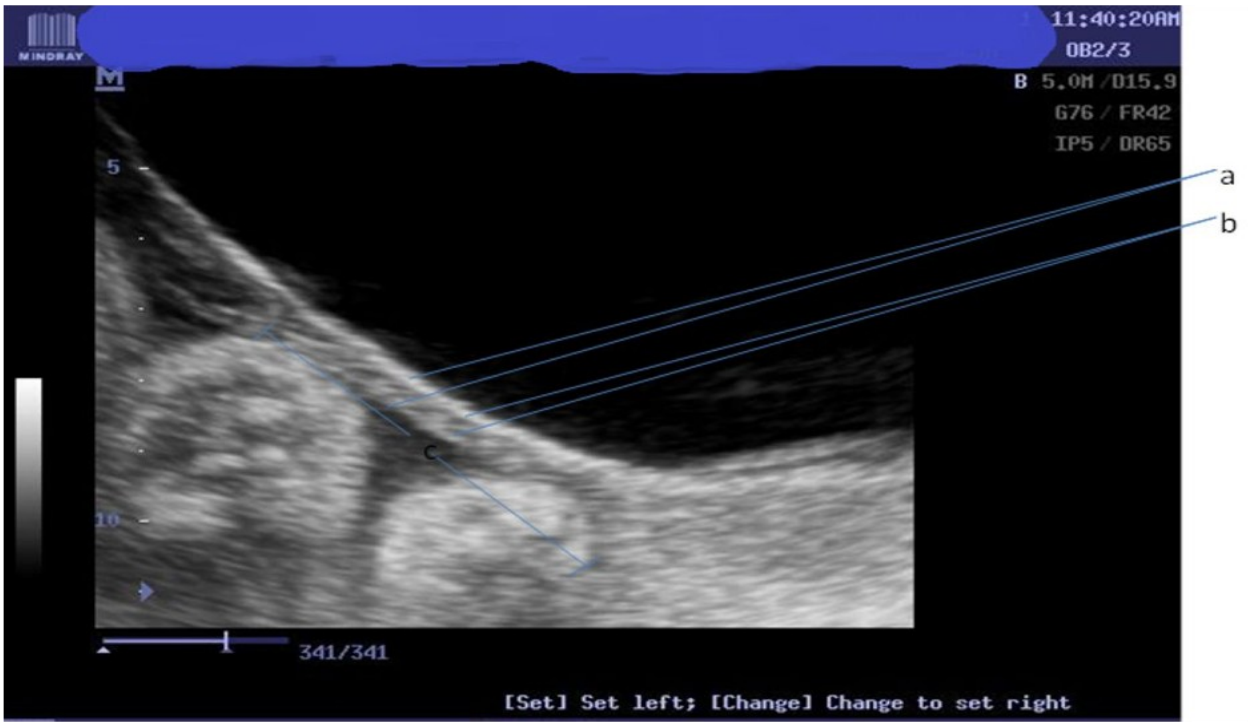


Figure 2. Transabdominal longitudinal sonogram showing the measurements of: (a) full thickness (b) myometrial thickness, at a point (c) which is > 3.0 cm but < 6.0 cm from the internal cervical os.

The LUS was also evaluated for abnormalities (10) such as wedge-shaped defects, abnormal thinning, ballooning effect, asymmetry or asymmetric thinning, abnormal movements, and focal area of thickened echogenic outer urinary bladder wall. The case notes were reviewed for the subjects' delivery outcome. If any patient in the Cesarean group had a repeat Cesarean delivery, the surgeon's comments on the appearance of the LUS were noted.

Statistical analysis was performed using the Statistical Package for Social Sciences (SPSS Inc., Chicago, IL, USA) software version 16.0 for windows. The Kolmogorov-Smirnov test was used to determine normality of distribution. Continuous variables were analysed with Student t test and categorical variables with Fisher's Exact test. Correlational analyses were done with Spearmann's ranking while Mann-Whitney U test was used for comparison of means. Statistical significance was taken as $p \leq 0.05$.

RESULTS

The study enrolled 38 pregnant women with previous Cesarean section. In this CS group, 18 (47.4%) had one previous CS only, 15 (39.4%) had a history of one previous CS and one or more vaginal delivery while five (13.2%) had 2 or more previous Cesarean deliveries. There were 43 women in the control group. Fourteen (32.6%) of them were nulliparous, 24 (55.8%) were multiparous and 5 (11.6%) were grand multiparous.

The age of the subjects ranged from 20 – 40 years, the height from 1.55m – 1.75m, and the weight from 62.8 to 75.8 kg (Tab. 1). In 34 (89.5%) women of the CS group, the previous uterine scar could not be identified - a sonographically normal-appearing LUS (consisting of intact layers) indistinguishable from that of controls were seen. In 2 (5.3%) women of the CS group, the previous scar was identified as isolated thickened echolucent area in the outer layer while the underlying myometrial layer appeared asymmetrically thinned out when compared with the adjacent myometrium (**Figs. 3A & 3B**). Furthermore, two (5.3%) subjects showed a scar consisting of a wedge-shaped defect in the underlying echogenic area with a thinned-out underlying myometrial layer.

The measured LUS values showed a non-parametric distribution. The mean LUS thicknesses of the CS and control groups are as shown in table 2.The LUS thicknesses showed an inverse relationship with the number of previous Cesarean sections suggesting that increasing number of Cesarean sections leads to thinner LUS.

In the CS group, there was no statistically significant difference between the LUS thicknesses of those pregnant women with a history of previous CS alone and those with previous CS plus subsequent vaginal birth(s); (P= 0.953 full thickness, P = 0.883 for myometrial thickness).

Eight (21.1%) of the 38 women in the CS group had successful vaginal deliveries and their LUS thicknesses ranged from 3.4 mm to 7.1 mm (full thickness) and 1.75 mm to 4.7 mm (myometrial thickness). Of those eight, five had had one previous CS while three had had one previous CS plus one or more subsequent vaginal births. The other 30 (78.9%) women in the CS group had repeat CS.

The findings at surgery in the 30 women who had repeat CS showed mainly pelvic adhesions between the LUS and adjacent pelvic structures. Only three women who underwent repeat CS had no adhesions. No other abnormality like thinning, dehiscence or uterine rupture was found at surgery in the repeat CS women.

A patient with one previous CS only who had a sonographic evidence of hypertrophic scar with underlying asymmetrical myometrial thinning was reported to have had "adhesion between anterior abdominal wall and bladder base and a drawing superiorly of the bladder base" at surgery. Of the 43 women in the control group, two (4.6 %) had Cesarean section while the other 41 (95.3%) had uneventful vaginal deliveries.

The CS group showed weak but statistically significant negative correlations between their gravidity and both the full and myometrial thicknesses (r = -0.3, P = 0.012 for both). There was low positive correlations between gravidity and the LUS thicknesses in the controls with correlation coefficient, r = 0.3 for both full thickness (P= 0.004) and myometrial thickness (P = 0.003).

A weak positive correlation was also observed between the parity of controls and their full LUS thickness (r = 0.3, P=0.005) as well as the myometrial thickness (r = 0.3, P = 0.006).

Table 1. Characteristics of the study population

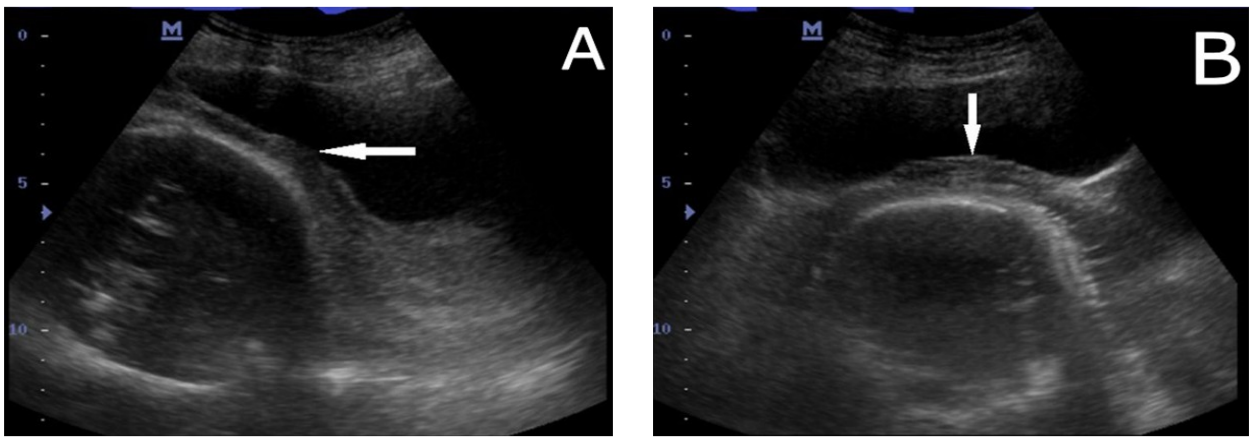
Parameters	**Cesarean group**	**Controls**	***P* value***
Age (years)	32.5 ± 3.6	30.8 ± 4.7	0.06
Weight (Kg)	69.4 ± 0.28	69.2 ± 3.8	0.09
Height (meters)	1.7 ± 0.05	1.6 ± 0.06	0.07
Full thickness (mm)	4.9 ± 2.5	6.4 ± 2.8	0.006
Myometrial thickness (mm)	3.4 ± 2.2	4.5 ± 2.2	0.007

*Mann-Whitney U test applied

Table 2. Comparison of the lower uterine segment thickness of Cesarean and control sub-groups

	CS [1]	**N [2]**	**M [3]**	**GM [4]**	***P*(1vs2)**	***P*(1vs3)**	***P*(2vs3)**	***P*(2vs4)**
FT (mm)	4.9±2.5	6.0±3.6	6.6±2.4	9.2±1.9	0.06	0.002	0.08	0.003
MT (mm)	3.4±2.2	4.2±2.9	4.7±1.9	7.1±1.4	0.07	0.002	0.06	0.004

CS = Cesarean section group, N = Nulliparous controls, M = Multiparous controls,
GM = Grandmultiparous controls, FT = Full thickness, MT = Myometrial thickness, *P* = *P* value
Vs = Statistical comparison of means using Mann-Whitney U test



Figures 3A & 3B. Transabdominal longitudinal and transverse sonograms respectively of a pregnant woman with a previous Cesarean section showing a hypertrophic hypoechoic scar (arrows) in the outer echogenic urinary layer with asymmetric thinning of the underlying myometrial layer.

DISCUSSION

The objectives of this study were to evaluate the LUS using ultrasound, with emphasis on its appearance and thickness in pregnant women with and without previous Cesarean section(s), and to observe the eventual obstetric outcomes in the CS. Although a number of similar studies had been done elsewhere, not much has been done in our environment to address this clinical question (12).

In this study, the mean full thickness and the mean myometrial thickness of the LUS were significantly thinner in the CS group than in the controls. Although women in the previous CS group had thinner LUS thickness than the nulliparous controls, the difference was not statistically significant. This is similar to what was reported by Cheung *et*al[13]and may be due to the progressive (possibly permanent) thinning of the LUS in previously sectioned women secondary to multiple repeated Cesarean sections, which may cause their LUS thickness to approach LUS thickness of the nulliparous state.

The general pattern of differences between subjects and controls is similar to what has been reported by previous researchers. Cheung *et al* (13) recorded full LUS thickness of 1.9 ± 1.4 mm for their CS group, 2.3 ± 1.1mm for the nulliparous controls, and 3.4 ± 2.2 mm for their multiparous controls. Michaels *et* al (14) reported a mean full thickness of 5.2 ± 2.6 mm in the previous CS group, 7.9 ± 2.8 mm in the nulliparous controls, and 6.3 ± 1.8 mm in the multiparous controls.

Jastrow *et al* (15) observed that previously sectioned pregnant women with full thickness of 2.0 – 3.5 mm and myometrial thickness of 1.4 – 2.0 mm have high negative predictive values for uterine rupture. Unfortunately, the pregnant women in our CS group with the thinnest LUS measurements of 2.0 – 3.4 mm and 1.0 – 2.1 mm for full and myometrial thicknesses, respectively all underwent repeat Cesarean sections without the benefit of a trial of labor and possible VBAC.

In our study, majority of the women (78.9%) in the CS group had repeat Cesarean sections and only 21.1% had VBAC. The thinnest LUS thickness in the VBAC group was 3.1mm for full thickness and 2.1 mm for myometrial thickness. In the controls, 4.6% underwent primary Cesarean section and 95.4% underwent normal vaginal birth. This shows a high rate of repeat Cesarean section secondary to previous Cesarean section and low VBAC attempts.

Cheung *et al* (13) [using] the transabdominal approach, reported that 83% of women in their CS group had normal-appearing LUS indistinguishable from that of the controls. This is similar to the 89.5% of our study. On the contrary, they also reported that 13.2% of their CS group had a thickened area of increased echogenicity with myometrial thinning but we found underlying myometrial thinning in only 5.3% of our CS group.

Most of the studies that used the transabdominal sonographic approach (7,9,13,16) measured full thickness of the LUS from the urine/bladder wall interface to amniotic fluid/decidualized endometrium interface while the myometrial thickness was taken as the width of the hypoechoic middle layer (measured from the myometrium/bladder interface to the myometrium decidualized endometrium interface). However, this study measured the full thickness from the bladder wall/myometrial interface to the amniotic fluid/decidualized endometrium interface due to the observation by Cheung *et al* (13) that measurements that included the bladder mucosa and the underlying tissues were more likely influenced by the variations in the urinary bladder size due to differences in the degree of urinary distension. However, the myometrial thickness was measured similarly to what was done in the previous studies.

The risk of uterine rupture in the presence of LUS defects, when identifiable sonographically, is unknown. Also the cut-off value at which an extremely thin LUS carries a high risk of uterine rupture could not be determined in this study due to the fact that no evidence of dehiscence or uterine rupture was found in the Cesarean section subjects at surgery. The thinnest individual LUS thickness in our study group was found in one of the nulliparous controls with full and myometrial thicknesses of 2.3 mm and 1.7 mm, respectively. This patient had a normal vaginal delivery. However, a meta-analysis of previous studies established that “full LUS thickness cut-off of 3.1–5.1 mm and a myometrium thickness cut-off of 2.1–4.0 mm provided a strong negative predictive value for the occurrence of a defect” during trial of labor and that “a myometrium thickness cut-off between 0.6 and 2.0 mm provided a strong positive predictive value for the occurrence of a defect” (17). The weak negative correlations between gravidity and LUS thicknesses in the CS group suggests that increasing number of Cesarean sections leads to thinner LUS. The low positive correlations between gravidity and the LUS thicknesses in the controls may likely indicate that as the number of pregnancies increases, the LUS thickens progressively in the controls.

The effect of gravidity appeared not to have been tested for by previous studies on LUS evaluation. Positive correlation between the parity of controls and their LUS thicknesses is a pointer to the fact that increasing parity possibly increases the thickness of LUS in that group. However, the maternal age, weight, and height in both the CS and control groups showed no relationship with the LUS thicknesses; as similarly documented in several other studies (7,13,16,18).

Ours was a transabdominal sonographic study of the LUS because this is more readily available in our environment. Although transvaginal sonography is reportedly more reproducible, the abdominal route could yield more accurate measurements in some cases where uterine scar defects are located on the upper part of the LUS (19). This often occurs when the previous CS was performed at a relatively early gestational age before or in early labor, necessitating higher incision on the LUS (17,19).

The limitations of our study include the fact that tocography was not performed to determine asymptomatic uterine contractions/pseudo-dilatation (which tends to thicken the LUS) (20,21). However, attempts were made to minimize this by carefully observing the LUS for sonographic signs of contraction before taking measurement. Furthermore, the practice by pregnant women in our environment of attending antenatal clinics in standard public health facilities and then opting to deliver their babies at home, churches, or private hospitals led to some attrition.

Hitherto in sub-Saharan Africa, the criteria for selection of pregnant women with previous CS for a VBAC/Trial of Labor After Previous Cesarean Section (TOLAC) had been mainly clinical (22). We therefore conclude that prenatal sonographic examination is capable of determining the degree of LUS thinning in patients with previous Cesarean delivery, detecting the site of the previous Cesarean scar, and would be useful in the antepartum diagnosis of uterine defects in African women. All these will aid in deciding objectively which patients are safe to attempt VBAC.

Conflict of Interest: The authors declare no conflict of interest.

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