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Ultrasonographic Evaluation of Lower Uterine Segment to Predict the Integrity and Quality of Cesarean Scar during Pregnancy: A Prospective Study

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Qureshi, B., Inafuku, K., Oshima, K., Masamoto, H. and Kanazawa, K. *Ultrasonographic Evaluation of Lower Uterine Segment to Predict the Integrity and Quality of Cesarean Scar during Pregnancy: A Prospective Study.* Tohoku J. Exp. Med., 1997, **183** (1), 55-65 —— A prospective randomized study was conducted to measure the serial thickness of the lower uterine segment (LUS) by transvaginal ultrasonography in a control group of 80 women having no history of uterine surgery and in a study group of 43 women having a history of previous cesarean section (C/S). In the study group, more than 2 mm of thickness of the LUS was considered as good healing and less than 2 mm of thickness as poor healing. After serial sonographic examination, the women with good healing were given trial for labor unless an obstetrical indication for C/S existed. The appearance of the LUS during surgery was compared with antenatal ultrasonographic assessment by direct inspection. Twenty two (79%) of 28 women with a well healed scar had trial labor with the result that 46% had a successful vaginal birth without any uterine rupture or dehiscence. Eight women with poor healing all had elective C/S. Seven women with a 2 mm LUS thickness were individually categorized for delivery mode. Two of those women delivered vaginally. The LUS was found to be thin to translucent in these later two groups. Two mm or less as a criterion for poor healing had the sensitivity and specificity of 86.7% and 100% respectively. The positive predictive value was 100% and the negative predictive value was 86.7%. Ultrasonographic evaluation is effective in predicting the quality of a uterine scar and in differentiating the risk group of probable uterine rupture from the non risk group. ———— transvaginal ultrasonography; cesarean section; lower uterine segment thickness

Today, as well as for the last two decades in obstetrics practice, one of the major topic of debate is decision making in cesarean birth. A history of a previous cesarean birth creates more difficulty in such a situation. The old dictum "Once a cesarean always a cesarean" (Craigin 1916) has changed now

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because of the awareness of obstetricians about the safety of vaginal birth in a scarred uterus as well as the awareness of greater maternal morbidity and increased risk of maternal mortality in cesarean birth. The cost of this major operation is also another factor to make the obstetrician think about the trial of labor by the vaginal route in scarred uterus as an alternative of routine repeat cesarean section (C/S). To reduce the overall C/S rate it is equally important to reduce the repeat C/S as well as the primary C/S.

Many authors have published reports on trial of labor in a scarred uterus but only a few could establish any suitable method for evaluation of the lower uterine scar. Although the rate is very low, the estimated frequency of uterine rupture in a scarred uterus with trial of labor is between 0.3%–3.8% (Leung et al. 1993). This may be due to the lack of awareness of the integrity of the scarred lower uterine segment (LUS) and to blindly selecting patients for trial of vaginal birth. History of vaginal birth after C/S does not warrant the safety of next delivery by the vaginal route. Scar deficiency sometimes overshoots the effect of labor although it may rupture in a subsequent pregnancy (Bockner 1960). Hysterography had been used previously for the assessment of uterine scar only in the non pregnant state and has not proved useful for assessment of safe vaginal delivery. Radiology is also not useful for prediction of a uterine rupture (Thubisi et al. 1993). With the availability of ultrasonography (USG) assessment of the integrity of the lower uterine scar has become possible even in a gravid uterus.

Michaels et al. (1988) used transabdominal ultrasound to diagnose the defect in the scarred LUS. Some other authors (Burger et al. 1982) have worked to evaluate the early puerpereal cesarean wound. Others have evaluated the LUS to detect the presence of scar tissue and its type (Loknky et al. 1989). Overall the transvaginal approach is less investigated for assessing the intactness of scarred LUS. In the present study we have prospectively measured the thickness of LUS in women with a previous C/S by transvaginal ultrasonography. With this thickness we categorized the quality of the healed scar and selected patients for mode of delivery to avoid undue repetition of a C/S or a hazardous uterine rupture. Our aim was to assess the predictive value for the safety of trial of vaginal delivery in patients having previous cesarean delivery from the assessment of transvaginal ultrasonographic LUS thickness.

Matelials and Methods

We started our prospective study to evaluate the healing status of the LUS cesarean scar by transvaginal ultrasonography considering LUS thickness of more than 2 mm as good healing, a thickness previously proposed by Fukuda et al. (1991). The study period was from May 1994 to April 1996. Forty three pregnant women with one or more prior C/Ss as the study group and 80 pregnant women without previous C/S or uterine surgery as the control were enrolled in the study. Parity in the control subjects was not considered as we wanted to compare

the lower segment of both a scarred and a non scarred uterus. The women selected were those who regularly visited our out patient department and confined in this hospital. All were informed about the proposed examination to be done.

By 16th week of pregnancy the isthmus of the uterus elongates and unfolds. The LUS becomes well developed and clearly visualized ultrasonographically thereon. So we started ultrasonographic examination from the 16th week onwards to see the serial changes in LUS as the pregnancy advanced and to detect any defect present in the LUS in early pregnancy. USG was done with a RT 3000 (Aloka, Japan) scanner with a 5 MHz transducer attached. We scanned with a partially filled bladder (waiting for 2 hours. after the last micturation) as Mason and Maresh. (1990) has shown that an over distended bladder could elongate the cervical length by stretching the LUS. Three layers can be identified ultrasonographically in a well developed LUS in a midline section of sagital view (Michaels et al. 1988). They are as follows from inside outwards: 1) chorioamniotic membrane with decidualized endometrium, 2) a middle layer of myometrium and 3) utero-vesical peritoneal reflection juxtaposed to muscularis and mucosa of the bladder. We measured the muscle thickness from the muscularis and mucosa of the bladder outside to the chorioamniotic membrane inside (Fig. 1). The LUS was visualized in sagital section in the mid line and lateral plane. Tocography was performed to detect asymptomatic uterine contraction. In asymptomatic contraction the LUS becomes thick, a condition described by some authors (Karis et al. 1991) as pseudo dilatation and may give false measurement. In those cases we measured the lower uterine thickness in the absence of uterine contraction. In cases with a low lying placenta the lower segment becomes highly vascularized and congested and appears thicker than normal. Therefore, such cases were not

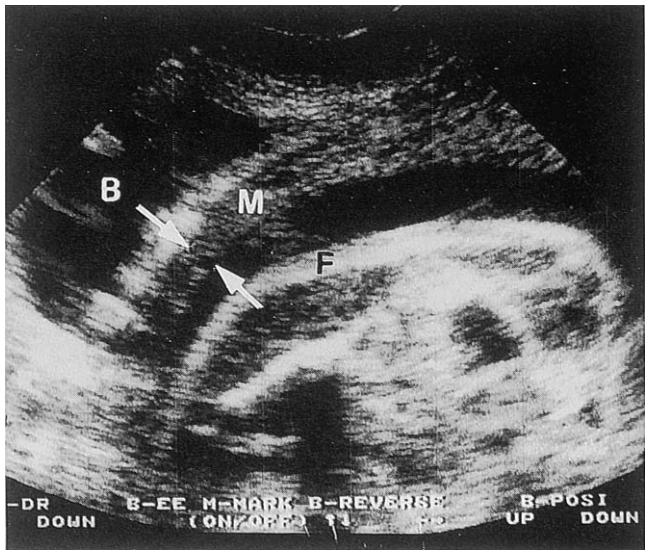


Fig. 1. Sonogram of a patient with no previous cesarean section at 25 weeks showing normal symmetrical thickness of myometrium of 5 mm between the arrows. B, bladder; M, myometrium; F, fetus.

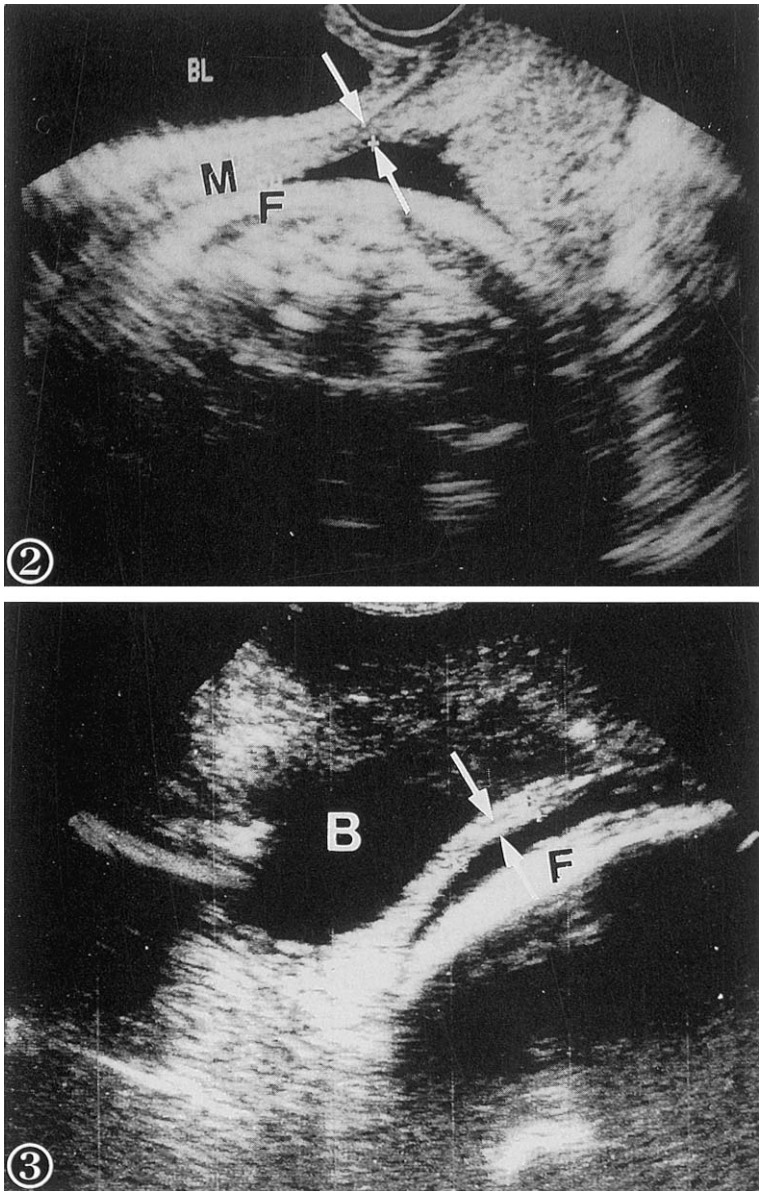


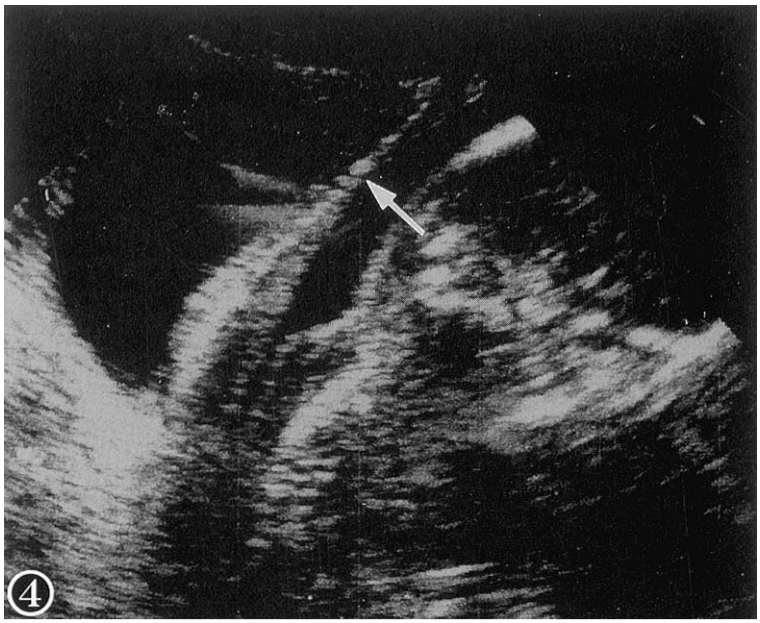
Fig. 2. Sonogram of a patient with previous cesarean section with good healing at 29 weeks. The myometrium shows thickness of 4 mm between the arrows. BL, bladder; M, myometrium; F, fetus.

Fig. 3. Myometrium shows asymmetrical thickness of less than 2 mm shown between the arrows in sonogram of a patient with poorly healed scar at 35 weeks. B, bladder; F, fetus.

included in the study. Thus we described the ultrasonographic findings of the LUS as follows:

Normal, Symmetrical or asymmetrical thickness of more than 2 mm (Fig. 2); Thin, Symmetrical or asymmetrical thickness of less than 2 mm (Fig. 3); Abnormal thinning, Loss of sonographic definition of myometrium and loss of continuity (Fig. 4); Defect, Some defect of the myometrium present in the lower segment (Fig. 5).

Since our study was not only observational, we prospectively examined the LUS to assess the quality of the healed scar as a means of categorizing the patients



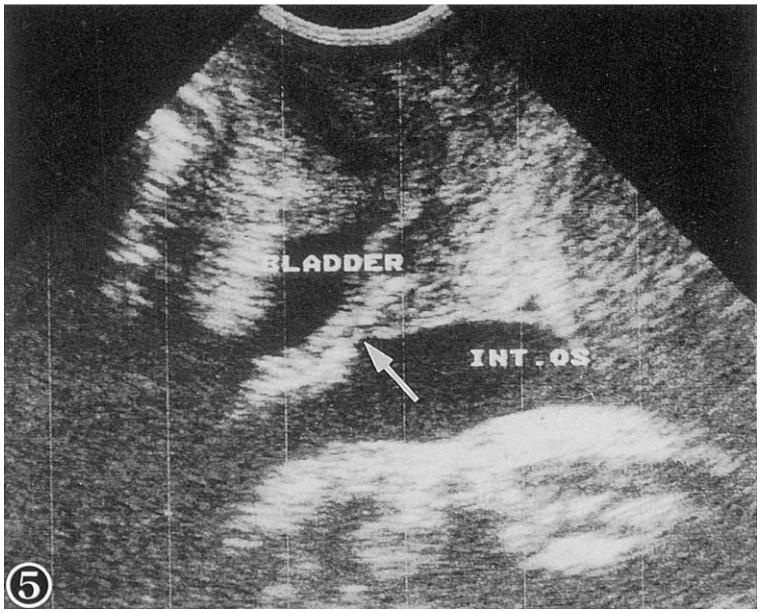


Fig. 4. Sonogram of a patient at 22 weeks with a history of previous silent rupture of uterus. Myometrium shows loss of continuity (arrow).

Fig. 5. Sonogram of a patient with two previous cesarean section with history of a silent rupture showing defect at 33 weeks (arrow). Int os, internal os.

TABLE 1. *Indications for elective repeat C/Ss (n = 17)*

Previous 2 C/S	7
Refusal for trial	2
Thin lower segment of <2 mm	4
Thin lower segment of 2 mm plus other indication (multiple pregnancy, breech)	3
Macrosomia	1

C/S, Cesarean section

for delivery mode. A LUS thickness of >2 mm was categorized as good healing and selected as trial for vaginal delivery if no other obstetrical indication existed for a repeat C/S. A LUS thickness of 2 mm was categorized individually. A LUS thickness of <2 mm, abnormal thinning and defect were categorized as poor healing and considered for elective C/S. The indications for a repeat electively C/S in the study sample is shown in Table 1. Intraoperative findings of the LUS were classified as follows: Class I- well developed lower segment; Class II- a thin lower segment but uterine contents not visible; Class III- translucent and uterine contents visible through the lower segment (Fig. 6); Class IV- a well circumscribed defect present in the lower segment. Biopsy was taken from the scar for histopathological examination to find out the reason for thinning of the scar tissue in patients who had undergone C/S followed by tubal ligation. Histological sections of the biopsy specimens were stained with hematoxylin-eosin and Malory Azan stain for microscopic examination. In the patients for vaginal delivery, the uterine scar was not routinely explored unless there was an abnormal symptom such as excessive vaginal bleeding or pain (Kaplan et al. 1994). Neither Oxytocin infusion nor a prostaglandin vaginal tablet were used according to the protocol of this hospital.

Statistical analysis

The chi square test and student t-test were used for statistical analysis. A p-value of <0.05 was considered significant.

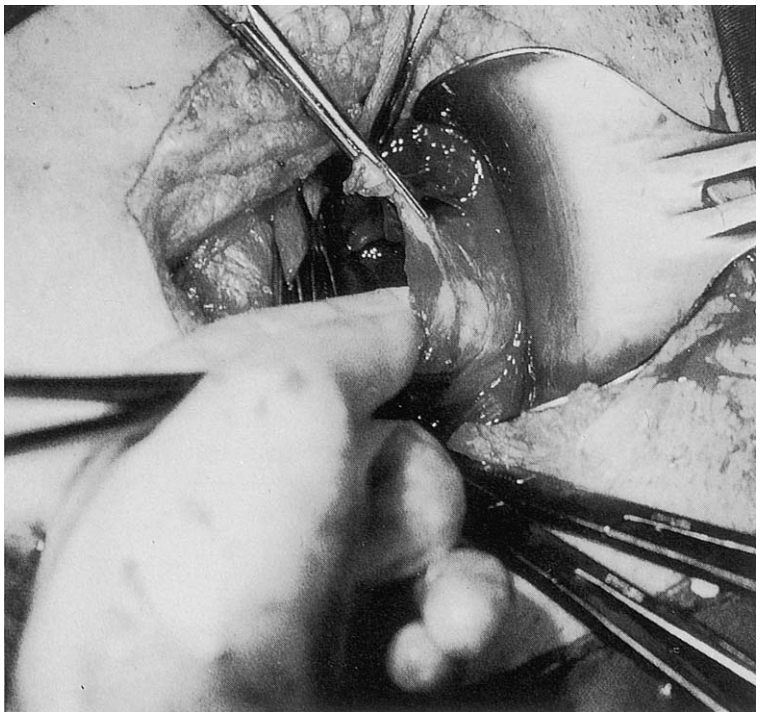


Fig. 6. Intraoperative picture of the same patient as in Fig. 5 at 36 weeks clearly shows A finger tip of the surgeon is clearly seen through the translucent lower uterine segment.

Results

The mean age of the control group was 32.76±4.92 years, the mean gravida was 1.66±1.46 and the mean parity was 0.78±0.97. The mean age of the study group was 35.04±4.63 years, the mean gravida was 2.48±1.22 and the mean parity was 1.51±0.58. In the study group the mean gestational age of the first USG examination was 23.2±6.5 with a median of 21 weeks. The mean number of examination was 2.6±1.0 with a median of 3. The mean gestational age of final examination was 33.3±5.3 with a median of 35 weeks. In the control group the mean gestational age of the first USG examination was 21.0±3.8 with a median of 20 weeks. Fig. 7 shows the serial USG examination performed in the control group. Sonographically we found that in all the patients of the control group the myometrial thickness was more than 2 mm at any gestational age. Among the 43 patients who had a previous C/S, 35 had one scar and 8 had two scars. There was no statistical significance between the number of scars and the quality of the

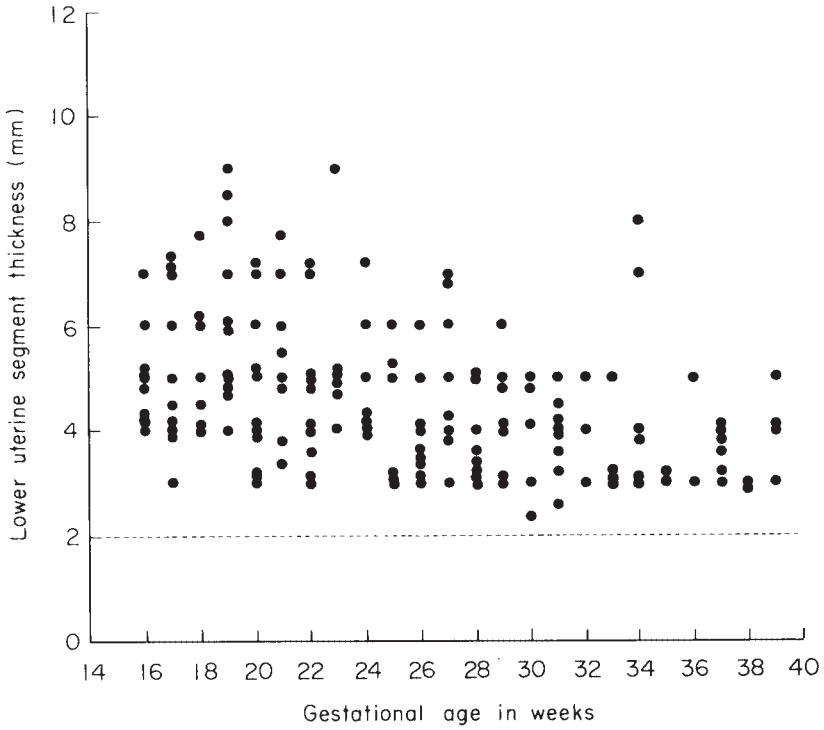


Fig. 7. Relation between lower uterine segment thickness and gestational age in the control group.

Table 2. *Number of previous cesarean section and delivery mode (n=43)*

Number of C/S	Number of cases	Elective C/S	Successful VD	Failed VD
One	35	10 (28.6%)	15 (42.9%)	10 (28.6%)
Two	8	7 (87.5%)	0	1 (12.5%)

C/S, Cesarean section; VD, vaginal delivery.

healed scar. The distribution of delivery mode by number of previous C/Ss in 43 cases is shown in Table 2. Thirteen women had one vaginal birth either before or after a C/S and 30 women had no history of vaginal birth. The frequency of vaginal births after trial of labor (TOL) was high in the group who had had a previous vaginal delivery ($p<0.05$, Table 3). No statistical significance was found between the time which had elapsed since the operation and the healing status.

Table 4 demonstrates the mode of delivery in the study sample according to the categorization of healing status. In the well healed group, no patient with trial of labor showed dehiscence or uterine rupture in the 9 cases observed during emergency C/S and no one had a clinical sign or symptom of dehiscence or rupture among 13 cases of successful vaginal delivery.

The intraoperative findings for 28 patients who were delivered by the abdominal route are shown in Table 5. The patients who showed a well developed LUS

TABLE 3. *Distribution of delivery mode with a history of VD*

History of VD	Number of cases	Elective C/S	Successful VD	Failed VD
With	13	2	9*	2
Without	30	15	6*	9
Total	43	17	15	11

VD, vaginal delivery; C/S, Cesarean section.
*$p<0.05$

TABLE 4. *Distribution of delivery mode by lower uterine segment thickness*

Lower uterine segment thickness	Number of cases	Elective C/S	Successful TOL	Failed TOL
>2 mm	28	6 (21.4%)	13 (46.4%)	9 (32.1%)
=2 mm	7	3 (42.9%)	2 (28.6%)	2 (28.6%)
<2 mm	8	8 (100%)	0	0
Total	43	17 (39.5%)	15 (34.9%)	11 (25.6%)

C/S, Cesarean section; TOL, trial of labor.

TABLE 5. *Per operative assessment of scarred lower uterine segment*

USG thickness of LUS	Total number of cases	Number of cases with TOL	Number of cases with C/S	Assessment of LUS			
				Class I	Class II	Class III	Class IV
>2 mm	28	22	15	13 (86.7%)	2 (13.3%)	0	0
=2 mm	7	4	5	0	4 (80.0%)	1 (20.2%)	0
<2 mm	8	0	8	0	0	7 (87.5%)	1 (12.5%)
Total	43	26	28	13 (46.4%)	6 (21.4%)	8 (28.6%)	1 (3.6%)

USG, ultrasonography; C/S, Cesarean section; LUS, lower uterine segment.

during the operation were all assessed preoperatively with a more than 2 mm LUS thickness. Conversely the thin and translucent per operative lower segment were all measured ≤ 2 mm in antenatal assessment. Two mm or less as a criterion for poor healing had the sensitivity and specificity of 86.7% and 100%, respectively. The positive predictive value was 100% and the negative predictive value was 86.7%.

Histopathology. Uterine biopsy specimens showed no significant changes in muscle tissue. Some specimens from scar tissue showed fibrosis and thinning of the muscle layer.

Discussion

Although transvaginal USG has been widely used for pelvic imaging it has been reported that the lower transverse cesarean scar can be identified only in approximately 30% of the patients (Lonky et al. 1989). But a method of evaluating the quality of the uterine scar is of utmost importance to the obstetrician in selecting the route of delivery. We speculate that the thickness of the LUS is related to the quality of wound healing. According to Rozenberg et al. (1996) the healing process of the uterine wound might affect the regeneration of the isthmus of uterus in such a way that it would become thinner. In subsequent pregnancies due to enlargement this thinning could lead to a thinner lower segment. However, we were unable to find any significant difference between the number of previous scars and the thickness of the lower segment. Our findings suggest that not all, but only the poorly healed scars might affect the regeneration of the isthmus and cause abnormal thinning of the LUS. In the good healing cases the LUS was found well developed during the operation. In some cases the scars could not be identified. Chen et al. (1990) described in their study that as time passes, the quality of the uterine wound improves progressively, although we could not find any significance between the time which had elapsed since an operation and the healing status.

This prospective study shows that the various sonographic patterns of the LUS have clinical significance. With trial of labor in cases showing normal findings vaginal delivery was successful without uterine rupture, which confirmed our assessment of the quality and soundness of the scar.

We categorized our patients into 3 groups, LUS$>$2 mm, LUS$=$2 mm, LUS$<$ 2 mm, because we felt that the mode of delivery for women with a lower segment of 2 mm was an important consideration. So with a double set up program we gave trial of labor in 4 of 7 patients. Of these 4 patients, two patients delivered vaginally. One of the remaining 2 patients who had repeat C/S showed a thin LUS and the other had a translucent LUS. The amniotic fluid and fetal hair could be visualized. The other 3 patients who underwent elective C/S also showed a thin lower segment. Therefore, we considered a LUS thickness of 2 mm as a poorly healed scar. In the good healing group, 2 patients had false assessment.

Ultrasonographically they showed a >2 mm lower segment thickness, but when there was elective C/Ss for patient's refusal for TOL, the lower segment was found to be thin at the lateral side although correlated centrally with USG findings. In these cases the measurements had been taken only in the midline sagital plane. The lateral view was not imaged. Therefore, the false assessments were thought to be due to technical error. The high negative predictive value leads us to conclude that a LUS >2 mm is safe for trial of vaginal delivery as there was no uterine rupture. The repeat elective C/S rate is high (39.5%) as mostly high risk patients are referred to this hospital. From the trial group (26 patients) 15 had successful vaginal birth (57%), although the overall vaginal rate is low in the study sample (34.9%). One of the reason might be the restricted use of oxytocin or vaginal prostaglandin in this institution. We also found that the frequency of vaginal birth was high in the patients who had had previous vaginal delivery, a finding also seen by Bedoya et al. (1992).

The question may arise whether a thin scar is actually necessarily an indication for elective C/S rather than an indication for allowing a trial of labor. Several researchers have worked on this subject and established the effectiveness of the assessment of the scar. Rozenberg et al. (1996) in their study examined the scarred uterus and found that the risk of uterine rupture was highest when the LUS thickness was between 1.6–2.5 mm. Papov (1994) also described a thickness of less than 3 mm as an insufficient scar and confirmed the assessment according to the mode of delivery. We measured the LUS by transvaginal ultrasonography which gives a better pelvic image and which is also a very simple technique and less time consuming. Moreover our study was not only observational, as the mode of delivery was decided prospectively according to the thickness of the LUS in order to evaluate the predictive value of such measurement.

Lonky et al. (1989) in their study could not find thinning before the third trimester. In our study concerning individual examination, the youngest gestational age at which a true positive diagnosis was made was the 17th week and the oldest gestational age was the 36th week. Some authors (Rozenberg et al. 1996) have selected 37–38 weeks for assessment of scar integrity, but we started our study from the 16th week to observe the serial changes in LUS with the advancement of pregnancy as well as to detect any defect as early as possible. As other investigators previously reported we also found that it is difficult to measure the LUS thickness at the third trimester because of the descent of the presenting part.

The present study showed that ultrasonographic evaluation of the LUS was well correlated with operative findings. Patients with LUS thickness of more than 2 mm as measured at the last trimester can be selected safely for trial of labor without potential risk of uterine rupture. Therefore, assessment of the scar integrity and quality by transvaginal ultrasonography might be helpful in selecting candidates for trial of labor with an optimally informed decision.

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