



# Accuracy of Cesarean Scar Indicators for Predicting Intra-abdominal Adhesions

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Received 2023 February 19; Accepted 2023 February 20.

## Abstract

**Background:** The cesarean section rate has increased in the last decade, a significant risk factor for intra-abdominal adhesion. This study investigated the diagnostic accuracy of cesarean scar indicators for intra-abdominal adhesions in pregnant women.

**Methods:** This cross-sectional study was conducted on pregnant women with a previous cesarean section who were candidates for elective repeated cesarean section. We gathered demographic information, including age, number of prior cesarean sections, past medical and surgical history, the time since the last operation, and the inspection of the cesarean incision. The evidence of pelvic adhesion was calculated in the operating room by the Manchester scar scale, and intra-abdominal adhesions were graded using a modified Nair's classification. The data were analyzed by proper tests.

**Results:** One hundred pregnant women were included in the study and divided into two groups with high and low incision indices. In the low incision index group, 82.1% had a history of one cesarean section, and 1.3% had three or more, and in the group with a high incision index, 54.5% had a history of one cesarean section, and 13.6% had three times or more ( $P < 0.05$ ). Women with a high incision index had a higher adhesion rate than the other group ( $P < 0.001$ ). The sensitivity and specificity of the scar index in the diagnosis of adhesions were 57.48% and 92.30%, respectively.

**Conclusions:** It is challenging to accurately predict the severity of adhesions resulting from cesarean section, but it is urged to prevent an unnecessary cesarean section.

**Keywords:** Cesarean Section Scars, Pelvic Adhesions, Delivery

## 1. Background

The cesarean section rate has increased in the last decade (1) and doubled only in two decades. One of the most prevalent indications of cesarean section is repeated cesarean (2, 3). The complication of the cesarean section includes the possibility of postoperative infection, pelvic adhesion, severe postpartum hemorrhage, the possibility of hysterectomy, and coagulation disorders.

Therefore, women may experience complications in their subsequent pregnancies (4), such as post-operation adhesions, which are the critical cause of complications leading to bowel obstruction, chronic pelvic pain, infertility, and complicated repeated surgery (4). Fibrin lysis disorder in the peritoneum leads to permanent fibrosis, vascular disorder, and loss of cell growth that causes adhesion (4). Peritoneum adhesions are pathological transplantation commonly formed between the omentum, small and large intestine, abdominal wall, and other internal abdom-

inal organs (5). The risk of adhesion after one cesarean section is 7%, which increases to 68% in subsequent cesarean sections (6).

## 2. Objectives

Due to the absence of a reliable method to identify intra-abdominal adhesion before the operation, abdominal scar characteristics have been considered a possible predictor for the existence and severity of intra-abdominal adhesions (7). Therefore, this study aimed to investigate the presence and severity of intra-abdominal adhesions that can be determined before surgery using a four-step evaluation based on the abdominal scar characteristics caused by previous operations, predicting related symptoms in patients. Due to the possibility of cesarean sections in subsequent births, the observation of the previous scar can make the necessary arrangements to make the surgery

easier and provide a healthy delivery for the fetus and the mother.

### 3. Methods

#### 3.1. Study Setting

This study was conducted at an academic referral center in Iran on pregnant women with repeated cesarean sections beyond 36 weeks.

#### 3.2. Ethical Approval

The Ethics Committee of the Islamic Azad University of Medical Sciences, Tonkabon Branch, approved this study with a code of IR.IAU.TON.REC.1399.102. Informed consent was obtained from all participants.

#### 3.3. Eligibility Criteria

The inclusion criteria were a history of previous Pfannenstiel incision cesarean sections with a similar surgery model with double layer suturing of Kerr incision and repair of visceral and peritoneal peritoneum, with gestational age around 36 weeks. The exclusion criteria were emergency cesarean, wound infection or endometritis after previous cesarean sections, connective tissue disorders, systemic corticosteroid use, diabetes and habit of smoking, and history of endometriosis or any previous abdominal surgery except cesarean section.

#### 3.4. Sample Size Calculation

The sample size was calculated by considering the confidence limits of 95% and the error coefficient of 0.5%. Based on the sample size formula, 100 people were selected.

$$n = \frac{\frac{z^2 pq}{d^2}}{1 + \frac{1}{N} \left( \frac{z^2 pq}{d^2} - 1 \right)}$$

#### 3.5. Adhesion Evaluation

We informed a physician for an examination of abdominal scar characteristics. The Manchester scar index (Beausang E, Floyd H, Dunn KW, Orton CI, Ferguson MW. A new quantitative scale for clinical scar assessment. *Plast Reconstr Surg.* 1998 Nov;102(6):1954-61. Doi: 10.1097/00006534-199811000-00022. PMID: 9810991.) was calculated for patients in the form of the following table by a single researcher to indicate the risk of adhesion. In this index, the criteria of the scar according to its appearance, which includes the scar's color, whether the scar is dull or shiny, lines on the scar, irregular appearance, and tissue quality, were scored on the Likert scale. In the first part of the checklist, the chance of adhesion was calculated by the

Manchester scar index. The score range of this system is 5 - 25. Then, another physician (who was the same in the whole study) evaluated the presence or absence of adhesions in the operating room by observing the surgery and studying the procedure description. Immediately after the operation, the evaluator declared his observations as the presence or absence of adhesion and divided the severity of adhesion into four groups. Intra-abdominal adhesions were graded using a modified Nair's classification into five categories (0 - 4), with grade 0 being the complete absence of adhesions and grade 4 being viscera directly adherent to the abdominal wall irrespective of the number and extent of adhesive bands. Grades 1 and 2 corresponded to filmy adhesions, and grades 3 and 4 to dense adhesions. Adhesions of intestines to the abdominal wall or the uterus, of the uterus to the abdominal wall, and a rectovaginal pouch obliterated by dense adhesions were all included in grade 4 (8).

#### 3.6. Data Gathering

Demographic characteristics were asked, such as age, the number of cesarean sections, the history of previous surgery, and the time since the previous operation.

#### 3.7. Statistical Analysis

For the descriptive analysis of the data, mean, frequency, cumulative frequency, and standard deviation were used and presented in frequency distribution tables and graphs. Also, trend analysis and cross-checking tests were used for the inferential analysis of the findings and for testing the research hypotheses according to the power of different statistical tests and research conditions. Data analysis was performed using SPSS v25, and various statistical tests were conducted to achieve the general and accessory goals.

### 4. Results

One hundred women with a history of cesarean section were enrolled in this study. The mean  $\pm$  standard deviation (SD) of age and the number of previous cesarean deliveries in the participants were  $32.2 \pm 4.2$  years and  $1.2 \pm 0.5$ , respectively. The adhesion status in women according to the scar index is summarized in Table 1. According to the results, there was statistical significance between the two groups with high and low scar indices regarding adhesion. Also, women with high scar index had higher adhesion rates than others (Table 2).

In the low scar index group, 15.6% of women with a single cesarean section had adhesions. In contrast, 53.8% of women with a history of two cesarean sections and 100%

**Table 1.** Adhesion Status in Women According to Scar Index

Scar Index	Adhesion, No. (%)		P-Value
	+	-	
Low	18 (23.1)	60 (76.9)	
High	17 (77.3)	5 (22.7)	< 0.001

with three or more cesarean sections had adhesions. The results showed a significant difference between the three groups with previous pregnancy histories in the low scar index group. Adhesion was significantly higher in women with a history of more cesarean sections ( $\chi^2 = 12.269$ ,  $P = 0.002$ ).

Also, according to the results, in the group with the high scar, 75% of women with a history of one cesarean section, 85.7% of women with a history of two cesarean sections, and 66.7% with a history of three or more cesarean sections had adhesions. According to the chi-square test, there was no statistically significant difference between the three groups with different cesarean histories in the group of women with high scar index ( $P = 0.712$ ,  $\chi^2 = 0.511$ ).

The accuracy and diagnostic value of the scar index in determining adhesion were investigated as follows.

*Sensitivity*

$$= \frac{\text{Number of true positives}}{\text{Number of true positives} + \text{Number of false negatives}} \\ = \frac{17}{17 + 18} \\ = 48.57$$

*Specificity*

$$= \frac{\text{Number of true negatives}}{\text{Number of true negatives} + \text{Number of false positives}} \\ = \frac{60}{60 + 5} \\ = 92.30$$

*Positive predictive value*

$$= \frac{\text{Number of true positives}}{\text{Number of true positives} + \text{Number of false positives}} \\ = \frac{17}{17 + 5} \\ = 77.27$$

*Negative predictive value*

$$= \frac{\text{Number of true negatives}}{\text{Number of true negatives} + \text{Number of false negative}} \\ = \frac{60}{60 + 18} \\ = 76.92$$

The results showed that the sensitivity of the scar index in the diagnosis of adhesion was 57.48%, the specificity

was 30.92%, the positive predictive value was 27.77%, and the negative predictive value was 76.92%.

According to the results, there was a statistically significant difference between the two groups with high and low scar index in terms of adhesion, and women with high scar index had a higher level of adhesion than others ( $\chi^2 = 22.155$ ,  $P < 0.001$ ).

## 5. Discussion

This study showed that the chance of adhesion is high in people with a high scar index. Given the sensitivity and specificity of 57.48% and 92.30% in this study, a high scar index should be taken into consideration, and in people with a low scar index, this finding emphasizes that the chance of adhesion increases with the increased number of cesarean sections.

Salim et al. investigated the characteristics of the abdominal cavity as a predictor of intra-abdominal adhesions in repeated cesarean delivery. The results showed that 16% had skin adhesions and 27% had dense adhesions, which is consistent with this study. This study showed no relationship between the characteristics of the scar and intra-abdominal adhesion following cesarean section, which was inconsistent with our findings. The disparity in these two studies can be attributed to the difference in the type and location of adhesions and the studied population (9).

Taylan's study showed a relationship between the presence and severity of adhesions in different patients according to the history of cesarean section, which is consistent with the results of the present study. Also, the accurate prediction of the severity of adhesions related to surgery remains beyond our current abilities (7).

We investigated the adhesion status in women based on the scar index according to the number of cesarean sections. According to the results, there was a significant difference between these three groups with a previous pregnancy history regarding adhesion in the low scar index group. Adhesion was significantly higher in women with a history of cesarean section. In fact, in people with a high scar index, the chance of adhesion is high that should be considered, and in people with a low scar index, this finding emphasizes that the chance of adhesion increases the number of cesarean sections.

We determined the adhesion status in women based on the scar index according to the distance from the previous surgery. The results showed no significant difference in adhesion between these three groups with different time intervals from the previous surgery in low and high scar index groups.

**Table 2.** Adhesion Status in Women According to Scar Index and Number of Cesarean Sections

Number of Cesarean Sections	Adhesion, No. (%)		Difference Between the Two Groups, Statistics	P-Value
	Have	Not Have		
<b>Low scar index</b>				
One	10 (15.6)	54 (84.4)		
Two	7 (53.8)	6 (46.2)		
Three or more	1 (100)	0 (0.0)		
<b>High scar index</b>				
One	9 (75)	3 (25)		
Two	6 (85.7)	1 (14.3)		
Three or more	2 (66.7)	1 (33.3)		

### Precision

$$\begin{aligned}
 &= \frac{\text{Number of true negatives} + \text{Number of true positives}}{\text{Number of true negatives} + \text{Number of false negative} + \text{Number of true positives} + \text{Number of true positives}} \\
 &= \frac{60 + 17}{60 + 18 + 17 + 5} \\
 &= 77.00
 \end{aligned}$$

Elprince et al. reported a strong correlation between the abdominal scar index and abdominal striae in predicting intra-abdominal adhesions. It is contrary to the present study, possibly because the striae factor is not discussed in the present study (10).

Drukker et al., to predict intra-abdominal adhesions through the sliding sign using ultrasound before repeated cesarean delivery, showed that in multivariable models, a negative sliding sign was associated with a longer interval from skin incision to delivery and a higher chance of bleeding (11). The limitation of the current study was the non-random convenience sampling procedure, so caution should be taken when generalizing the results.

### 5.1. Conclusions

The results of this study, which was conducted among pregnant women with a prior cesarean section, showed that those with a high scar index had a higher adhesion rate than others. According to the Scar questionnaire score, the higher the score, the greater the adhesion level. In addition, high body mass index, history of multiple pregnancies, history of previous cesarean sections, and the time elapsed since the previous surgery played a role in predicting adhesions.

### Footnotes

**Authors' Contribution:** P.Sh is responsible for the thesis, and VSH, with other authors, helped her.

**Conflict of Interests:** The authors have no conflict of interest.

**Ethical Approval:** The Ethics Committee of the Islamic Azad University of Medical Sciences, Tonkabon Branch, approved this study with a code of IR.IAU.TON.REC.1399.102.

**Funding/Support:** This research received no specific grant, funding, or support.

**Informed Consent:** Informed consent was obtained from all participants.

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