

# Does surgeon seniority affect adhesion assessment at cesarean delivery? A prospective study



Shai Ram, MD; Ziv Shapira; Hila Shalev-Ram; Shira Alon; Roza B. Shperling; Margaret J. Lipinski; Yariv Yogev; Ariel Many

**BACKGROUND:** Intraabdominal adhesions may develop following cesarean delivery and are considered a major concern.

**OBJECTIVE:** This study aimed to determine the effect of surgeon seniority in evaluating intraabdominal adhesions at cesarean delivery.

**STUDY DESIGN:** A prospective study to estimate interrater reliability between surgeons was conducted. Women who underwent cesarean delivery (January–July 2021) in a single tertiary university-affiliated medical center were included. Blinded questionnaires assessing adhesions were completed by the surgeons. Questions were limited to 4 main anatomic sites and 3 possible categories of adhesion (each site was scored between 0 and 2; the sum score range was 0–8). The surgeons were ranked by increasing seniority (1–4) as: (1) junior residents (less than half of residency completed), (2) senior residents (more than half of residency completed), (3) young attending physicians (attending physicians for <10 years), and (4) senior attendings (attending physicians for >10 years). The weighted percentage of agreement was calculated between the 2 surgeons assessing the same adhesions. Scoring differences between the 2 surgeons (senior vs less senior) were also calculated.

**RESULTS:** A total of 96 pairs of surgeons were included in the study. The sum interrater reliability found in the weighted agreement tests between surgeons was 0.918 (confidence interval, 0.898–0.938). When scoring differences between surgeons (senior vs less senior) were calculated, nonsignificant difference was found (mean sum score difference of 0.09 with a standard deviation of 1.03 in favor of the more experienced surgeon).

**CONCLUSION:** Surgeon seniority does not affect subjective scoring of adhesion reports.

**Key words:** interrater reliability, post-cesarean delivery complication, postoperative adhesions

From the Lis Maternity and Women's Hospital, Tel Aviv Sourasky Medical Center, Tel Aviv, Israel; Sackler Faculty of Medicine, Tel Aviv University, Tel Aviv, Israel (Dr S Ram, Dr Shapira, Dr H Ram, Dr Shperling, Dr Lipinski, Prof Yogev, and Prof Many); Department of Obstetrics and Gynecology, Meir Medical Center, Kfar Saba, Israel (Dr H Ram); Department of Statistics and Data Science, Hebrew University of Jerusalem, Jerusalem, Israel (Mr Alon)

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Corresponding author: Shai Ram, MD.  
shairam85@gmail.com

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## Introduction

Adhesions are fibrous bands that form after tissue injury in response to hypoxia, accumulation of red and white blood cells, and clotting and inflammatory factors.<sup>1</sup> Although there are a number of causes, intraabdominal adhesions are mostly a complication of abdominal surgeries.<sup>2</sup>

Adhesion development following cesarean delivery (CD) is an important source of postoperative complications, and incidence is correlated with the number of CDs. Adhesions are found in approximately 25% to 46% of women after the first CD, whereas rates increase to 43% to 75% after the second, and up to 83% after the third CD.<sup>1,3,4</sup> Furthermore, because the CD rate is steadily rising and currently stands at over 30% in the United States,<sup>5,6</sup> postoperative adhesions are becoming a major concern.

Abdominal adhesions have negative maternal and obstetrical implications that may be related to: bowel obstruction<sup>1,7</sup> (which may occur in the

immediate postoperative period and recur in as much as 29% of women up to 25 years later),<sup>8</sup> increased risk for bladder and urinary tract injury,<sup>1,9,10</sup> infertility with increased risk of ectopic pregnancy,<sup>1,11,12</sup> chronic pain,<sup>11</sup> and a significant rise in rehospitalizations.<sup>13</sup> In terms of obstetrical complications, adhesions delay delivery time in correlation with adhesion severity.<sup>3,4,14</sup>

Adhesions can be categorized in several ways and are often described as filmy or dense. Whereas filmy adhesions are weak and generally easy to remove, dense adhesions tightly connect tissues, and removal usually requires the use of devices. Some previous studies used an adhesion scoring system to describe post-CD adhesions,<sup>14–17</sup> but only a few described the interrater reliability between surgeons.<sup>15,17</sup> Lyell et al<sup>15</sup> described 75 cases of CD and found an interrater reliability of 0.84. Tulandi et al<sup>16</sup> described adhesions among women of different ethnicities, with or without keloid formation, and found an interrater reliability of 0.85.

## AJOG Global Reports at a Glance

**Why was this study conducted?**

Intraabdominal adhesions commonly develop following cesarean delivery (CD), which may have consequences for future repeated operations and the postoperative course. Presurgical assessments based on recent surgical report are important. Thus, we aimed to determine the effect of surgeon seniority in evaluating and reporting pelvic adhesions during CD.

**Key findings**

Adhesion assessment is not affected by surgeon seniority, with sum interrater reliability in the agreement tests between surgeons of 0.918. When scoring differences between surgeons (senior vs less senior) were calculated, nonsignificant difference was found.

**What does this add to what is known?**

There is good interrater reliability in adhesion scoring between surgeons that is not affected by surgeon seniority. To the best of our knowledge, no previous studies have addressed this topic.

Neither study aimed to describe interrater reliability between surgeons, nor did they examine the effect of surgeon seniority.

Intraabdominal adhesions may have consequences for future surgeries and the postoperative course; thus, presurgical assessments are based on the most recent surgical report, usually written by a surgical resident, as opposed to a senior surgeon. Therefore, this study examines the interrater reliability between surgeons of varying levels of experience, and whether the reported adhesion severity is influenced by surgeon seniority.

**Materials and Methods**

We conducted a prospective study to estimate interrater reliability between surgeons. Women who underwent CD between January and July of 2021 in a single university-affiliated medical center were included in the study population. Blinded questionnaires assessing adhesions were completed by the surgeons after each CD that they performed.

This study was approved by the local institutional review board (0579-21-TLV).

We built and used our own questionnaire, which was based on an adhesion scoring system from previous studies.<sup>15–17</sup> The questionnaire applied to 4 main anatomic sites: (1) abdomen-to-uterus,

(2) uterus-to-bladder, (3) skin-to-fascia, and (4) other (Figure 1). The term “other site” refers to adhesions in the ovarian area, omentum, intestine, or any other intraabdominal anatomic site.

The surgeons were instructed to classify adhesions into 3 possible categories: none (score=0), filmy (score=1), or dense (score=2). Filmy adhesions are those that are weak and therefore easily removed without using a device (eg, scissors, scalpel, diathermy), whereas the removal of dense adhesions requires a device. A sum score that collates the 4 sites and ranges between 0 and 8 was calculated. The surgeons were approached with the questionnaire after the operation. Furthermore, the surgeons were instructed to avoid discussing how to score the adhesions, and to individually complete the postoperative questionnaire.

Each CD is usually performed by 2 operators: a senior and a junior surgeon. In this study, the surgeons were ranked by their seniority as: (1) junior residents (less than half of residency completed), (2) senior residents (more than half of residency completed), (3) young attending physicians (attending physicians for <10 years), and (4) senior attendings (attending physicians for >10 years).

Information about the number of previous CDs and their urgency (ie,

elective vs nonelective) was obtained from electronic medical records.

Descriptive statistics were used to assess the distribution of variables. Categorical variables were summarized as counts and percentages.

First, the percentage of agreement was calculated between the 2 surgeons assessing the adhesions. Percentage of agreement<sup>18</sup> is a naive measurement for the observed agreement, which is a binary variable that equals 1 if the 2 raters agreed (ie, gave the same score), and equals 0 otherwise. Then, the calculation of the percentage of agreement is done by summing all the observed agreements and dividing by the size of the sample.

Because adhesion rates are ordinal categories, we also calculated weighted percentage agreement. Hence, if the 2 raters gave the same score, it is equivalent to 1 minus 0 (which stands for 100% of observed agreement), but if the first rater gave 1 out of 2 whereas the second rater gave 2 out of 2, the observed value will be 0.5 (50%). Then, the percentage is calculated in the same manner as described above.

We conducted the agreement test separately for the total, status post CD, and nonelective CD populations.

Furthermore, we calculated the scoring differences between the 2 surgeons (senior minus less senior) and the average difference for each anatomic site and for the sum scores.

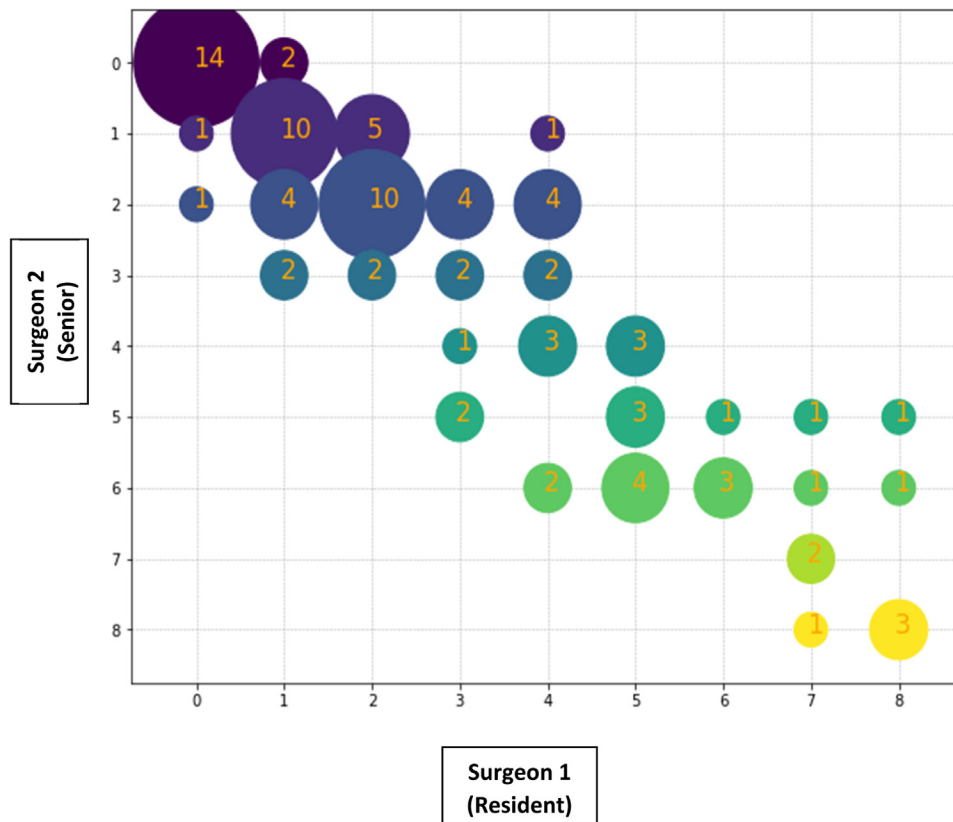
The analyses were carried out using Python, version 3.7.3 (Python Software Foundation, Wilmington, DE). Significance was defined as *P* value >.05.

**Results**

A total of 96 pairs of surgeons were included in the study, with 384 adhesion scores logged across the 4 anatomic sites. Among the 96 CDs included, 85 were status post CD, and 14 were nonelective. Among the less senior surgeons (Surgeon 1), 99% were ranked as having seniority level 1, whereas among the senior surgeons (Surgeon 2), 92% were ranked as having seniority levels 3 to 4. The difference in adhesion scores was not significant between the groups, with

**FIGURE 1**

**Sum scores for the 4 anatomic sites by Surgeon 1 and Surgeon 2 on X and Y axis, respectively. Numbers and point size indicate matching between sum scores of the 2 surgeons.**



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a *P* value of .516 for the sum score (Table 1).

In total, the sum interrater reliability found in the agreement tests between surgeons was 0.918 (95% confidence interval [CI], 0.898–0.938). The highest agreement was found for “other sites” (0.917; 95% CI, 0.874–0.96), whereas the lowest was found for the abdomen-to-uterus site (0.833; 95% CI, 0.779–0.887) (Table 2).

Similar results were obtained for the status post CD data, with a sum interrater reliability in the agreement test of 0.907 (95% CI, 0.886–0.929) (Table 2). An even stronger correlation was found for the nonelective surgeries (0.937; 95% CI, 0.896–0.973) (Table 2).

The correlation between sum scores given by Surgeon 1 and Surgeon 2 is shown in Figure 2. The differences between the scores, calculated as

Surgeon 2–Surgeon 1 (Table 3; Figure 3), were nonsignificant (mean sum score difference of 0.09 with a standard deviation of 1.03, in favor of the more experienced surgeon).

## Discussion

### Principal findings

This study demonstrates good correlation between surgeons regarding their adhesion severity scores. The high reliability of adhesion scoring was not influenced by surgeon seniority or patient history of CD, elective or not.

## Results

The sum interrater reliability found in the agreement tests between surgeons was 0.918. Among the 4 described anatomic sites, “other sites” had the highest interrater reliability, whereas the abdomen-to-uterus site had the lowest. This

result could be because of the fact that 78% of “other sites” had no adhesions at all, whereas the abdomen-to-uterus site not only had a higher incidence of adhesion formation, but also a variability that led to differing scores between the surgeons.

When the adhesion scoring was examined according to surgeon seniority (Table 3; Figure 3), a nonsignificant difference was found, with a mean difference of 0.09 points (standard deviation, 1.03). This result indicates high interrater reliability that is not affected by surgeon seniority.

Furthermore, it is reasonable to expect that in an emergency CD there would be less time for evaluation of adhesions, and thus less similarity in the scoring between the 2 raters. Conversely, we found that the similarity was even greater in these cases.

**TABLE 1**  
**Characteristics of the study population**

Characteristics	Surgeon 1 (Resident)	Surgeon 2 (Senior)	P value
Number of cases	96	96	
Seniority rank, n (%)			<.001
1	95 (99.0)	0 (0.0)	
2	0 (0.0)	7 (7.3)	
3	1 (1.0)	62 (64.6)	
4	0 (0.0)	27 (28.1)	
Adhesion score			
Skin-fascia, n (%)			.664
0	31 (32.3)	31 (32.3)	
1	38 (39.6)	43 (44.8)	
2	27 (28.1)	22 (22.9)	
Abdomen-uterus, n (%)			.786
0	48 (50.0)	44 (45.8)	
1	24 (25.0)	24 (25.0)	
2	24 (25.0)	28 (29.2)	
Bladder-uterus, n (%)			.739
0	41 (42.7)	41 (42.7)	
1	35 (36.5)	31 (32.3)	
2	20 (20.8)	24 (25.0)	
Other sites, n (%)			.817
0	75 (78.1)	75 (78.1)	
1	14 (14.6)	12 (12.5)	
2	7 (7.3)	9 (9.4)	
Sum score, n (%)			.516
0	16 (16.7)	16 (16.7)	
1	17 (17.7)	18 (18.8)	
2	23 (24.0)	17 (17.7)	
3	8 (8.3)	9 (9.4)	
4	7 (7.3)	12 (12.5)	
5	8 (8.3)	10 (10.4)	
6	11 (11.5)	4 (4.2)	
7	2 (2.1)	5 (5.2)	
8	4 (4.2)	5 (5.2)	

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**TABLE 2****Adhesion scoring agreement tests calculated between the 2 surgeons for the 4 anatomic sites, per population**

Total population (N=96)			
Anatomic sites	Agreement test	CI lower	CI upper
Abdomen-uterus	0.833	0.779	0.887
Bladder-uterus	0.865	0.82	0.91
Other sites	0.917	0.874	0.96
Skin-fascia	0.891	0.846	0.935
Sum score	0.918	0.898	0.938
Status post CD population (N=85)			
Anatomic site	Agreement test	CI lower	CI upper
Abdomen-uterus	0.818	0.758	0.877
Bladder-uterus	0.847	0.797	0.897
Other sites	0.912	0.864	0.959
Skin-fascia	0.876	0.827	0.926
Sum score	0.907	0.886	0.929
Nonelective CD population (N=14)			
Anatomic site	Agreement test	CI lower	CI upper
Abdomen-uterus	0.826	0.723	0.929
Bladder-uterus	0.87	0.775	0.965
Other sites	0.957	0.896	1
Skin-fascia	0.913	0.831	0.995
Sum score	0.935	0.896	0.973

CD, cesarean delivery; CI, confidence interval.

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### Clinical implications

Several studies have attempted to evaluate postoperative adhesion severity (by creating a scoring system) and formation risk factors. Tulandi and Lyell<sup>16</sup> developed a classification for adhesions after CD using prospective studies with site-specific adhesion scoring<sup>15,17,19</sup> and a point system for size and consistency across 5 anatomic sites.

In evaluating the effect of parietal peritoneal closure at CD on adhesion formation using comparisons of adhesion assessments between 2 surgeons in 75 cases, Lyell et al<sup>15</sup> found an interrater reliability of 0.84, and Tulandi et al<sup>3</sup> and Tulandi and Lyell<sup>16</sup> found an interrater reliability of 0.85.

Nevertheless, no study thus far was designed to evaluate the surgeon

interrater reliability of post-CD adhesions or the effect of surgeon seniority. The results of this study suggest that adhesion reports are reliable regardless of surgeon seniority.

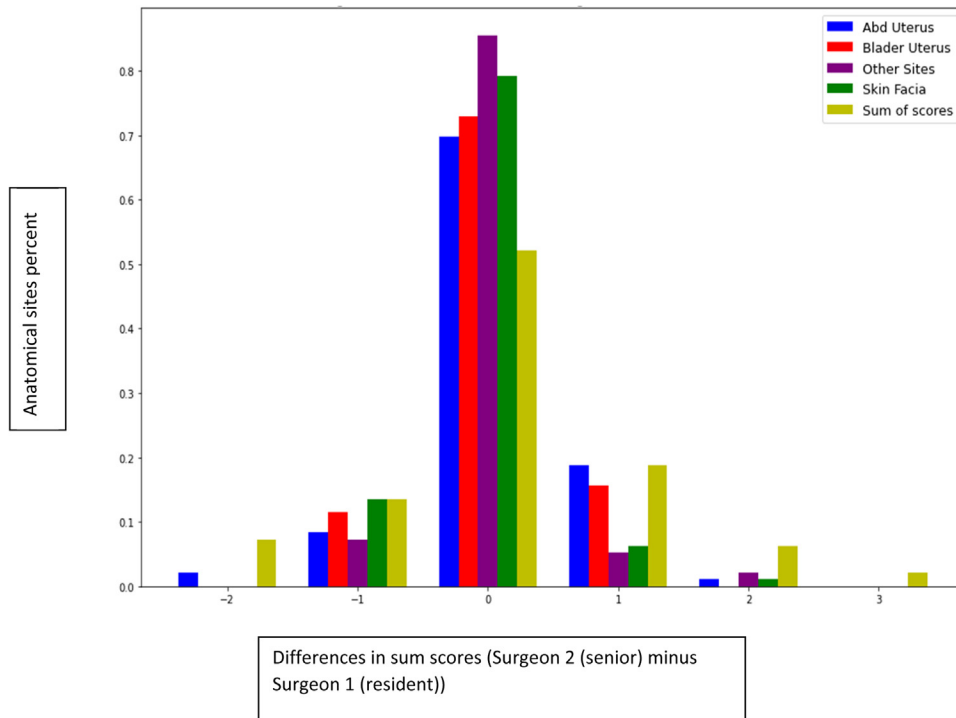
### Strengths and limitations

This study has several notable advantages. It explored the correlation between surgeon seniority and the evaluation of postoperative adhesions in specific anatomic sites. In addition, rather than relying on surgical reports, we used a score sheet completed individually by the 2 surgeons immediately following the CD. Furthermore, we calculated not only percentage of agreement between surgeons, but also weighted percentage agreement.

This study also has a few limitations. First, we did not describe adhesion consistency or size, as did other studies, but instead used a scoring system that assesses adhesion severity across 4 anatomic sites by the need for a device for removal, as described in the methods section. We used the most simple adhesion scoring system possible to both describe adhesions accurately and allow surgeons to remember scoring that was completed in the postoperative questionnaire. Another limitation is that we had only 14 cases of nonelective CD, which raises doubts about the subanalysis results. Furthermore, it is possible that the residents (surgeons 1) were trained by the same senior doctors (surgeons 2) assisting them during this study. However, this study included 89

**FIGURE 2**

**Differences in sum scores (Surgeon 2 Surgeon 1) presented on axis X: 0—no difference between surgeons' rates; 1—Surgeon 2 gave 1 point more than Surgeon 1, etc. Anatomic site percentage presented on axis Y.**



Abd, abdomen.

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**TABLE 3**

### Scoring differences between surgeons (senior vs less senior)

Variable	Abdomen-uterus	Bladder-uterus	Other sites	Skin-fascia	Sum scores
Mean	0.08	0.04	0.02	-0.05	0.09
Std.	0.63	0.52	0.46	0.49	1.03
Min.	-2	-1	-1	-1	-2
Max.	2	1	2	2	3

Max., maximum; Min., minimum; Std., standard deviation.

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surgeries that were rated by senior doctors (seniority rank 3 and 4), of which 27 were performed by different surgeons, and 95 surgeries that were rated

by residents (seniority rank 1 and 2), of which 13 were performed by different surgeons. This reduces the likelihood of bias because of training by a certain

senior. In addition, we considered surgeon seniority but not surgeon experience. Given that CD is a fundamental operation, we assumed that there is a

**FIGURE 3**

**The adhesion scoring system questionnaire that was completed by the surgeons after each cesarean delivery that they performed.**

Location / Severity	None (0)	Filmy (1)	Dense (2)
Skin-Fascia			
Abdomen-Uterus			
Bladder-Uterus			
Other Sites			

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correlation between surgeon seniority and surgical experience.

### Conclusions

This study described a good interrater reliability in adhesion scoring between surgeons, that is not affected by surgeon seniority. These results provide reassurance with regard to adhesion evaluation in surgical reports, regardless of the seniority of the reporter. ■

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