Outcomes of adhesion barriers in gynecologic surgeries
A retrospective study at a medical center

Ci Huang, MD, Dah-Ching Ding, MD, PhD

Abstract
During second-look surgery or hospitalization, intra-abdominal surgeries may cause severe postoperative complications, such as pelvic adhesion, postoperative ileus, and severe pain. However, only few studies have analyzed the outcomes of antiadhesive barriers in second-look surgery. This retrospective study aims to identify the outcomes of different antiadhesive barriers by analyzing surgical images. The study included patients who received an adhesion barrier during second-look surgery between January 2011 and November 2017. Four brands of adhesive barriers were used: Interceed, Seprafilm, Adept, and SurgiWrap. Adhesion scores were calculated for four quadrants of the uterus and surrounding structures before and after the use of antiadhesive barriers. The differences between the data of 2 observers and surgery times were also determined. A total of 18 patients were enrolled in the study. The adhesion scores were not significantly different before and after the placement of antiadhesive barriers. The difference in the adhesion scores between the two observers was also not significant, except in the Seprafilm group ($P = .029$). Furthermore, no significant change in the adhesion scores was observed between the first and second surgeries. Therefore, using adhesion barriers may not decrease the adhesion scores in the current setting.

Keywords: Adept, adhesion barrier, Interceed, Seprafilm, SurgiWrap

1. Introduction
Intra-abdominal surgery may lead to severe postoperative complications, such as pelvic adhesion, postoperative ileus, and severe pain, due to surgical trauma-induced ischemia and inflammation. Consequently, fibrin persistence may develop in the form of bands, thus affecting the peritoneal surfaces on the opposite side. A second-look laparoscopic survey has revealed that 50% to 100% of pelvic adhesions develop in the first few weeks after surgery. Adhesions may be caused by subfertility, chronic abdominal pain, and dyspareunia. Therefore, their formation must be reduced to prevent subsequent events.

Compared with open surgery, laparoscopy reduces peritoneal trauma and de novo adhesion formation; however, it may cause peritoneal inflammation due to pneumoperitoneum pressure duration and thermal injuries. Therefore, the use of an antiadhesive barrier has become common.

Pelvic adhesion after gynecologic surgeries may cause pelvic pain, gastrointestinal upset, or infertility, influencing the patients’ quality of life. Therefore, its prevention is mandatory. Despite the use of rigorous surgical techniques, several antiadhesive barriers can be used after gynecologic surgeries. Theoretically, inert physical barriers can be used to separate the serosal surface from the trauma area for more than 3 days, preventing adhesion formation. Most previous studies have demonstrated the outcomes of different antiadhesive barriers using second-look laparoscopy 3–16 weeks after a primary surgery. A subsequent surgery can effectively evaluate the effects of antiadhesive barriers used in previous surgeries. However, only few reports have investigated the effects of antiadhesive barriers in subsequent gynecologic surgeries.

Several antiadhesive barriers are currently used in gynecologic surgeries. Adept (Baxter, Deerfield, IL), which comprises 4% icodextrin, can prevent postoperative adhesions. Interceed (Ethicon, New Brunswick, NJ), which comprises oxidized regenerated cellulose, and Seprafilm (Genzyme, Cambridge, MA), which comprises 4% icodextrin, oxidized regenerated cellulose, and hyaluronic acid–carboxymethylcellulose membrane, are also effective in adhesion prevention.

This retrospective study aims to identify the outcomes of different antiadhesive barriers via the analysis of surgical images obtained during subsequent surgeries.
2. Materials and methods

The Research Ethics Committee of the Hualien Tzu Chi Hospital approved this study (REC No: IRB 108-33-B).

2.1. Patient enrollment

In this retrospective study, the medical records of our hospital as well as procedure codes were reviewed to identify patients who received an adhesion barrier with second-look surgery between January 2011 and November 2017. Furthermore, the procedure codes for laparoscopic adnexectomy (80420C), laparoscopic bilateral adnexectomy (80425C), and laparoscopic myomectomy (80402B) were explored.

In total, 255 procedural events were recorded, of which 8 were excluded because they included the same patient. Furthermore, 205 more events were excluded because they involved only one procedure that was not followed by second-look surgery. Finally, 42 patients were enrolled. The patients who underwent staging surgery (4 patients) and laparotomy (18 patients) were also excluded. In total, 20 patients who underwent second-look surgery during the study period were identified; however, the surgical images of only 18 patients were available for review. The patient selection process is illustrated in Figure 1.

2.2. Brands of antiadhesive barriers

Four brands of antiadhesive barriers were found in operation notes: Interceed (Johnson & Johnson, New Brunswick, NJ), Seprafilm (Genzyme Corp., Cambridge, MA), Adept (icodextrin w/v 4% solution; Baxter Healthcare, Deerfield, IL), and Surgi-Wrap (MAST BIOSURGERY Inc., San Diego, CA).

2.3. Adhesion scores

Adhesion scores were calculated for 4 quadrants of the uterus and surrounding structures before and after using antiadhesive barriers during surgery (Fig. 2A). The modified American Fertility Society score was used to evaluate adhesion scores.[11] In brief, the surgical field was divided into four parts: uterus and surrounding structures, right adnexa, left adnexa, and omentum and peritoneum. Adhesion scores were divided into 5 categories based on previous studies:[7,12] no adhesion (score = 0), mild adhesion and localized (score = 1) and mild adhesion and no extent evaluation (score = 2), moderate adhesion (mild and extensive extent (score = 4) and severe and localized extent (score = 8)), and severe adhesion (severe and extensive extent (score = 16)). The localized and extensive extents were classified as <50% and ≥50% of the site covered by adhesions, respectively, whereas severity was categorized as mild (filmy, avascular) and severe (dense, cohesive, vascular, or organized). The basic adhesion score was based on the surgical image during the whole procedure. Grading was conducted by two reviewers. The basic scoring system is shown in Figure 2B.

2.4. Statistical analysis

SPSS software version 25 (IBM, New York, NY) was used for statistical analyses. All continuous variables were presented as
median or mean ± standard deviation. The Mann–Whitney U test was used to compare the average of variables between 2 groups (before and after surgery, 2 observers, the first and second surgery) to determine the association between 2 continuous variables. \( P \) values < .05 were considered statistically significant.

3. Results

3.1. Patient characteristics

This study included a total of 18 patients. The surgical types included laparoscopic myomectomy (n = 23), laparoscopic-assisted ovarian cystectomy (n = 6), adhesiolysis (n = 21), laparoscopic subtotal hysterectomy (n = 9), and others (n = 5). The mean number of surgical events in one person was 1.7. The surgical time ranged between 80 and 205 min based on surgical complexity. In addition, the mean age and bodyweight of the patients were 37.8 ± 7.9 years old and 60.2 ± 12.3 kg, respectively.

3.2. Surgical time for different barriers

The mean surgical time for the whole procedure and adhesion barrier placement ranged between 123 (no adhesion barrier) and 205 min (SurgiWrap barriers) (Fig. 3).

3.3. Time interval between surgeries in our study patients

Table 1 shows the time interval between the 2 surgeries (primary and secondary). The median time intervals of the first, second, and third surgeries were 3.56, 1.87, and 1.89 years, respectively.

Figure 2. Adhesion score pattern. (A) Adhesion location. (B) Adhesion severity was classified as none (score = 0), mild (score = 1–2), moderate (score = 4), moderate to severe (score = 8), and severe (score = 16).

Figure 3. Surgical time of different antiadhesive barrier brands.
The adhesion score was used to evaluate adhesion severity, which
was determined by the observer. Weijsenborg et al.\cite{17} have
reported that the evaluations of videotaped laparoscopies for
endometriosis were reliable and justified the use of recorded
findings. To assess the adhesion scores, laparoscopic surgical
images, and not videos, were used in the present study. These
were reliable and justified the results; furthermore, the 2
observers were not the primary operators.

Recently, a randomized controlled trial was conducted to
evaluate Interceed as an antiadhesive barrier in colorectal
surgery. It was found that Interceed was safe and technically
feasible for laparoscopic colorectal surgeries.\cite{18} Another study
using Interceed in gynecologic surgeries for adolescent and
pediatric patients found no major adverse outcome or adhesion
during the second surgery in the Interceed group.\cite{19} However, a
retrospective study comparing the use and nonuse of antiadhesive
barriers in myomectomy and hysterectomy reported the presence
of ileus and fever in the antiadhesive barrier group.\cite{19} In our
study, a slight decrease in the adhesion scores was noted.

The antiadhesion effect of Seprafilm has been well docu-
dented.\cite{19,20} A randomized study has explored the antiadhesive
capability of Seprafilm in myomectomy cases and has shown that
48% of patients were free of adnexal adhesions.\cite{21} They checked
adhesion after a short period of time following the first surgery.
However, according to our data, the antiadhesive ability of
Seprafilm, which is the most popular brand, did not have a
significant effect on second-look surgeries. In addition, the
median time between the first and second surgery was 3.56 years,
which was different from that observed in previous studies.

In a randomized controlled trial, Adept was demonstrated to
be an effective antiadhesive barrier.\cite{17} However, we found that
it was ineffective. This may be because high adhesion scores
were noted in the Adept group during the first surgery. This high score
may have been due to the presence of many adhesions that could
not be covered by only one sheet of Interceed or Seprafilm.

Therefore, Adept was the reasonable choice of antiadhesive
barrier for this situation.

Owing to cost and infective conditions, 30% of the surgeries
did not use antiadhesive barriers in our study. Moreover, among

### Table 1

| First re-operation | Second re-operation | Third re-operation |
|--------------------|---------------------|--------------------|
| Interval (operation 2- operation 1) | Interval (operation 3- operation 2) | Interval (operation 4- operation 3) |
| N (times) | Mean±SD (year) | Median (year) | Mean±SD (year) | Median (year) | Mean±SD (year) | Median (year) |
| 20 | 3.87±3.07 | 3.56 | 4 | 2.28±1.86 | 1.87 | 2 | 1.89±2.24 | 1.89 |

SD = standard deviation.

#### 3.4. Adhesion scores of different barriers

Two reviewers who were blinded to the patient profile assessed
the adhesion scores. Table 2 presents the average adhesion scores
before and after the use of adhesion barriers. No significant
differences were observed before and after the use of Seprafilm
\((P=.057)\), Adept \((P=.057)\) and Interceed \((P=1.0)\) as well as
without the use of a barrier \((P=1.0)\).

#### 3.5. Interobserver differences

Two reviewers assessed the adhesion scores. Table 3 shows the
outcomes of different adhesion brands. The \(t\) test revealed a
significant difference in the Seprafilm group between 2 observers
\((P=.029)\).

#### 3.6. Differences in the adhesion scores for various pelvic parts between the 2 surgeries

Table 4 presents the differences in the adhesion scores between
the 2 surgeries at various anatomic sites. During second surgery,
the adhesion scores tended to increase; however the difference
was nonsignificant.

### Table 2

| Antiadhesive barriers | The 1st time of surgery | The 2nd time of surgery | \(P\) value* |
|-----------------------|-------------------------|-------------------------|-------------|
| Seprafilm (n=17)      | 4.1±0.7                 | 5.7±1.6                 | .057        |
| Interceed (n=6)       | 6.0±1.7                 | 4.7±2.8                 | .10         |
| Adept (n=7)           | 6.9±1.2                 | 8.7±0.5                 | .057        |
| No use (n=14)         | 4.1±1.5                 | 5.0±1.5                 | 1.0         |

* Mann–Whitney U test

\(n\) = event numbers.

SurgiWrap \(n=1\), no adhesion score available in the 1st time of surgery.

### Table 3

| Difference in adhesion scores observed by the 2 doctors. |
|---------------------------------------------------------|
| Antiadhesive barriers | Adhesion score | Doctor 1 | Doctor 2 | \(P\) value |
|-----------------------|----------------|----------|----------|-------------|
| SurgiWrap (n=1)       | 0.25±0.5       | 0.5±1.0  | 1.0      |
| Seprafilm (n=17)      | 5.7±1.6        | 2.5±1.1  | .029*    |
| Interceed (n=6)       | 4.7±2.8        | 3.2±5.0  | .343     |
| Adept (n=7)           | 8.7±0.5        | 8.0±4.0  | .343     |
| No use (n=14)         | 5.0±1.5        | 5.0±1.3  | 1.0      |

* Mann–Whitney U test

\(n\) = event numbers.
the barrier groups, no significant difference in the adhesion scores was noted after the second surgery. Therefore, this finding deserves further study.

A study has reported that adhesions start to form after starting surgeries. Another study has reported that the longer the surgical time, the more severe is the adhesion. Surgical time is also affected by surgical complexities and antiadhesive barrier types. Because Adept and Interceed are a solution and fabric film, respectively, they can be easily placed. However, Seprafilm placement requires advanced skills in laparoscopic surgeries. SugiWrap also requires a suturing skill to fix the film, necessitating more surgical time. Therefore, surgical time may indicate the complexity of the surgery and the placement of antiadhesive barriers, affecting the choice of antiadhesive barrier that is used. If the surgical time is longer than expected, the surgeons may select barriers that have easy placement, such as Interceed or Adept. In our study, the surgical time of each adhesive barrier brand was different. Furthermore, the personal favorite barrier of a surgeon also affects the choice of barriers. In our study, one doctor only used Seprafilm to prevent adhesion. The longest surgical time was noted in SugiWrap. We speculate that this may be due to the surgical complexity and unfamiliarity of the placement of SugiWrap.

Some studies have explored interobserver variance, and some variation has been observed between observers. In our study, interobserver difference in the Sepra film was statistically significant. Each doctor had his/her own opinion regarding the surgical picture. Therefore, some variation existed in score counting.

Our study showed a surprising finding that all antiadhesive barriers cannot effectively prevent adhesion. This may be due to the small sample size and surgery complexity. Moreover, selection bias may have existed. The patients who need second surgeries may indicate that their pelvic condition is not well due to their diseases or body conditions. In our study, one doctor only used Seprafilm to prevent adhesion. The longest surgical time was noted in SugiWrap. We speculate that this may be due to the surgical complexity and unfamiliarity of the placement of SugiWrap.

The strength of the present study is that our results were real-world outcomes because we did not schedule a second-look surgery. The patients were enrolled based on our hospital procedure coding system, and the need for second-look adhesion was determined based on laparoscopic images. Furthermore, different adhesion brands were used and selected based on the surgeon’s personal experience or surgical complexity. Finally, the American Fertility Society adnexal adhesion score was used to evaluate adhesion severity.

However, our study has some limitations. The sample size was small, the data were obtained from a single center, and the study design was retrospective. In addition, second-look surgeries were performed at different time periods. The initial surgeries were of different types and performed under different conditions. Furthermore, the pain scores before and after the placement of different antiadhesive barrier brands were not compared. In conclusion, we observed that using antiadhesive barriers may not decrease the adhesion scores in the current setting. A prospective large-scale study investigating the long-term efficacy of antiadhesive barriers should be conducted.

**Author contributions**

Conceptualization: Dah-Ching Ding.

Data curation: Ci Huang, Dah-Ching Ding.

Formal analysis: Ci Huang, Dah-Ching Ding.

Funding acquisition: Dah-Ching Ding.

Investigation: Ci Huang, Dah-Ching Ding.

Methodology: Ci Huang, Dah-Ching Ding.

Project administration: Dah-Ching Ding.

Supervision: Dah-Ching Ding.

Visualization: Dah-Ching Ding.

Writing – original draft: Ci Huang, Dah-Ching Ding.

Writing – review & editing: Ci Huang, Dah-Ching Ding.

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