

Adhesion formation after laparoscopic excision of endometriosis and lysis of adhesions

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Objective: To evaluate adhesion reformation after laparoscopic excision of endometriosis and adhesiolysis in women with chronic pelvic pain.

Design: Prospective clinical trial.

Setting: University hospital.

Patient(s): Thirty-eight women with endometriosis and chronic pelvic pain.

Intervention(s): A primary and second-look laparoscopy with adhesiolysis and excision of endometriotic lesions with a neodymium-yttrium argon garnet surgical laser technologies (SLT) contact laser.

Main Outcome Measure(s): Adhesion formation and character (thin, thin and thick, or thick). Location of adhesions at a first laparoscopy was compared with de novo or reformation of adhesions and the location of adhesions at a second surgery.

Result(s): Adhesions or adhesions combined with endometriotic lesions were significantly more likely to reform at second surgery compared with sites having only an endometriosis lesion. Thick adhesions were associated with a significantly increased likelihood of an adhesion reforming, compared with thin adhesions or thin and thick adhesions. Lesions or adhesions involving the ovary were more likely to be associated with adhesions at a subsequent surgery, compared with lesions in the adjacent ovarian fossa or fallopian tube.

Conclusion(s): Most patients developed adhesions after radical surgical excision of endometriosis for pelvic pain. The high incidence of adhesion formation after surgery for endometriosis underscores the importance of optimizing surgical techniques to potentially reduce adhesion formation. (*Fertil Steril*® 2005;84:1457–61. ©2005 by American Society for Reproductive Medicine.)

Key Words: Endometriosis, laser surgery, adhesion formation, chronic pelvic pain

Intra-abdominal adhesions lead to significant morbidity. In 1994, 303,836 hospitalizations resulted from surgeries that were performed primarily for adhesiolysis due to adhesions of the digestive and female reproductive systems. These procedures resulted in 846,415 days of inpatient care at a cost of \$1.3 billion (1). Chronic pelvic pain and infertility associated with endometriosis have been successfully treated with surgery, resulting in significant pain relief over the short term (2), as well as increased pregnancy rates (3). A laparoscopic approach to surgery is more

convenient for the patient (4) and is considered to be less traumatic to tissue and associated with reduced inflammatory response, which is presumed to lower the risk of postsurgical adhesion formation (5).

The disruption of the peritoneal surface during surgery, adhesiolysis, and the local inflammation of endometriosis each influence whether adhesions form after surgery (6–11). Data relating to adhesion formation at second look laparoscopy (12) or de novo adhesion formation after operative laparoscopy are available (12–14), but information about adhesion formation in women with chronic pelvic pain and histologically proven endometriosis is not presented.

In this study, we scored the presence, consistency (thin, thin and thick, or thick), and location of adhesions in patients with chronic pelvic pain caused by endometriosis. Laparoscopic resection of endometriosis and adhesiolysis was performed with a neodymium-yttrium argon garnet (Nd-YAG) contact laser. The findings at the first surgery were compared with those at a second look surgery. Specifically, de novo or reformation of adhesions and location of adhesions at the second laparoscopic surgery were determined.

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MATERIALS AND METHODS

Patients were a subgroup of 38 healthy women with chronic pelvic pain and endometriosis enrolled in a prospective clinical trial that combined surgical excision of lesions and adhesions with a new medical therapy. Two to three weeks after surgery, patients were randomized to raloxifene (180 mg/d) or placebo and continued for 6 months. After initial surgery, subjects underwent a second surgery 2 years after the first surgery or when the chronic pelvic pain returned, whichever came first. All women undergoing a second surgery were included. The institutional review board of the National Institute of Child Health and Human Development approved the study.

All surgeries followed a similar protocol for surgical techniques with trocars placed at the umbilicus and two lower quadrants. Detailed surgical findings were recorded on the American Society of Reproductive Medicine pain classification system (15). All surgical findings were meticulously and prospectively recorded with surgical diagrams, videotapes, and photographs at the time of surgery. For this analysis, all operative reports, surgical findings, diagrams, videotapes, and photographic documentation were systematically reviewed to confirm the location of adhesions and lesions.

Adhesions were classified as occurring at the site of peritoneal endometriosis lesions, with endometriomas, or as adhesions only. Adhesions were defined as attaching at least two pelvic structures together. When multiple adhesions to endometriomas occurred, they were scored separately. This detailed scoring system served as a reference point to categorize the number of adhesions compared with lesions and could be cross-referenced at second look laparoscopy to determine de novo or reformed adhesion rates. Endometriosis sites were categorized by pelvic regions, including right and/or left ovary, fallopian tube, bladder, cul de sac, uterosacral ligament, sidewall, and ovarian fossa. Information regarding bowel and appendiceal endometriosis sites was also recorded for analysis.

At the second surgery, adhesions were classified as reformed or de novo (new adhesions not present at the first surgery). Findings at first surgery that might influence the adhesion formation were tabulated and included adhesion consistency (thick vs. a combination of thick and thin vs. thin), whether new adhesions formed at lesion (or endometrioma) sites, and ovarian endometrioma size. The presence of fallopian tube, ovarian, and ovarian fossa adhesions at second surgery were examined separately and compared with those noted at first study surgery.

Operative Intervention

An Nd-YAG contact laser was used to excise all endometriosis lesions and to perform lysis of adhesions, as previously described (16). Both ovarian and non-ovarian endometriomas were also excised, with non-ovarian endometriomas removed en bloc. Ovarian endometriomas were drained, the

pseudocyst wall was stripped from the ovary, and then the ovary was wrapped in an absorbable adhesion barrier (Interceed; Johnson & Johnson Patient Care, New Brunswick, NJ). We routinely used Interceed to wrap the ovaries after resection of endometriomas but not in other circumstances. For example, we did not use Interceed on the ovaries after excision of endometriosis lesions or excision and/or lysis of adhesions involving the ovary. Endometriomas, endometriosis lesions, and adhesion biopsies were examined by pathology, and the presence of glands and stroma were considered diagnostic of endometriosis.

Statistical Analysis

Frequency distributions were used to describe the cohort of women by demographic characteristics, history of prior surgeries (laparoscopy or laparotomy) for endometriosis, and surgical findings. Chi-square tests were used to compare adhesions at first and second surgeries, including their presence, consistency, location, and characteristics (i.e., relationship with lesions or endometriomas), as well as other assessments, such as the presence of adhesions at first surgery and history of previous surgeries for endometriosis. Chi-square tests for trend were used to assess the likelihood of de novo adhesion formation or reformation by findings at first surgery.

RESULTS

Demographic characteristics and surgical history of 38 women with two study surgeries are shown in Table 1. Among the 38 women, 28 (74%) had pelvic adhesions at the time of the first study surgery, and 31 (82%) had adhesions at the second study surgery. Of the 8 women without a prior endometriosis surgery, 6 (75%) had pelvic adhesions at the first surgery.

TABLE 1

Patient characteristics.

Characteristic

No. of patients	38
Age (y)	32.0 (19–44)
Body mass index (kg/m ²)	25.1 (17.5–44.5)
Nulliparity	25 (76.3)
Ethnicity	
Asian	1 (2.6)
African American	6 (15.8)
Caucasian	31 (81.6)
History of endometriosis surgery	
None	8 (21.1)
Laparoscopy	28 (73.7)
Laparoscopy & laparotomy	2 (5.2)

Note: Values are mean (range) or n (%).

Parker. Adhesion risk after endometriosis surgery. *Fertil Steril* 2005.

TABLE 2

Combined surgical findings of 38 patients at first surgery compared with the presence of adhesions occurring at second surgery.

	Surgical findings at first surgery				
	Lesions only (n = 168)	Adhesions without lesions (n = 29)	Adhesions with lesions (n = 9)	Endometrioma only (n = 9) ^a	Adhesions with endometrioma (n = 9) ^b
Adhesions at second surgery	26 (15.5)	9 (31.0)	3 (33.3%)	7 (77.8%)	8 (88.9%)

Note: Values are n (%).
^aIncludes one non-ovarian endometrioma.
^bTotal number of adhesions for six endometriomas.

Parker. Adhesion risk after endometriosis surgery. Fertil Steril 2005.

Surgical findings for all of the 38 subjects, including endometriosis lesions excised at first surgery, were as follows: 168 endometriosis lesions, 9 endometriomas, 29 adhesions not associated with lesions, 9 adhesions combined with lesions, and 9 adhesions combined with endometriomas (Table 2). Of 47 adhesions, 20 reformed (42.7%), and 53 new adhesions were found at second surgery. Of the new adhesions, 33 were at a lesion site or endometrioma from first surgery, whereas 20 were de novo adhesions. Adhesions without an associated lesion or those that were combined with lesions were significantly more likely to reform at second surgery than sites having only a lesion ($P=.02$).

Adhesion consistency was characterized as thin and filmy, thick and vascular, or a combination of thin and thick characteristics (Table 3). Adhesion consistency was significantly associated with the likelihood of an adhesion reforming, with thin adhesions least likely and thick adhesions most likely to reform ($P=.001$).

At the second surgery, adhesions recurred at the operative site of 15 of 18 endometriomas. Endometriomas were more likely to result in adhesions than superficial lesions or adhesions alone ($P<.0001$). Endometrioma size (<2 cm vs. ≥ 2 cm) affected the likelihood of adhesion formation (Table 4), and smaller ovarian endometriomas were more successfully treated by surgical excision, whereas larger ones were not.

However, regardless of size, nearly all endometriomas were associated with adhesion formation.

Data pertaining to the location of adhesions are shown in Table 5. Adhesion location was scored as ovarian (non-endometriomas), fallopian tube, and ovarian fossa or associated with endometrial lesions. Lesions or adhesions involving the ovary were significantly more likely to result in adhesions at a subsequent surgery compared with lesions related to the adjacent ovarian fossa or fallopian tube ($P=.03$).

DISCUSSION

To our knowledge, this is the first prospective analysis to evaluate de novo and/or reformation of adhesions at second-look laparoscopy in women with surgically confirmed endometriosis and chronic pelvic pain. Sutton et al. (2) reported on the progression of endometriosis at second-look laparoscopy but did not include findings pertaining to adhesions. In the group of 38 patients, a total of 168 endometriosis lesions were excised and 47 adhesions lysed. At second-look laparoscopy, 20 of 47 adhesions (43%) reformed, and 57 new adhesions were found. Of the total number at second surgery, 46% were noted at the site of a former lesion, and 54% were de novo adhesions. Adhesions were most likely to form at the site of a former adhesion rather than an endometriosis

TABLE 3

Adhesion consistency and adhesion reformation between surgeries.

	Thin (n = 22)	Thin and thick (n = 7)	Thick (n = 9)
Reformed at second surgery	5 (22.7)	3 (42.9)	8 (88.9)

Note: Values are n (%). Chi-square test for trend, $P=.001$. Adhesion consistency missing for nine adhesions.

Parker. Adhesion risk after endometriosis surgery. Fertil Steril 2005.

TABLE 4**Adhesion reformation at second surgery after ovarian endometrioma excision at first study surgery as related to size of endometrioma.**

Second surgery findings	Endometrioma <2 cm (n = 7)	Endometrioma ≥2 cm (n = 7)
Cured with no adhesion	0 (0)	1 (14.3)
Cured with adhesion reformed	5 (71.4)	0 (0)
Reformation of endometrioma and adhesion	2 (28.6)	6 (85.7)

Note: Values are n (%).

Parker. Adhesion risk after endometriosis surgery. Fertil Steril 2005.

lesion (30% vs. 15%). The number of adhesions formed at lesion sites was similar to the number of de novo adhesions.

The results of this study reflect follow-up of up to 2 years' duration from first study surgery. Interestingly, others have reported higher rates of adhesion reformation (97.1%) at second-look laparoscopy (12). Our results resemble the rate of de novo adhesion formation, which is reported to vary from 12% to 50% (12–14).

Our results suggest that adhesion consistency had a significant impact on the likelihood of adhesion reformation because we found that thicker adhesions were 88.9% more likely to reform than thinner adhesions in a cohort of patients whose second-look surgery was at least 6 months after the first. By contrast, Trimbos-Kemper et al. (17) reported that more than 50% of filmy adhesions at laparoscopy 8 days after salpingostomy, fimbrioplasty, or adhesiolysis did not reform if lysed. Others have also shown that filmy adhesions are less likely to reform after lysis (4, 17–19). Filmy adhesions are reportedly seen at laparoscopies done within a couple of weeks after first surgery, but denser and more vascular adhesions are noted at second laparoscopies performed later (20). This likely suggests that filmy adhesions might be easier to treat surgically.

Adhesion formation was more likely when the ovary was involved with endometriomas, lesions, or adhesions. Endometriomas were significantly more likely to result in adhesion formation than lesions or adhesions not associated with the ovary. When the size of endometriomas was considered, smaller endometriomas (<2 cm) were significantly more likely than large endometriomas (71% vs. 14%) to be cured. We routinely used Interceed to wrap the ovaries after resection of endometriomas as a strategy to minimize adhesions. However, both small and large endometriomas had a similar high rate (100% vs. 87%) of adhesion formation, despite interventions designed to reduce adhesions.

When comparing the ovary with adjacent areas involved with lesions or adhesions, more adhesions were observed on the ovary at a subsequent surgery (38% vs. 14%). Other investigators have reported that adhesions formed in all women after surgery on the ovary (21). When excising endometriosis lesions or lysing adhesions involving the ovary, an adhesion barrier was not used. Even though an adhesion barrier did not prevent reformation of endometriomas, we speculate that the use of an adhesion barrier might have prevented the formation of ovarian adhesions related to removal of adhesions or superficial lesions on the ovary or ovarian fossa.

TABLE 5**Adhesion formation at second surgery after excision of non-endometrioma ovarian, ovarian fossa, and fallopian tube lesions and adhesions.**

	Surgical findings at first surgery			
	Ovarian lesions alone (n = 10)	Ovarian adhesions (n = 8)	Ovarian lesions and adhesions (n = 3)	Ovarian fossa and fallopian tube lesions (n = 49)
Adhesion formed at second surgery	4 (40)	3 (37.5)	1 (33.3)	7 (14)

Note: Values are n (%). $P = .03$ by χ^2 comparing ovarian lesions/adhesions with lesions/adhesions of ovarian fossa and fallopian tube.

Parker. Adhesion risk after endometriosis surgery. Fertil Steril 2005.

Our surgical approach for women with pain associated with endometriosis included lysis of adhesions in addition to the removal of endometriosis lesions and endometriomas because lysis of adhesions might relieve pain symptoms in some women. In one study of conscious pain mapping, 80% of patients with pelvic adhesions reported tenderness with probing of adhesions (22). Others have suggested that filmy adhesions might cause more pain than denser adhesions (23). Adhesions have been shown to contain sensory nerves (24, 25), but nerve fibers were found at similar rates in postsurgical adhesions, postinfectious adhesions, and in endometriosis-associated adhesions (26).

Strengths of the present study include the prospective systematic mapping and approach to all surgeries. Despite minimal bleeding and meticulous tissue handling, most patients developed some adhesions after radical surgical excision of endometriosis, with a third of these adhesions occurring in locations different from previous lesions or adhesions. We have demonstrated a high rate of de novo adhesion formation and reformation in women with chronic pelvic pain due to endometriosis after a surgery specifically intended to treat both adhesions and endometriosis lesions.

Despite treatment, adhesions reformed. Thus, adhesions might continue to be a source of pain even though endometriosis has been completely resected. The formation of adhesions after removal of endometriosis might have a greater contribution to the etiology of pain than previously realized. The high incidence of adhesion formation after surgery for endometriosis underscores the importance of research directed at reducing adhesion formation.

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