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ORIGINAL ARTICLE

A comparative study using early second-look laparoscopic evaluation of post-operative adhesion formation between two surgical procedures for polycystic ovarian syndrome

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Abstract No studies have been performed to evaluate and compare adhesion formation after laparoscopic ovarian drilling with that after ovarian wedge resection by mini-laparotomy at the very early stage one week after surgery in women with polycystic ovarian syndrome (PCOS). We investigated adhesion formation after surgical ovarian wedge resection by minilaparotomy (group I; *n*=37) and laparoscopic ovarian electrodrilling (group II; *n*=39) in 76 clomiphene citrate-resistant anovulatory infertile women with PCOS. All patients underwent an early second-look laparoscopy one week after operation. Thirty-six women (92.3%) in group II were found to be free of adhesions, whereas 81.1% (30 of 37) of the women in group I had periovarian adhesions. The frequencies of periovarian, intra-abdominal and uterine adhesions in group I were significantly higher than those in group II. There were significant differences in the AFS adhesion scores between group I (9.0±9.7 points) and group II (0.1±0.5 points). After surgery all women ovulated spontaneously or with clomiphene citrate. The pregnancy rate within 1 year after surgery in group II (87.2%) was significantly higher than that in group I (59.5%). The women with PCOS who were treated with laparoscopic ovarian electrodrilling were almost free of postoperative adhesion formation and most of them conceived within 1 year after surgery. This laparoscopic technique should be considered at an early stage in infertile women with PCOS who have failed to respond to clomiphene citrate therapy.

Keywords PCOS · Laparoscopic treatment · Adhesion formation · Early second-look laparoscopy

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Introduction

Ovarian wedge resection by laparoscopy was the first established treatment for anovulatory polycystic ovarian syndrome (PCOS) patients who failed to respond to medical therapy, but this technique has fallen into disfavor because of the risk of postoperative adhesion formation [1]. Less invasive surgical methods such as laparoscopic surgery (wedge resection by Nd:YAG laser) [2, 3], multiple ovarian biopsy [4], ovarian electrocautery [5–8], and laser vaporization [9] have been reported for the treatment of anovulation in patients with PCOS. Even more recently ovarian wedge resection by minilaparotomy has been offered as an alternative approach in patients with PCOS who did not conceive with standard ovulation induction protocols since this technique offers high pregnancy rates and minimal adhesion formation [10].

Although these clinical results appear promising, no study has evaluated the incidence of early postoperative adhesions at the early stage one week after these procedures. In the present study, we evaluated and compared postoperative early adhesion formation after laparoscopic ovarian drilling with that after ovarian wedge resection by minilaparotomy in women with PCOS.

Materials and methods

A total of 76 women between 21 and 37 years of age who presented to the infertility/endocrine clinic at Shimane Medical University Hospital, Izumo, Japan, with infertility and anovulation, who were diagnosed with PCOS, and who failed to ovulate with increasing doses of clomiphene citrate up to a maximum of 150 mg/d for 5 days, were the subjects of this study. Male infertility, tubal factors or uterine factors were excluded. Clinical PCOS was diagnosed according to the criteria reported previously [11]. The criteria involve endocrine abnormality [luteinizing hormone (LH)/follicle stimulating hormone (FSH) ratio >1 and androstenedione (ASD) ≥1.2 ng/ml] in basal serum concentrations and detection of multiple (≥10) small bilateral ovarian cysts on transvaginal ultrasonic examination by a Sonovista-MSC scanner (Mochida, Tokyo, Japan) equipped with a 5.0, 6.0 or 7.5 MHz frequency transvaginal transducer. After full Institutional Review Board approval was obtained, all the women recruited gave written informed consent and agreed to undergo ovarian wedge resection by minilaparotomy or laparoscopic ovarian drilling. The operations were performed by the first author (KT), who is skilled in microsurgical and laparoscopic techniques. Thirty-seven women who presented from January 2000 to December 2002 were chosen to receive bilateral ovarian wedge resection by minilaparotomy (group I), with the remaining women who presented from January 2003 to December 2004 undergoing bilateral laparoscopic ovarian electrodrilling (group II).

Minilaparotomy (a 3–4 cm transverse incision) was performed above the symphysis pubis and after entering the abdominal cavity, surgical gloves were washed again with saline in order to eliminate talk. One of the ovaries was pulled out of the abdominal cavity with the surgeon's index and middle fingers. Wedge resection using monopolar electrosurgery was performed with a vertical incision to the horizontal axis of the ovary deep into the medulla near the utero-ovarian ligament and approximately half of ovarian tissue was resected. The defect was closed with double layered continuous 2/0 polyglactine (Vicryl) sutures and during operation the ovary was kept continuously moist. After complete hemostasis, the ovary was replaced into the abdominal cavity and the same procedure was performed on the other ovary.

Laparoscopic ovarian drilling was performed using a three-puncture technique. The ovary was immobilized with laparoscopic forceps, and monopolar electrodrilling with 30 W of coagulating current for 2 s at each point was applied to 10–15 points on each ovary. At the completion of the procedure, the ovarian surface was lavaged and the absence of bleeding from the ovarian surface was confirmed. Prior to closing the peritoneal cavity, 250 ml of saline was instilled into the dependent portion of the pelvis. All women were found to be free of adhesions at the initial operation.

All patients underwent an early second-look laparoscopy seven days after the initial procedure for assessment of adhesion formation on periovarian, intra-abdominal and uterine lesions. The American Fertility Society (AFS) system for classification of adnexal adhesions [12] was used to assess periovarian adhesion. The degree of adhesion in groups I and II were compared. In cases where adhesions had developed, they were lysed wherever possible, using a combination of blunt and sharp dissection with laparoscopic scissors and/or cautery.

There were no complications during any procedure and all patients were discharged on the day of surgery. We followed all patients for 12 or more months after the early second-look laparoscopy. In addition, the ovulatory rate and pregnancy rate of the two groups were also compared.

Values were expressed as the mean value ± SD. Differences between groups were analyzed for statistical significance using Sheffe F test, or the chi-squared test. A P value <0.05 denoted the presence of a statistically significant difference.

Results

The two groups did not differ significantly in age, body mass index, smoking habits, operation time and pre- and postoperative serum LH, FSH, and ASD values. Abnormality of pre-operative serum LH and ASD values in both groups markedly improved after the treatment (Table 1).

In group II, 7.7% (3 of 39) of the women had only periovarian adhesion, and other women were found to be free of adhesions. In group I, however, 30 (81.1%), 20 (54.1%) and 17 (45.9%) of 37 women had periovarian, intra-abdominal and uterine adhesions, respectively. The frequencies of periovarian, intra-abdominal and uterine adhesions in group I were significantly higher ($P<0.0001$) than those in group II (Fig. 1).

There were significant differences ($P<0.0001$) in the AFS adhesion scores between group I (9.0±9.7 points) and group II (0.1±0.5 points) (Fig. 2).

After surgery, all women ovulated spontaneously or with clomiphene citrate. Thirty-four (87.2%) of 39 women in group II and 22 (59.5%) of 37 women group I achieved conception within 1 year after surgery.

The pregnancy rate in group II (87.2%) was significantly ($P=0.0061$) higher than that in group I (59.5%) (Fig. 3). There were also significant differences ($P=0.0283$) in the period until pregnancy after surgery between group II (4.4±3.8 months) and group I (6.5±2.9 months). Patients who underwent laparoscopic ovarian drilling conceived earlier than those in the wedge resection group.

Table 1 Demographics of the study groups

	Group I (n=37)	Group II (n=39)
Mean±SD (range) age (yrs)	29.6±5.3 (21–36)	29.9±3.7 (24–37)
Mean±SD (range) BMI (kg/m^2)	22.4±3.1 (18–28)	21.8±3.4 (18–27)
Smokers (no.)	6	11
Mean±SD (range) operation time (min)	56.1±5.4 (40–60)	58.1±8.2 (40–70)
Mean±SD (range) preoperative LH (mIU/ml)	13.1±2.4 (10.6–18.5)	13.7±2.9 (8.7–19.8)
Mean±SD (range) postoperative LH (mIU/ml)	5.1±1.0* (2.8–6.8)	4.9±1.3* (2.8–6.8)
Mean±SD (range) preoperative FSH (mIU/ml)	6.7±1.3 (4.9–9.1)	7.1±1.1 (5.2–8.9)
Mean±SD (range) postoperative FSH (mIU/ml)	6.5±1.0 (4.8–8.8)	6.8±1.0 (5.0–8.8)
Mean±SD (range) preoperative ASD (ng/ml)	2.6±0.8 (1.5–4.0)	2.5±0.5 (1.4–3.1)
Mean±SD (range) postoperative ASD (ng/ml)	0.9±0.4* (0.4–1.8)	0.9±0.3* (0.4–1.4)

BMI=body mass index; LH=luteinizing hormone; FSH=follicle stimulating hormone; ASD=androstenedione
*P<0.0001 vs. pre-operation

Blood loss (33.8±17.4 ml) during operation in group II was significantly (P<0.0001) greater than that (<10 ml) in group I.

Discussion

About 10–15% of women with PCOS will not ovulate in response to clomiphene citrate, and in those who do, half will not conceive. Ovulation induction in these patients may involve the administration of human chorionic gonadotropin or pure FSH, without prior pituitary desensitization by gonadotropin releasing hormone agonists. However, gonadotrophin therapy is associated with a significant incidence of ovarian hyperstimulation syndrome, multiple pregnancies and pregnancy loss [13]. An alternative to the medical approach is surgical treatment. Less invasive techniques are emerging for minimizing postoperative adhesion formation. The most widely used surgical treatment today is laparoscopic ovarian drilling [14–19]. Many surgical modalities (laser, unipolar, and bipolar cauteries) and techniques have been used.

Compo [20] reviewed the literature from 1969 to 1996 concerning adhesion formation as a complication of surgical treatment of PCOS. After ovarian wedge resection by laparotomy, the mean incidence of adhesions was 90% (range: 42–100%). Laparoscopic treatment, although only minimally invasive, may also cause adhesions. The mean incidence of adhesions after laparoscopic electrocauterization was 29.1% (range: 0–100%), whereas after laparoscopic laser vaporization it was 50% (range: 0–80%). However, even more recently ovarian wedge resection by minilaparotomy has been reported as an alternative approach in patients with PCOS who did not conceive with standard

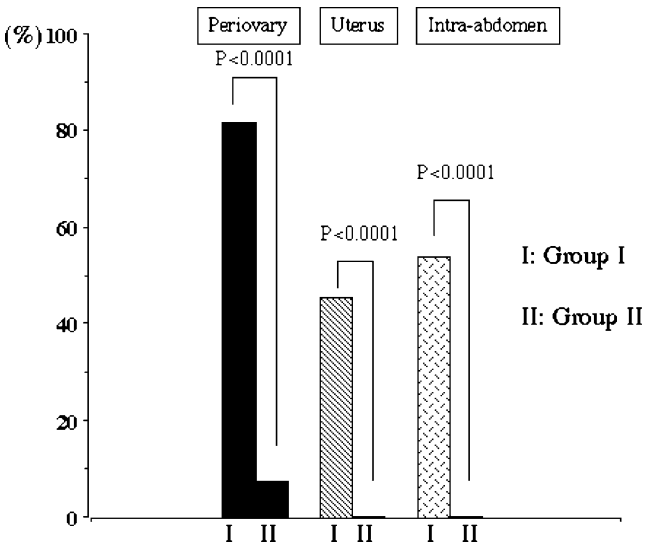

Fig. 1 The frequency of periovarian, uterine and intra-abdominal adhesions after PCOS treatment. I: group I (ovarian wedge resection). II: group II (laparoscopic ovarian electrodrilling)

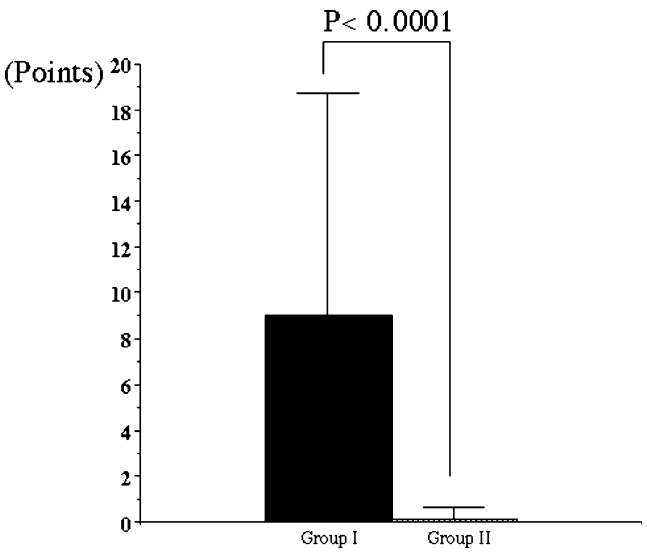

Fig. 2 AFS adhesion scores. Group I (ovarian wedge resection), group II (laparoscopic ovarian electrodrilling)

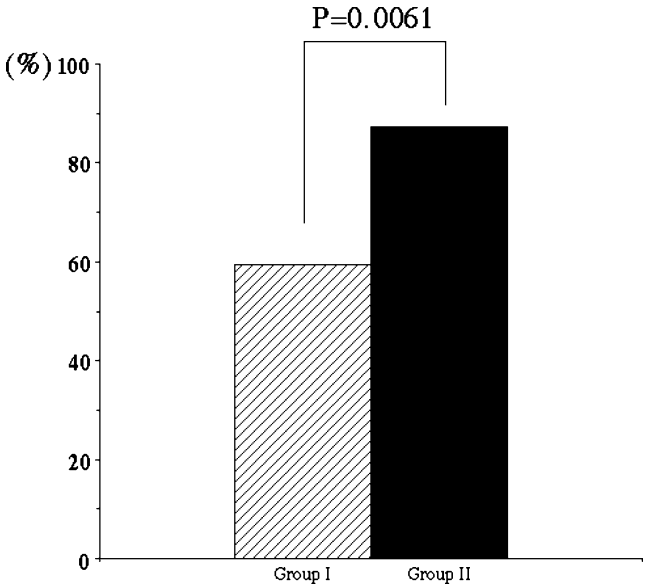

Fig. 3 Pregnancy rate. Group I (ovarian wedge resection), group II (laparoscopic ovarian electrodrilling)

ovulation induction protocols since this technique offers high pregnancy rates and minimal adhesion formation [10].

Despite being minimally invasive, laparoscopic drilling results in postoperative adhesions, although at a lower frequency than with ovarian wedge resection by laparotomy. Adhesion rates vary from 0–100% in published studies. Only a few women who were initially treated with ovarian drilling eventually had a second-look laparoscopy or laparotomy. The risk of postoperative adhesion formation and the role of second-look laparoscopy in the prevention of this undesirable complication remain uncertain.

Greenblatt and Casper [5] observed periovarian adhesions of varying severity in eight women after laparoscopic cauterization. The use of an Interceed adhesion barrier showed no protective effect. Despite this finding, seven of the eight women spontaneously conceived without any further therapy. The adhesion score at second-look laparoscopy was evaluated according to the revised AFS classification [12]. Total adhesion score at the second laparoscopy ranged from 2–42. There was no significant difference between total adhesion score and achievement of conception. However, in the present study there was adhesion formation in only 7.7% of the women in the laparoscopic electrodrilling group. Furthermore, there were significant differences in the AFS adhesion scores between laparoscopic electrodrilling and minilaparotomy.

Liguori et al. [6] evaluated 97 anovulatory infertile women with PCOS treated with laparoscopic electrocautery of the ovarian surface after they had failed to ovulate under ovarian stimulation. Thirty patients underwent a second-look operation, including 12 patients who had received a Cesarean section. No adnexal adhesions were observed in patients who had received a Cesarean section. In seven patients de novo adhesion formation was detected by diagnostic laparoscopy. Four cases were evaluated as minimal, two cases as mild and only one as moderate. In a total of 30 second-look operations, de novo adhesions were found in 23.3% of the patients. In another study of 15 women who underwent a second-look laparoscopy after laparoscopic ovarian drilling using an insulated needle cautery, 11 women were found to be free of adhesions. Four women had periadnexal adhesions that were filmy, minimal, and found on the ovarian surface only [8].

It would appear that adequate homeostasis and peritoneal post-drilling washing are important factors in minimizing adhesion formation. Another approach to minimizing postoperative adhesion formation is the use of short-interval second-look laparoscopy to lyse any adhesion that has occurred. Although there is no consensus, a second-look laparoscopy is usually performed four weeks after surgery. Considering the physiology of adhesion formation, after injury an inflammatory response occurs, with an increase in the permeability of blood vessels in traumatized tissues secondary to the release of histamine and vasoactive kinins. This results in an outpouring of proteinaceous seroangineous fluid, which generally coagulates within 3 hours. As a result, fibrinous bands are formed. Thereafter with the aid of endogenous fibrinolytic activity, these adhesions are generally lysed within 72 hours. Once these bands are lysed, the underlying connective tissue undergoes metaplasia. Much of the healing is completed within 5 days, and adhesion formation is mostly complete by 21 days. A very early adhesiolysis may not be inappropriate, but it should be kept in mind that the process of adhesion formation might continue until as long as the 21st day and that some adhesions may occur at a late stage.

The time interval before evaluating adhesion formation with second-look laparoscopy also varied greatly, from 2 weeks to more than one year after initial surgery [5–8, 21–23]. In the present study, an early second-look laparoscopy for adhesion formation was performed 7 days after the initial surgery. Raj and Hulka [21] evaluated 60 women who underwent microsurgical adhesiolysis at laparotomy, followed by second-look laparoscopy. The tuboovarian adhesive disease was staged according to the severity of the disease and findings at second-look laparoscopy were compared with those at the original operation. Sixty percent of adnexa showed improvement at second-look laparoscopy. They further determined that the optimal interval between primary surgery and second-look laparoscopy is 4–8 weeks, because newly formed or reformed adhesions were most easily lysed at that time. DeCherney and Mezer [22] compared the gross and histopathologic differences between adhesions found in early second-look laparoscopy, which they defined as 4–16 weeks after surgery, with laparoscopy after 18 months or more. The

majority of adhesions seen at late laparoscopy were thicker and neovascularized whereas early adhesions tended to be filmy and avascular. Experimental data indicated that an early second-look lysis of adhesions is effective in reducing postoperative adhesion only when performed after 14 days [23].

On the other hand, several investigators have suggested that all adhesions can be separated easily at 8 days [24–26], and that a more suitable time to perform second-look laparoscopy is 10 days after the first operation [26]. In the present study one reason we decided to carry out the early second-look laparoscopy 7 days after the primary operation is because it is more convenient for patients to receive the second-look laparoscopy during the same period of hospitalization as the initial operation. Therefore, we performed an early second-look laparoscopy at 7 days after the first operation during the same hospital admission and were able to separate all postoperative adhesions with no bleeding.

The reported rate of adhesions differs greatly depending on the author or technique. The adhesions may be due to bleeding from the ovarian surface or to premature contact between the ovary and the bowel after cauterization. After laparoscopic electrocoagulation, adhesion formation was detected in 19.3% of the subjects; however, this incidence was reduced to 16.6% with the use of abdominal lavage [16]. In the surgical treatment of PCOS, the aim should be removal of stroma with minimal surface damage and without causing bleeding of the ovarian capsule in order to minimize adhesion formation. In the present study, we used abdominal lavage after laparoscopy. Using this technique, the adhesion formation rate (7.7%) in patients evaluated with early second-look diagnostic laparoscopy was very low compared with the literature.

Adhesiolysis during second-look surgery does not necessarily improve pregnancy rates [27]. On the other hand, 15 women who did not achieve conception 1 year after laparoscopic ovarian drilling underwent a second-look laparoscopy, and 6 of these 15 women subsequently conceived within 6 months after the second procedure [8]. In the present study, after adhesiolysis during early second-look laparoscopy, 59.5% of patients who underwent wedge resection by minilaparotomy subsequently conceived within 1 year after surgery. No adhesion formation was observed in 36 (92.3%) of 39 patients who underwent laparoscopic ovarian electrodrilling, and 34 (87.2%) of these patients subsequently achieved conception within 1 year after surgery. Although the difference in pregnancy rate between the two groups might be coincidental, it may be related to pelvic readhesion occurring after the lysis of adhesions at the early second-look laparoscopy and/or it is possible that some pelvic adhesions could be occurring at a late stage. Larger numbers of subjects would be required to statistically determine the effects of laparoscopic electrosurgical treatment for de-novo adhesion formation after surgery in women with PCOS.

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References

1. Adashi EY, Rock JA, Guzick D et al (1981) Fertility following bilateral ovarian wedge resection: A critical analysis of 90 consecutive cases of the polycystic ovary syndrome. Fertil Steril 36:320–325
2. Kojima E, Yanagibori A, Otaka K et al (1989) Ovarian wedge resection with contact Nd:YAG laser irradiation used laparoscopically. J Reprod 34:444–446
3. Ostrzenski A (1992) Endoscopic carbon dioxide laser wedge resection in resistant PCO. Int J Fertil 37:295–299
4. Cibula D, Kuzel D, Rezabek K et al (2000) Multiple ovarian biopsy in the treatment of women with polycystic ovary syndrome (PCOS). Clin Exp Obstet Gynecol 27:194–196
5. Greenblatt EM, Casper RF (1993) Adhesion formation after laparoscopic ovarian cautery for polycystic ovarian syndrome: lack of correlation with pregnancy rate. Fertil Steril 60:766–770
6. Liguori G, Tolino A, Moccia G et al (1996) Laparoscopic ovarian treatment in infertile patients with polycystic ovarian syndrome (PCOS): endocrine changes and clinical outcome. Gynecol Endocrinol 10:257–264
7. Saravelos H, Li TC (1996) Post-operative adhesions after laparoscopic electrosurgical treatment for polycystic ovarian syndrome with the application of Interceed to one ovary: a prospective randomized controlled study. Hum Reprod 5:992–997
8. Felemban A, Tan SL, Tulandi T (2000) Laparoscopic treatment of polycystic ovaries with insulated needle cautery: a reappraisal. Fertil Steril 73:266–269
9. Daniell JF, Miller N (1989) Polycystic ovaries treated by laparoscopic laser vaporization. Fertil Steril 51:232–236
10. Yildirim M, Noyan V, Tiras B et al (2003) Ovarian wedge resection by minilaparotomy in infertile patients with polycystic ovarian syndrome: a new technique. Eur J Obstet Gynec Reprod Biol 107:85–87
11. Takahashi K, Eda Y, Abu Musa A et al (1994) Transvaginal ultrasound imaging, histopathology and endocrinopathy in patients with polycystic ovarian syndrome. Hum Reprod 9:1231–1236
12. The American Fertility Society (1988) The American Fertility Society classifications of adnexal adhesions, distal tubal occlusion, tubal occlusion secondary to tubal ligation, tubal pregnancies, Mullerian anomalies and intrauterine adhesions. Fertil Steril 49:944–955
13. Greenblatt E (1993) Surgical options in polycystic ovary syndrome patients who do not respond to medical ovulation induction. Baill Clin Obstet Gynaecol 7:421–433
14. Gjonnaess H (1984) Polycystic ovarian syndrome treated by ovarial electro-cautery through the laparoscope. Fertil Steril 41:20–25
15. Merchant RN (1996) Treatment of polycystic ovary disease with laparoscopic low-watt bipolar electrocoagulation of the ovaries. J Am Assoc Gynecol Laparos 3:503–508
16. Naether OG, Fischer R, Weise HC et al (1993) Laparoscopic electrocoagulation of the ovarian surface in infertile patients with polycystic ovarian disease. Fertil Steril 60:88–94
17. Armar NA, McGarrigle HH, Honour J et al (1990) Laparoscopic ovarian diathermy in the management of anovulatory infertility in women with polycystic ovaries: endocrine changes and clinical outcome. Fertil Steril 53:45–49

18. Li TC, Saravelos H, Chow MS et al (1998) Factors affecting the outcome of laparoscopic ovarial drilling for polycystic ovarian syndrome in women with anovulatory infertility. Br J Obstet Gynecol 105:338–344
19. Donesky BW, Adashi EY (1995) Surgically induced ovulation in the polycystic ovary syndrome: wedge resection revisited in the age of laparoscopy. Fertil Steril 63:439–463
20. Compo S (1998) Ovulatory cycles, pregnancy outcome and complications after surgical treatment of polycystic ovary syndrome. Obstet Gynecol Surv 53:297–308
21. Raj SG, Hulka JF (1982) Second-look laparoscopy in infertility surgery: therapeutic and prognostic value. Fertil Steril 38:325–329
22. DeCherney AH, Mezer HC (1984) The nature of posttuboplasty pelvic adhesions as determined by early and late laparoscopy. Fertil Steril 41:643–646
23. Haney AF, Doty E (1998) The temporal efficacy of early second-look lysis of adhesions in reducing postoperative adhesions in a murine model. Am J Obstet Gynecol 179:368–373
24. Trimbos-Kemper TCM, Trimbos JB, van Hall EV (1985) Adhesion formation after tubal surgery: results of eighth-day laparoscopy in 188 patients. Fertil Steril 43:395–399
25. Jansen RPS (1985) Failure of intraperitoneal adjuncts to improve the outcome of pelvic surgery in young women. Am J Obstet Gynecol 153:363–365
26. Jansen RPS (1988) Early laparoscopy after pelvic operations to prevent adhesions: safety and efficacy. Fertil Steril 49:26–30
27. Gurgan T, Urman B, Aksu T et al (1992) The effect of short-interval laparoscopic lysis of adhesions on pregnancy rates following Nd:YAG laser photocoagulation of polycystic ovaries. Obstet Gynecol 80:45–47