Gynecol Surg (2016) 13:445–450
DOI 10.1007/s10397-016-0963-3

REVIEW ARTICLE

# Ovarian suspension for adhesion prevention during laparoscopic excision of severe pelvic endometriosis and endometrioma excision: a systematic review

**Vasilios Pergialiotis**[1,2] · **Anastasia Prodromidou**[1] · **Nikoleta Karampetsou**[1] · **Marios Diamantopoulos**[1] · **Despina Perrea**[1] · **Nikolaos Nikiteas**[3]

Received: 12 February 2016 / Accepted: 13 June 2016 / Published online: 17 June 2016


**Abstract** Ovarian adhesions are fibrous connections, which develop between the ovaries and the surrounding organs as a result of a prior traumatic surgery in this area. Several studies suggest ovarian suspension as a way to prevent them; however, to date, there is no consensus regarding its effectiveness in the field. To investigate whether the application of ovarian suspension would be beneficial in the prevention of postoperative ovarian adhesions. We used Medline (1966–2015), Scopus (2004–2015), ClinicalTrials.gov (2008–2015), Cochrane Central Register of Controlled Trials (CENTRAL; 1999–2015), and Google Scholar (2004–2015) search engines in our primary search, together with reference lists from included studies. Four studies were included in our systematic review, which recruited 105 women of fertile age. The rates of absence of adhesions were between 41 and 80 %. In their majority, adhesions were mild whenever reported, with the exception of the study of Ouahba et al. who found that adhesions of moderate severity had an incidence of 33 %. None of the included studies reported the incidence of preoperative and postoperative symptoms. Current evidence suggests that ovarian suspension could be an effective and feasible surgical technique, which might actually help reduce postoperative adhesions. However, future research is needed in this field, as the number of studies published in this field is relatively small to reach firm conclusions.

**Keywords** Ovarian suspension · Endometriosis · Laparoscopy · Adhesions

## Introduction

Endometriosis is one of the most frequent gynecologic disorders which affects 5–10 % of women of reproductive age worldwide [1]. More specifically, 50 % of adolescents who suffer from chronic pelvic pain and dysmenorrhea and 4 % of adults in which tubal ligation is performed are finally diagnosed with endometriosis [2]. Despite the fact that surgical treatment of abdominopelvic endometriosis has shown quite satisfactory results throughout the years and has been considered as a gold standard in the management of the disease, it has commonly been complicated by postoperative adhesions [3]. These adhesions are fibrous connections that develop between the peritoneum and the organs as a result of a prior traumatic surgery, and they can often cause short- or long-term issues, such as infertility, dyspareunia, chronic pelvic pain, and small bowel obstruction [4]. Due to their anatomic position, ovaries are the most common sites of the postoperative adhesions. For this purpose, many surgical techniques and pharmacological agents, as well as antiadhesion barriers that can potentially reduce adhesions, have been studied. Many studies focus on the significance of minimal invasive procedures, such as laparoscopic techniques and transvaginal ones as well as a gentle tissue handling during operation for the prevention of postoperative adhesions [5]. In addition, ovarian suspension, which was first mentioned in 1970 as a treatment for women who would receive radiotherapy for Hodgkin

✉ Vasilios Pergialiotis
pergialiotis@yahoo.com

[1] Laboratory of Experimental Surgery and Surgical Research N.S. Christeas, National and Kapodistrian University of Athens, Athens, Greece

[2] 6, Danaidon Str, Chalandri 15232, Greece

[3] Second Department of Surgery, Laiko University Hospital, National and Kapodistrian University of Athens, Athens, Greece

disease, has also been suggested [6]. This procedure includes the ovarian separation from the surrounded injured areas at the start of peritoneal healing and the subsequent ovarian attachment to the anterior abdominal wall [7].

The aim of this systematic review is to investigate the effectiveness of ovarian suspension in the reduction of postoperative adhesions after endometriosis treatment procedures.

## Methods

### Study design

The present study was designed according to the PRISMA guidelines [8]. Eligibility criteria were predetermined by the authors. No language or date restrictions were applied during the literature search. All observational studies, prospective and retrospective, were held eligible for inclusion. Case reports were excluded. NK and MD abstracted and tabulated predetermined data to a structured form, while the rest reviewed them independently. Discrepancies between the authors during data collection were resolved by the consensus of all authors.

### Literature search and data collection

We used the Medline (1966–2015), Scopus (2004–2015), ClinicalTrials.gov (2008–2015), Cochrane Central Register of Controlled Trials (CENTRAL; 1999–2015), and Google Scholar (2004–2015) search engines in our primary search, together with reference lists from included studies. We restricted our search strategy to a minimum number of keywords in order to assess an eligible number that could be hand searched, minimizing the loss of articles. All the articles, which met or were presumed to meet the inclusion criteria, were retrieved in full text.

We searched the literature using the words "ovarian suspension, oophoropexy, ovariopexy, endometriosis, severe endometriosis, infertility, gynecological surgery, gynecological adhesions, ovarian adhesions." The PRISMA flow diagram summarizes the process of article retrieval (Fig. 1).

### Quality assessment

We assessed the methodological quality of all included studies using the Oxford level of evidence criteria [9, 10].

### Definitions

Ovarian suspension was performed with a single synthetic non-absorbable suture. The technique involves a single passage of a laparoscopic suture through the ovarian parenchyma, which is then approximated to the lower abdominal wall. The stitch was removed at the fourth postoperative day. The presence of postoperative adhesions was examined with second-look laparoscopy. Studies that investigated postoperative adhesions with transvaginal ultrasound (TVUS) or other methods apart laparoscopy were excluded from statistical analysis.

## Results

### Excluded studies

Four studies were excluded from the present systematic review. The first one focuses on an extensive description of the technique of ovarian suspension as a method in laparoscopic surgeries for severe endometriosis [7]. The second one focused on the complications of the surgery [11]. Hence, neither of them gave results concerning ovarian suspension as a method to prevent ovarian adhesions, so both were excluded. Finally, Hoo et al. and Seracchioli et al. evaluated postoperative adhesions formation only by TVUS, while in the same patient, one ovary was suspended, and the other was not serving as control group, and therefore, the study was excluded due to lack of scientific objectiveness [12, 13].

### Included studies

Four studies were finally included which recruited 105 women of fertile age [14–17]. Transient suspension was performed in 79 patients, while 26 patients were recruited as controls. In Table 1, we present the methodological characteristics of included studies. In Table 2, we present the postoperative adhesion rates according to their severity.

The rates of the absence of adhesions ranged between 41 and 80 %. In their majority, adhesions were mild whenever reported, with the exception of the study of Ouahba et al., who found that adhesions of moderate severity had an incidence of 33 % [16]. None of the included studies reported the incidence of preoperative and postoperative symptoms. However, the perioperative complications seem to be of minor importance, as the procedure is usually carried out easily, without adding additional burden to the initial operation.

## Discussion

Laparoscopic surgery remains the gold standard in the treatment of endometriosis [18]. However, adhesions between the ovaries and the surrounding structures often occur after the procedure resulting in adverse postoperative outcomes, including chronic pelvic pain, infertility, and bowel obstruction. A recent systematic review by Duffy et al. suggests that laparoscopic surgery seems to benefit patients with mild and

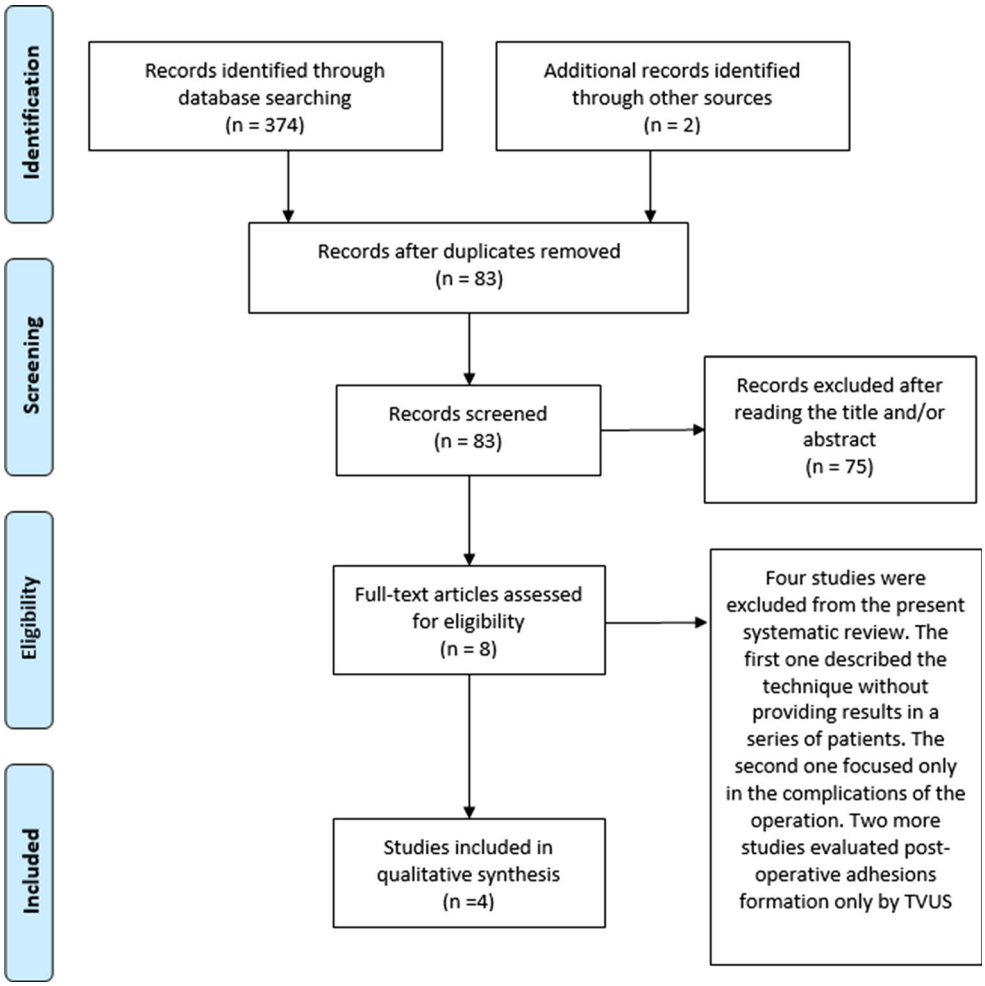


**Fig. 1** Search plot diagram of the search strategy for article retrieval

moderate endometriosis in terms of overall pain score and live birth or ongoing pregnancy rates [19]. However, the quality of evidence seems to be moderate. It is estimated that about one third of women is readmitted after open gynecologic surgery due to adhesions [20]. Laparoscopic techniques result in lower rates of adhesions compared to traditional laparotomy [21]. A potential explanation for this seems to be the limited extent of tissue trauma during laparoscopy, which protects the peritoneum from tissue hypoxia, foreign bodies such as gauze particles, surgical glove powder, overheating by lamps, or irrigation fluid, and several other factors which may irritate this membrane [22, 23]. This result reduced activation of plasminogen activator inhibitors and tissue plasminogen activator (tPA), thus limiting the development of fibral connections [22, 23].

The implementation of novel surgical techniques is necessary to further reduce postoperative adhesions [24]. In this context, antiadhesion barriers have been introduced in current clinical practice [25]. However, they are expensive, and according to recent meta-analyses, they seem to have no effect on pain or fertility outcomes [26, 27].

Several other techniques have been also suggested to enhance the effectiveness of laparoscopy in reducing postoperative adhesions, including non-steroidal antiinflammatory drugs, corticosteroids, antihistamines, progesterone, anticoagulants, fibrinolytics, and antibiotics [28]. A recent RCT by Koninckx et al. reported improved postoperative outcomes in terms of pain ($p < .001$) and recovery rates ($p < .0001$) with a combination of various techniques, which was referred as "peritoneal full conditioning" [29]. The technique briefly incorporates the use of pneumoperitoneum with a mixture of 86 % $CO_2$, 10 % of $N_2O$, and 4 % of $O_2$. Consecutively, the peritoneal cavity is cooled to 30 °C by sprinkling 2–3 mL/min of Ringers lactate with 1000 IU of heparin/L. Lastly, at the end of the operation, dexamethasone (5 mg) is administered intramuscularly [29]. However, all these methods, including antiadhesion, barriers are not site specific; hence, the implementation of a novel site-specific technique could potentially have increased efficacy.

Ovarian suspension during laparoscopic excision of endometriosis has been suggested as a site-specific method, which might actually help reduce the formation of postoperative

**Table 1** Methodological characteristics of included studies and potential bias

| Date; author | Type of study (OLE) | Inclusion criteria | Exclusion criteria | Groups definition | Adhesions diagnostic procedure | Time of suture removal | Structure of suspension type of suture |
|---|---|---|---|---|---|---|---|
| 2014; Pellicano | N/A | Age between 18 and 40 years; history of infertility >2 years; single endometrioma cysts ≥4 or ≤7 cm on preoperative ultrasound screen | Masses to the Douglas pouch; previous surgery for endometriosis or additional concomitant surgical procedure planned during the laparoscopic procedure; current and/or ectopic pregnancy; SGOT and SGPT and/or bilirubin >20 % above the upper limit of the normal range; azotemia and Cr >30 % above the upper limit of the normal range; use of systemic corticosteroids, antineoplastic agents, and/or radiation; active pelvic or abdominal infection | Group A: ovary suspended to the ipsilateral round ligament vs group B: no ovarian suspension | Transvaginal outpatient hydrolaparoscopy | Suture not removed | Ipsilateral round ligament, 1 cm from the inguinal canal<br>Absorbable monofilament suture (Vicryl Rapid 2.0), intraovarian knots |
| 2011; Carbonnel | Retrospective (4) | Severe endometriosis | N/A | Twenty-four patients (12 %) underwent second-look surgery; 38 suspended ovaries: 17 on the right and 21 on the left | Second-look surgery | 5 days postoperatively | Lower anterior abdominal wall<br>Non-absorbable 0 prolene Mersuture |
| 2004; Ouahba | Retrospective (4) | N/A | N/A | Thirty-two suspended ovaries/12 second-look laparoscopies bilateral in 12 (60 %) cases, right in 2 (10 %), and left in 6 (30 %) | Second-look laparoscopy | 4 days postoperatively | Lower anterior abdominal wall synthetic nonabsorbable monofilament suture (3–0 Prolene; Ethicon, Somerville, NJ) in a one-stitch simple technique |
| 2002; Abuzeid | Retrospective (4) | Stages 3 and 4 endometriosis | No second-look procedures | Ovarian suspension (all patients) | Second-look laparoscopy | 5 to 7 days postoperatively | Anterior abdominal wall-<br>30-inch 3.0 polypropylene on a tapered ski needle |

*OLE* Oxford level of evidence criteria

**Table 2** Postoperative rates of adhesion (ovarian suspension vs control)

| Date; author | Postoperative adhesions | | | |
|---|---|---|---|---|
| | Absence | Mild | Moderate | Severe |
| 2014; Pellicano | 16/24 vs 5/26 | 8/24 vs 21/26 | | |
| 2011; Carbonnel | 19/38 | | N/A | N/A |
| 2004; Ouahba | 5/12 | 3/12 | 4/12 | |
| 2002; Abuzeid | 4/5 | 1/5 | 0 | 0 |

adhesions. The rationale behind its conception is that the procedure inhibits direct attachment of the opposed deperitonealized surfaces. According to the findings of our systematic review, there seem to be evidence to support this hypothesis. In the majority of studies included in the present systematic review, the suture that retained the ovary suspended was removed between postoperative days 4 and 7. At 4 days, peritoneal healing allows cells to be in direct contact, whereas at 5–6 days, the wound surface is fully covered by mesothelial cells, thus, prohibiting direct contact of deperitonealized surfaces [30]. Aside from the present meta-analysis, two more studies evaluated the presence of adhesions with postoperative ultrasound at 3 and 6 months, respectively, with conflicting results [12, 13]. Specifically, Hoo et al. suspended only one of the two ovaries and observed that there was no difference in the prevalence of postoperative ovarian adhesions ($p = .23$) [12]. Seracchioli et al., on the other hand, observed that the presence of moderate adhesions was increased among patients who did not receive ovarian suspension 56.8 vs 28.9 % ($p = .003$) [13]. Summarizing these findings, we believe that the available evidence, although promising, does not suffice to introduce this technique in current clinical practice.

Long-term complications are rare during ovarian suspension, as the technique is relatively easy [7]. To date, only one study evaluated the immediate postoperative complications, and researchers reported that these are restricted to fever ($T > 38$) in five cases, postoperative blood loss in three, and transient urinary retention in one case [13].

Because adhesions seem to be related with low pregnancy rates, adhesiolysis combined with thorough laparoscopic excision of endometriotic lesions might actually improve pregnancy rates, and according to previous studies, this seems to be independent of the mode of conception among women with prior history of endometriosis [31–33]. However, the pathophysiology behind ovarian suspension cannot per se guarantee improved fertility rates, thus the rationale to support this hypothesis remains debatable. Three of the included studies presented fertility outcomes of women after surgery for endometriosis. Carbonnel et al. reported that more than half of women (53 %) conceived an outcome that was observed after second-look laparoscopy. Ouahba et al. and Abuzeid et al. also reported similar results (53.3 and 55 %, respectively) [14–16]. Unfortunately, none of these studies contained a control group; therefore, the impact of ovarian suspension on fertility rates remains unknown. In this context, we believe that future studies should specifically examine this association.

### Strengths and weaknesses of our study

Our study consists a meticulous review of the literature, presenting precise information and summarizing the methodological heterogeneity and the limitations of included studies. However, firm conclusions to introduce suggestions for current clinical practice are precluded by several limitations. These include the retrospective nature of the majority of studies, which increases the possibility of selection bias, the relatively low scientific quality of studies, and the small number of enrolled patients, which is particularly small in at least two of them [15, 16]. Another potential bias arises from the different methods of ovarian suspension used by Pelicano et al. (the largest study included) [17]. In this particular study, the authors used absorbable suture, whereas in the remaining three studies, researchers used a polypropylene suture, which was removed 4–7 days postoperatively. Given these limitations, we believe that current knowledge does not suffice to institute this technique in daily clinical practice.

## Conclusion

Ovarian suspension is a feasible surgical technique, which might actually help reduce postoperative adhesions. Current literature is encouraging but, unfortunately, not enough to draw firm conclusions. Furthermore, its impact on postoperative pain scores and fertility rates remains unknown. Taking in mind these interesting information, we believe that future randomized trials are needed in the field, which should consistently record these outcomes. Several other factors should also be taken into account such as the type of sutures and the duration of ovarian suspension to improve the technique and to avoid complications.

#### Compliance with ethical standards

**Funding** The authors did not receive funding for the present study.

**Conflict of interest** The authors declare that they have no conflict of interest.

**Ethical approval** This article does not contain any studies with human participants or animals performed by any of the authors.

## References


1. Ahn SH, Monsanto SP, Miller C et al (2015) Pathophysiology and immune dysfunction in endometriosis. Biomed Res Int 2015: 795976
2. Bruner-Tran KL, Herington JL, Duleba AJ et al (2013) Medical management of endometriosis: emerging evidence linking inflammation to disease pathophysiology. Minerva Ginecol 65:199–213
3. Grammatikakis I, Trompoukis P, Zervoudis S et al (2015) Laparoscopic treatment of 1522 adnexal masses: an 8-year experience. Diagn Ther Endosc 2015:979162
4. De Wilde RL, Brolmann H, Koninckx PR et al (2012) Prevention of adhesions in gynaecological surgery: the 2012 European field guideline. Gynecol Surg 9:365–368
5. Robertson D, Lefebvre G, Leyland N et al (2010) Adhesion prevention in gynaecological surgery. J Obstet Gynaecol Can 32:598–608
6. Ray GR, Trueblood HW, Enright LP et al (1970) Oophoropexy: a means of preserving ovarian function following pelvic megavoltage radiotherapy for Hodgkin's disease. Radiology 96:175–180
7. Cutner AS, Lazanakis MS, Saridogan E (2004) Laparoscopic ovarian suspension to facilitate surgery for advanced endometriosis. Fertil Steril 82:702–704
8. Liberati A, Altman DG, Tetzlaff J et al (2009) The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate healthcare interventions: explanation and elaboration. BMJ 339:b2700
9. Howick J, Chalmers IG, Greenhalgh PT et al. OCEBM levels of evidence working group*. "The Oxford levels of evidence 2". Oxford Centre for Evidence-Based Medicine. http://www.cebm.net/index.aspx?o=5653
10. Guyatt G, Oxman AD, Akl EA et al (2011) GRADE guidelines: 1. Introduction-GRADE evidence profiles and summary of findings tables. J Clin Epidemiol 64:383–394
11. Poncelet C, Ducarme G, Yazbeck C et al (2012) Safety of transient abdominal ovariopexy in patients with severe endometriosis. Int J Gynaecol Obstet 118:120–122
12. Hoo WL, Stavroulis A, Pateman K et al (2014) Does ovarian suspension following laparoscopic surgery for endometriosis reduce postoperative adhesions? An RCT. Hum Reprod 29:670–676
13. Seracchioli R, Di Donato N, Bertoldo V et al (2014) The role of ovarian suspension in endometriosis surgery: a randomized controlled trial. J Minim Invasive Gynecol 21:1029–1035
14. Carbonnel M, Ducarme G, Dessapt AL et al (2011) Efficacy of transient abdominal ovariopexy in patients with severe endometriosis. Eur J Obstet Gynecol Reprod Biol 155:183–187
15. Abuzeid MI, Ashraf M, Shamma FN (2002) Temporary ovarian suspension at laparoscopy for prevention of adhesions. J Am Assoc Gynecol Laparosc 9:98–102
16. Ouahba J, Madelenat P, Poncelet C (2004) Transient abdominal ovariopexy for adhesion prevention in patients who underwent surgery for severe pelvic endometriosis. Fertil Steril 82:1407–1411
17. Pellicano M, Giampaolino P, Tommaselli GA et al (2014) Efficacy of ovarian suspension to round ligament with a resorbable suture to prevent postoperative adhesions in women with ovarian endometrioma: follow-up by transvaginal hydrolaparoscopy. Gynecol Surg 11:261–266
18. Berker B, Seval M (2015) Problems with the diagnosis of endometriosis. Women's Health (Lond Engl) 11:597–601
19. Duffy JM, Arambage K, Correa FJ et al (2014) Laparoscopic surgery for endometriosis. Cochrane Database Syst Rev 4:CD011031
20. Lower AM, Hawthorn RJ, Ellis H et al (2000) The impact of adhesions on hospital readmissions over ten years after 8849 open gynaecological operations: an assessment from the Surgical and Clinical Adhesions Research Study. BJOG 107:855–862
21. Vrijland WW, Jeekel J, van Geldorp HJ et al (2003) Abdominal adhesions: intestinal obstruction, pain, and infertility. Surg Endosc 17:1017–1022
22. Practice Committee of American Society for Reproductive Medicine in collaboration with Society of Reproductive Surgeons (2013) Pathogenesis, consequences, and control of peritoneal adhesions in gynecologic surgery: a committee opinion. Fertil Steril 99:1550–1555
23. Gutt CN, Oniu T, Schemmer P et al (2004) Fewer adhesions induced by laparoscopic surgery? Surg Endosc 18:898–906
24. Baakdah H, Tulandi T (2005) Adhesion in gynecology complication, cost, and prevention: a review. Surg Technol Int 14:185–190
25. Pados G, Venetis CA, Almaloglou K et al (2010) Prevention of intra-peritoneal adhesions in gynaecological surgery: theory and evidence. Reprod Biomed Online 21:290–303
26. Ahmad G, O'Flynn H, Hindocha A et al (2015) Barrier agents for adhesion prevention after gynaecological surgery. Cochrane Database Syst Rev 4:CD000475
27. Ahmad G, Mackie FL, Iles DA et al (2014) Fluid and pharmacological agents for adhesion prevention after gynaecological surgery. Cochrane Database Syst Rev 7:CD001298
28. Pados G, Makedos A, Tarlatzis B (2013) Adhesion prevention strategies in laparoscopic surgery, endoscopy. InTech; Available from: http://www.intechopen.com/books/endoscopy/adhesion-prevention-strategies-in-laparoscopic-surgery
29. Koninckx PR, Corona R, Timmerman D et al (2013) Peritoneal full-conditioning reduces postoperative adhesions and pain: a randomised controlled trial in deep endometriosis surgery. J Ovarian Res 6:1–9
30. Cheong YC, Laird SM, Li TC et al (2001) Peritoneal healing and adhesion formation/reformation. Hum Reprod Update 7:556–566
31. Jacobson TZ, Duffy JM, Barlow D et al. (2010) Laparoscopic surgery for subfertility associated with endometriosis. Cochrane Database Syst Rev: CD001398
32. Boujenah J, Bonneau C, Hugues JN et al (2015) External validation of the endometriosis fertility index in a French population. Fertil Steril 104:119–123.e111
33. Centini G, Afors K, Murtada R et al (2015) The impact of laparoscopic surgical management of deep endometriosis on pregnancy rate. J Minim Invasive Gynecol