

Effect of laparoscopic surgery for moderate and severe endometriosis on depression, relationship satisfaction and sexual functioning: comparison of patients with and without bowel resection

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STUDY QUESTION: Is there a difference between women with endometriosis who underwent laparoscopic surgery with bowel resection or without bowel resection regarding depressive symptoms, relational adjustment and sexual functioning?

SUMMARY ANSWER: Radical surgery for endometriosis in both groups improved the levels of depression and sexual functioning, but only the bowel resection patients showed improvements in relationship satisfaction.

WHAT IS KNOWN ALREADY?: The frequent pain symptoms in endometriosis patients can have an impact on psychological issues, relationships and sexual functioning. There are no data available on depression and relationship adjustment after endometriosis surgery. Sexual dysfunction problems have been described after bowel resection for rectal cancer, but no data are available for endometriosis surgery.

STUDY DESIGN, SIZE, DURATION: This prospective cohort study included 203 consecutive women operated at the Leuven University Fertility Center (LUFC) between 1 September 2006 and 30 September 2008 for moderate ($n = 67$) or severe ($n = 136$) endometriosis. The preoperative response rate was respectively 84% in the bowel resection group and 79% in the no bowel resection group.

PARTICIPANTS, SETTING, METHODS: The Beck depression inventory (BDI) measured depression, the dyadic adjustment scale (DAS) measured relationship satisfaction and the short sexual functioning scale (SSFS) measured sexual functioning before and 6, 12 and 18 months after women had laparoscopic surgery at the LUFC, a tertiary referral centre for fertility exploration, treatment and surgery.

MAIN RESULTS AND THE ROLE OF CHANCE: Both groups had better post-operative outcomes when compared with the preoperative assessments. Mean BDI and DAS levels were comparable with the normal population. Overall assessment points, the bowel resection patients had better outcomes for DAS ($P < 0.05$) and SSFS 'arousal' ($P < 0.05$) than the no bowel resection patients. At 6 months after the operation, when compared with the no bowel resection group, the bowel resection group reported lower mean levels of BDI ($P < 0.05$), a lower incidence of SSFS 'pain during intercourse' and 'orgasm problems' ($P < 0.05$), and a lower proportion of patients with severe orgasm problems ($P < 0.05$). The data show that radical but fertility sparing surgery, with or without bowel resection, for the treatment of endometriosis results in comparable and good psychological outcomes concerning depression levels, relationship satisfaction and sexual functioning.

LIMITATIONS, REASONS FOR CAUTION: Although the initial response rate was good, response dropped over time and was significantly higher for bowel resection patients compared with the no bowel resection patients ($P = 0.05$). A responder/non-responder analysis for the whole study population showed no significant differences concerning pain problems. This reduces the possible risk of (positive) bias in the results.

WIDER IMPLICATIONS OF THE FINDINGS: Endometriosis is a complex condition and the focus should not be on a one-dimensional end-organ gynaecological outcome, but should take into account the role of psychological factors in pain-related outcome. To this end, more prospective data are needed on sexual functioning and psychological outcomes.

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Key words: endometriosis / bowel resection / depression / relationship satisfaction / sexual functioning

Introduction

The definitive diagnosis of endometriosis is made following laparoscopic inspection of the pelvis (Kennedy *et al.*, 2005) and should ideally be confirmed by histological examination of the excised lesions. It is widely agreed that surgical management is the primary treatment for more severe forms of endometriosis, such as symptomatic deep infiltrating endometriosis (DIE) with colorectal involvement (Garry, 2004; Emmanuel and Davis, 2005). Intestinal involvement has been estimated to occur in ~3–37% of DIE cases (Coronado *et al.*, 1990; Graham and Mazier, 1998; Collin and Russell, 1999). A positive correlation seems to exist between the extent of endometriosis resection and the degree of post-operative improvement (Chapron *et al.*, 2004). However, the appropriate surgical approach for DIE with involvement of the bowel remains controversial. Little is known about the impact of the different types of surgery in the treatment of DIE on complications, pain, recurrence rates, fertility and the patients' quality of life (Meuleman *et al.*, 2011a,b).

There are, to our knowledge, no data available on depression levels and relationship satisfaction after surgery for endometriosis. The quality of sexual life after medical or surgical treatment for DIE has not been thoroughly investigated, although prospective studies with laparoscopic excision of symptomatic endometriosis have shown improvements in the quality of sexual functioning (in terms of increased sexual pleasure, habit and decreased sexual discomfort) after 4 month follow ups (Garry *et al.*, 2000), 12 month follow ups (Lyons *et al.*, 2006) and 5 year follow ups (Abbott *et al.*, 2003) as well as improved quality of sexual life after 6 and 12 month follow ups (Ferrero *et al.*, 2007).

Sexual disturbances such as anorgasmia and functional bladder problems have been described after low rectum resection due to damage of the autonomic nerves in female patients with rectal cancer (Davalos *et al.*, 2007), but no good data are available on the effect of surgery for deeply infiltrative endometriosis on sexual function (De Cocco *et al.*, 2010; Meuleman *et al.*, 2011a,b). Based on the favourable clinical outcome after bowel resection and reanastomosis in patients with DIE of the bowel in our previous studies (Meuleman *et al.*, 2009, 2011a,b), this study was done to test the hypothesis that depression levels, relationship satisfaction and sexual functioning improve after laparoscopic surgery for moderate and severe endometriosis (rAFS III and IV) with or without bowel resection and reanastomosis in a multidisciplinary setting.

Materials and Methods

Study design: patient selection

The protocol of this prospective study (ClinicalTrials.gov ID: NCT00463398) was approved by the Ethical Committee of the University Hospital Leuven, Belgium. All women who underwent reproductive surgery between 1 September 2006 and 30 September 2008 at the Leuven University Fertility Center (LUFc) were asked to participate in this prospective follow-up study. For this paper, only the group of patients classified during intervention as moderate or severe endometriosis (rAFS III or IV, respectively) was selected.

Patient population operated at the LUFc during the study period

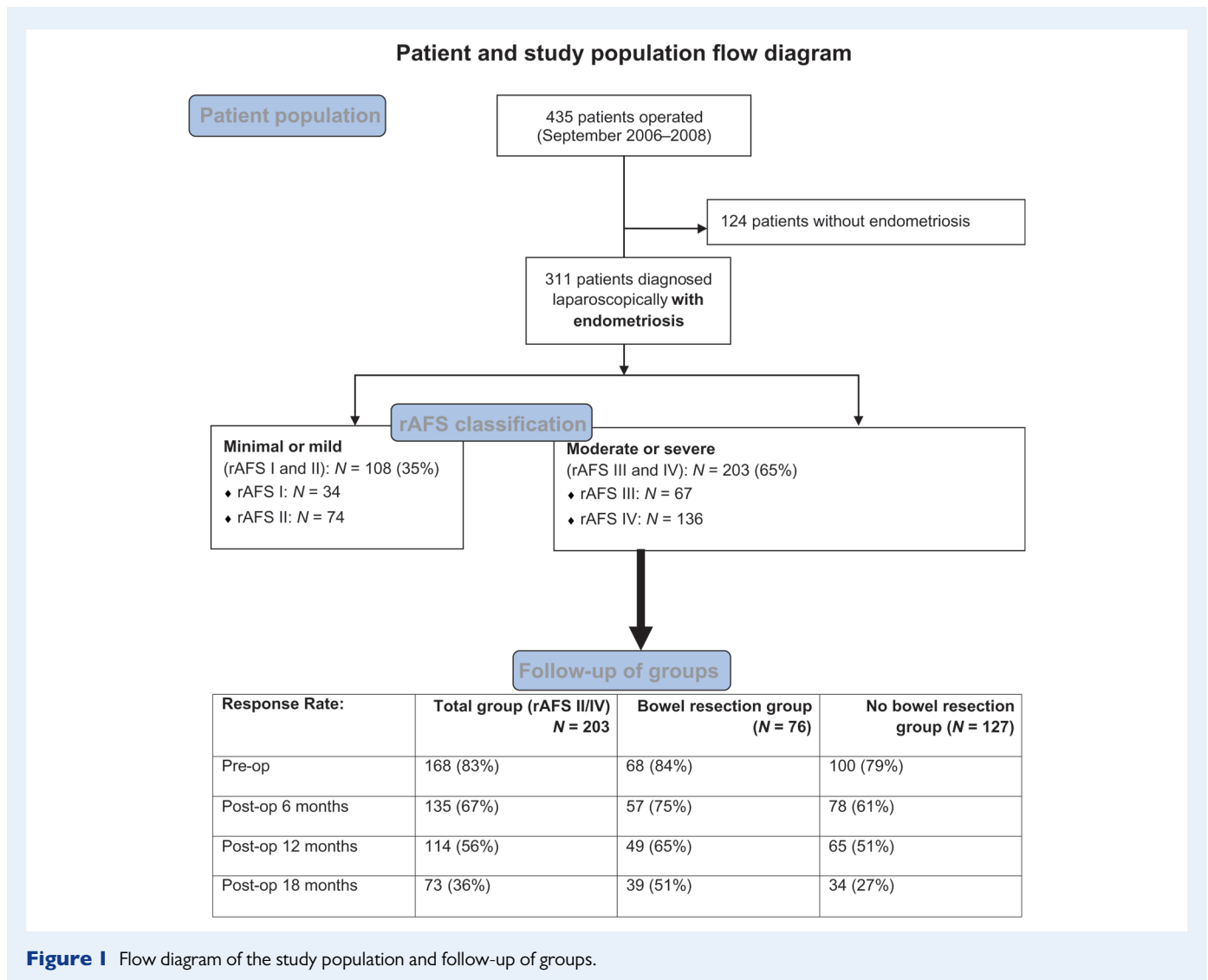
The flow chart detailing the patient population and follow-up is shown in Fig. 1.

Preoperative characteristics of the study population (rAFS III/IV, $n = 203$)

The study population and patient characteristics are described in detail in Meuleman *et al.* (2013).

Most patients (162/203; 80%) underwent surgery because of pain and a desire for fertility. This pregnancy wish was present as either active infertility or a child wish in the near future (116/162; 72%), or in the distant future (46/162; 28%). Only 14 (14/203; 7%) patients were operated because of pain alone (10 and 4 in the no bowel resection group and in the bowel resection group, respectively); 8 of them (8/14; 57%) had their family completed and 6 (6/14; 43%) were childless but without any further pregnancy wish. Only 27 (27/203; 13%) patients had no pain at all but underwent surgery because of an active unfulfilled child wish (25/27; 93%) or a passive future child wish (2/27; 7%) after an abnormal clinical and ultrasound examination. In the group of patients, who underwent bowel resection, only four patients did not suffer from pain (4/76; 5%).

In the group of 76 patients, who underwent bowel resection, 70% (47/67), 29% (19/65) and 32% (22/68) preoperatively suffered from dysmenorrhea (degree II and III), deep dyspareunia and chronic pelvic pain, respectively. In the group of 127 patients, who did not undergo bowel resection, the corresponding numbers were 60% (57/95), 26% (25/96) and 19% (19/99). For these three types of pain, the proportions of patients suffering pain were not significantly different between the two groups ($P > 0.05$).



Questionnaires

Participating patients were asked to complete the Dutch versions of the beck depression inventory (BDI), dyadic adjustment scale (DAS) and the short sexual functioning scale (SSFS) 1 month prior to and 6, 12, 18 and 24 months after the intervention. These questionnaires were part of a larger study package that also included questions on pain, quality of life and medical and gynaecological history as reported by Meuleman *et al.* (2009, 2011a,b).

Depression

The total score on the BDI is used to evaluate the presence and degree of depression (Beck *et al.*, 1961). The BDI is a self-assessment instrument that permits the identification of symptoms of depression. It consists of 21 symptoms of depression (e.g. guilt, sadness, irritability, indecisiveness, etc.). The scores were classified according to the criteria of cut-off points suggested for the Dutch validation of the instrument as follows: 0–16 normal to mild range, 17–30 moderate depression levels and above 30 severe depressions. Using the cut-off score of 17 marks, the proportion of patients reporting clinically moderate to severe symptoms of depression was determined.

Relationship satisfaction

The DAS (Spanier, 1976) was used for assessing the quality of marriage. The DAS is a self-assessment instrument and consists of 32 items. After summing the scores, a minimum score of 0 and maximum of 151 is obtained. A higher score represents higher quality of marriage and higher relationship satisfaction. Spanier (1976) published the original normal scores that are population averages for married couples (mean = 114.8; SD 17.8) and divorced couples (mean = 70.7; SD = 23.8).

Sexual functioning

To measure the impact on sexual functioning the 'SSFS' was developed. The SSFS is a self-designed questionnaire consisting of four items that address sexual dysfunctions: decreased/increased sexual desire, dry vagina, orgasmic dysfunction and pain during intercourse. Each of these items were scored on a four-point scale ranging from 0 (not or doubtfully present) to 3 (extremely present). To better address the Diagnostic and Statistical Manual of Mental Disorders, fourth edition definition of a sexual dysfunction, a measurement of personal and partner distress and interpersonal difficulty was added. Women reported to have a sexual dysfunction (a score of > 1 on the previous items) were invited to evaluate the distress of it by means of a scoring

system ranging from 0 (slight problem) to 2 (extreme problem) for the patient, the partner and their relationship. Higher scores indicate a more outspoken presence and greater severity of the reported problem. A 'sexual dysfunction' was considered to be present only if a woman rated the problem to be moderate (score 1) or severe (score 2) combined with a sum score of 5 on the distress scale (at least an extreme level of distress on two distress dimensions, i.e. patient, partner or relationship). This implies that women reporting a 'slight' problem were not taken into account to estimate prevalence rates. The rationale behind this is that 'slight' problems are supposed to rather induce 'no or slight' distress, and thus may need less clinical attention, and that including them would create inflated prevalence rates. Reliability analysis of the SSFS revealed a good internal consistency (Cronbach's $\alpha = 0.84$).

Surgery

The preoperative, operative and post-operative procedures are described in detail elsewhere (Meuleman et al., 2009, 2011a, 2013).

Briefly, in the first step of our multidisciplinary-3-step-operative procedure for patients with extensive DIE with colorectal extension, patients underwent temporary double J ureteric stenting by the urologist in the case of endometrioma exceeding 4 cm in diameter, DIE invading the bladder wall or in the posterior compartment of the pelvis extending to the fossae (Meuleman et al., 2009, 2011a). After induction of pneumoperitoneum at a maximum of 15 mmHg, all visible endometriosis was excised with a CO₂ laser (Lumenis Inc., USA: Compact 40W CO₂ laser) and normal anatomic relations of the pelvic organs were restored as much as possible. If perforation of the vaginal vault occurred, it was laparoscopically sutured by the reproductive surgeon. The presence of endometriosis was scored and staged according to the rAFS classification system of the ASRM (rAFS, 1997). In the second step, the urologist evaluated ureters and the bladder and, if applicable, did a laparoscopic suture of seromuscular injury, perforation of the bladder or ureter injury. In a third step, the colorectal surgeon evaluated the integrity of the rectosigmoid colon and rectum. Depending on the type of lesions and their extensions, it was decided whether or not to resect the involved segment with primary reanastomosis. The decision to perform bowel resection and reanastomosis was taken in the following conditions: large direct full-thickness trauma to the colorectal wall too extensive to be sutured without potential impact on the bowel function, extensive lesion to the bowel wall musculature in the absence of full-thickness damage but with impact on functionality and extensive lateral dissection compromising the colorectal wall vascularization and/or innervation. Bowel resection was performed laparoscopically as described previously (Meuleman et al., 2009, 2011a). The dissection was conducted close to the bowel. If neurovascular structures were involved in the endometriosis, they were sacrificed in order to eliminate all endometriotic tissue. Histological examination was performed on all resected tissue specimens.

Statistical analysis

For the analysis of the BDI and DAS scores, linear mixed models were used, whereas for the four sexual functioning scores, a random-effects proportional odds model was used. For each of the scales, the observed score was taken as the response variable and the baseline (pre-op) measurement, time of assessment and group (bowel resection yes or no) were taken as explanatory variables. Additionally, the main effect of group and/or interaction between time and group was tested. Including the pre-op measurement in the model allows correction for possible inequalities that exist between the two groups before the operation. The time of the assessment was included in the model as a categorical variable, allowing for nonlinear evolutions. Patients without any post-operative measurement were excluded from all analyses. Differences between groups for the BDI, DAS and SSFS were examined using a Mann–Whitney *U*-test. All tests were two-sided and considered to be significant with *P*-values smaller than 0.05. Differences between groups (such as

responder versus non-responder/lost-to-follow-up group) were examined with a χ^2 test.

Additional analyses were performed to investigate the impact of pregnancy after surgery on the levels of depression and relationship satisfaction. As information regarding child wish and pregnancy outcome was not the main focus of the current study, it was not recorded in the main study database. However, a clinical database from a separate ongoing project was available that included 136 women of the 162 women who had indicated an active child wish. Information on pregnancy outcome and child wish was available for 123 women and for 13 women it was missing. When these data were matched with the above questionnaire data, analyses could be performed for 37 women with bowel resection and for 58 women without bowel resection, for whom BDI scores and pregnancy outcome were available, and for 36 women with bowel resection and for 58 women without bowel resection, for whom DAS scores and pregnancy outcome were available. A linear mixed model with BSI and DAS scores as response variables and pregnancy and time as explanatory variables was used to explore differences in the level of depression and relationship satisfaction between women with or without a pregnancy after surgery. A random intercept accounts for correlation between repeated measurements.

To investigate differences concerning pregnancy between the bowel and no bowel resection group a log-rank test was used based on a Kaplan–Meier curve of cumulative pregnancy.

Analyses were performed using the MIXED procedure in SAS (version 9.2 of the SAS System for Windows).

Results

Response rate to the questionnaires

The initial response rate (preoperative questionnaire) was 83% (168/203; Fig. 1). In the group of patients, who underwent bowel resection ($n = 76$), 68 completed the questionnaire (84%), compared with 79% (100/127) of the patients who did not undergo bowel resection. There were 35 patients (35/203; 17%) who did not respond. One patient with vision problems (bad eyes) could not complete the questionnaire, 1 patient found the questions too difficult to understand, 5 patients moved abroad, 1 patient had a psychological crisis due to family problems, 7 patients did not speak Dutch and 20 patients did not want to collaborate.

Six months after surgery, the questionnaire was completed by 67% (135/203) of the patients: 75% (57/76) and 61% (78/127) of the patients who underwent bowel resection and who did not, respectively. At 12 and 18 months after surgery, respectively, 56% (114/203) and 36% (73/203) of the patients completed the questionnaires. The patients who underwent bowel resection were more compliant with 65% (49/76) and 51% (39/76) of them completing the questionnaire 12 and 18 months after surgery, respectively, compared with 51% (65/127) and 27% (34/127) of the patients who did not undergo bowel resection. No statistically significant differences in response rates between the bowel resection and no bowel resection group were found preoperatively, at 6 or 12 months follow-up after surgery. However, at 18 months follow-up after surgery, the response rate in the bowel resection group was significantly higher ($P < 0.001$) than in the no bowel resection group. The response rate dropped over time partly due to the length and elaborateness of the questionnaire package and the time consuming nature of prospective studies. In order to reduce the risk of bias at 12 and 18 months follow-up, an additional analysis investigated differences in pain symptoms (which are associated with psychological outcome)

between the bowel resection and no bowel resection group. To maximize standardization and to obtain a homogenous group concerning pain symptoms, only those women with mainly pain complaints and a child wish in the near future ($n = 41$) were considered. Those with an active child wish ($n = 116$) who wanted to become pregnant immediately after the surgery for endometriosis were not considered as pregnancy or fertility treatment can influence pain perception and experience. No significant differences were found for post-operative dysmenorrhea (Grade I–IV), chronic pain and deep dyspareunia (as documented in the clinical medical file) between the patients lost-to-follow-up (i.e. the women with no active child wish who filled out the preoperative and 6 months post-operative questionnaire package but not the 12 and 18 month assessment) and the responders (i.e. those women who responded to the pre-op, 6, 12 and 18 month assessment).

Depression

In both groups, the mean score for depression over all the assessment points [bowel resection mean = 7.6 (SD = 7.0) and no bowel resection mean = 8.8 (SD = 7.4)] was in the normal range based on the BDI scoring manual (Fig. 2). There was a significantly lower mean level of depression ($P = 0.03$) in the bowel resection group compared with the no bowel resection group 6 months after surgery, whereas no significant differences ($P > 0.05$) were observed preoperatively or 12–18 months after surgery. In addition, the mean BDI scores decreased from the preoperative assessment point to the post-operative assessment points at 6, 12 and 18 months after surgery, which suggests a positive impact of the intervention in both groups.

The proportion of patients reporting moderate to severe clinical symptoms of depression [by using the BDI cut-off score of 17 (Beck *et al.*, 1961)] is shown in Table I for each assessment point. At the preoperative assessment point, no significant differences ($P > 0.05$)

between the groups were found and comparable proportions of moderate to severe levels of depression were observed, 22% (22/98) of women in the no bowel resection group versus 23% (15/65) in the bowel resection group. At 6 months after surgery, the proportion of women with moderate to severe clinically significant levels of depressive symptoms was significantly lower in the bowel resection group (only 7%; 4/57) than in the no bowel resection group (19%; 15/79; $P < 0.05$). At 12 and 18 months follow-up, no significant differences were found between the two groups in the proportion of patients reporting clinical symptoms of depression.

To take into account the possible positive effect of a pregnancy (after surgery) on depression levels, differences in depressive symptoms between the women becoming pregnant after surgery and those not becoming pregnant were examined. In the no bowel resection group, 81 women indicated an active child wish; 16 of them did not become pregnant and 65 women did become pregnant. In the bowel resection group, 42 women indicated an active child wish; 11 of them did not become pregnant and 31 women did become pregnant. No significant differences were found ($P = 0.92$) between women with or without bowel resection in terms of their cumulative probability of pregnancy. We did not find significant differences concerning depression between those who were pregnant and those who were not when baseline depression levels were considered ($P < 0.05$). An additional analysis explored the association between pregnancy and levels of depression longitudinally. The longitudinal model that takes into account the follow-up of 6–18 months showed a significant difference in the bowel resection group ($P = 0.0008$) as well as in the no bowel resection group ($P = 0.02$) in mean depression levels between the pregnant and not pregnant women. These results suggest that women with an active child wish after surgery, who became pregnant, experience lower levels of depression than those who did not become pregnant. However, the mean levels of depression for both pregnant and not pregnant women were in the mild range of depressive symptoms (according to the BDI scoring manual). The clinical relevance of these findings should therefore be interpreted with caution.

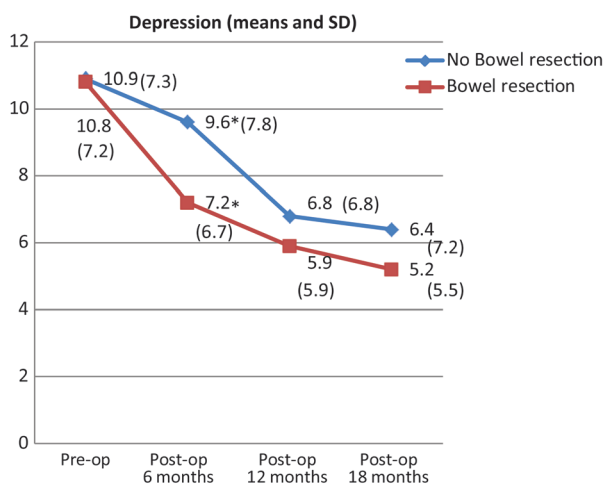


Figure 2 Mean BDI scores [and standard deviation (SD)] for depressive symptoms from the preoperative assessment point to the 6, 12 and 18 months post-operative assessment points. At 6 months after surgery, the bowel resection group showed significantly lower mean BDI scores ($P = 0.03$; represented by * in the graph) compared with the no bowel resection group.

Table I Proportion (%) of women reporting moderate to severe levels of depression (BDI score < 17) in the bowel resection group and the no bowel resection group and statistical significance (Mann–Whitney U-test) between the two groups.

% Moderate/severe BDI scores	Bowel resection group	No bowel resection group	Statistical significance (P-value)
Preoperative assessment	23% (15/65)	22% (22/98)	>0.05
6 months after surgery	7% (4/57)	19% (15/79)	<0.05
12 months after surgery	6% (3/48)	11% (7/62)	>0.05
18 months after surgery	7% (3/38)	11% (4/36)	>0.05

The number of women in each group is shown within brackets.

Relationship satisfaction

The mean score for relationship satisfaction in the bowel resection group (mean = 115.6; SD = 13.1) and in the no bowel resection group (mean = 110.9; SD = 14.3) over all the assessment points was within the expected range compared with the normal population of married couples (mean = 114.8), as described previously (Spanier, 1976). Nonetheless, the differences observed between the two groups (bowel resection versus no bowel resection) in mean relationship satisfaction were statistically significant ($P < 0.05$): relationship satisfaction was on average higher overall assessment points in the group of patients, who underwent a bowel resection, with an average difference in the DAS score of 2.7 (Fig. 3).

Relationship satisfaction for women with or without a pregnancy showed no significant differences in the longitudinal model (follow-up 6–18 months; $P = 0.67$ in the bowel resection group; $P = 0.22$ in the no bowel resection group). Pregnancy did not seem to have a significant impact on relationship satisfaction, as these levels remained stable and similar in both pregnant and not pregnant women.

Sexual functioning

With the SSFS, four categories of sexual dysfunction (pain during intercourse, orgasm problems, sexual desire and sexual arousal) were assessed and compared between the bowel and no bowel resection group. The women in the bowel resection group showed significantly better mean outcomes ($P < 0.05$) for all assessment points (both pre-op and post-op) concerning sexual arousal than those in the no bowel resection group. For sexual desire, orgasm problems and pain during intercourse, no significant differences over all assessment points between the two groups were found ($P > 0.05$).

Taken into account the effect of surgery (pre-op versus post-op), a significant interaction between assessment point and bowel resection

($P < 0.05$) was observed for the SSFS scale ‘pain during intercourse’ and ‘orgasm problems’. Results indicate significantly lower levels ($P < 0.01$) of pain during intercourse combined fewer orgasm problems in the bowel resection group than in the no bowel resection group from the preoperative assessment point to the first post-operative assessment point at 6 months after surgery. At 12 and 18 months after surgery, the women in the bowel resection group still showed fewer orgasm problems but this did not reach significance between the groups ($P > 0.05$). No significant interaction effects between assessment point and bowel resection group were found for sexual desire and arousal.

The SSFS questionnaire takes into account the severity of the sexual dysfunction as well as the distress that women experience as a consequence of the sexual dysfunction. In this way, a classification could be made of women who indicated only a mild sexual problem and no distress (score of 0 on the SSFS) versus women who reported severe sexual dysfunction and experienced considerable distress (score of 2 on the SSFS). The proportion of women, who reported severe sexual dysfunction and distress (score of 2 on the SSFS), is shown for each sexual dysfunction and significant differences are marked in Fig. 4. Before surgery, roughly one-third of patients (31% in no bowel resection group versus 45% in bowel resection group; $P > 0.05$) reported severe problems with pain during intercourse and with sexual desire (28% in the no bowel resection group versus 32% in the bowel resection group; $P > 0.05$). Severe problems with arousal (11% no bowel resection group versus 22% with bowel resection group; $P > 0.05$) and orgasm (16% no bowel resection group versus 11% bowel resection group; $P > 0.05$) were less frequent and varied from 10 to 20% of patients. After surgery, overall the proportion of patients indicating a severe sexual problem with moderate to severe degrees of distress was reduced indicating a positive outcome of the surgical intervention (Fig. 4). Six months after surgery, the proportion of women in the no bowel resection group who indicated severe orgasm problems was significantly higher than in the bowel resection group (respectively, 10% compared with 0%; $P < 0.05$). Post-operatively (6, 12 and 18 months after surgery), no significant differences ($P > 0.05$) in the proportion of severe sexual dysfunction in the two groups were observed for pain during intercourse, sexual arousal and desire.

Discussion

To our knowledge, this is the first prospective study comparing depression levels, relationship satisfaction and sexual functioning after multidisciplinary CO₂ laser laparoscopic excision of moderate-severe (rAFS III/IV) endometriosis in women with or without bowel resection and reanastomosis. The data show comparable and improved levels of depression, relationship satisfaction and sexual functioning in both groups after surgery. However, patients in the bowel resection group had significantly better outcomes than patients without bowel resection with respect to the proportion of women with clinically significant levels of depressive symptoms as well as lower levels of sexual problems with orgasm and pain during intercourse.

Relationship satisfaction in the patients with moderate to severe endometriosis was comparable with that of married couples in the general population, with higher levels of satisfaction in the group receiving bowel resection than in the group not receiving bowel resection. On average, normal levels of depression were found in patients with moderate to severe endometriosis (rAFS III and IV), although 20%

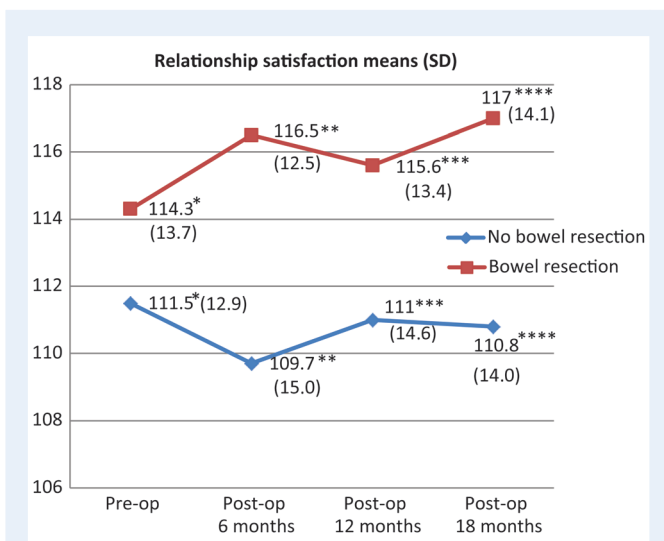


Figure 3 Means [and standard deviation (SD)] for relationship satisfaction. Women in the bowel resection group have significantly higher mean levels of relationship satisfaction: $P < 0.05$ at the preoperative assessment point (*) and at the 6-month- (**), 12 month- (***) and 18 month (****) postoperative assessment point than women in the no bowel resection group.

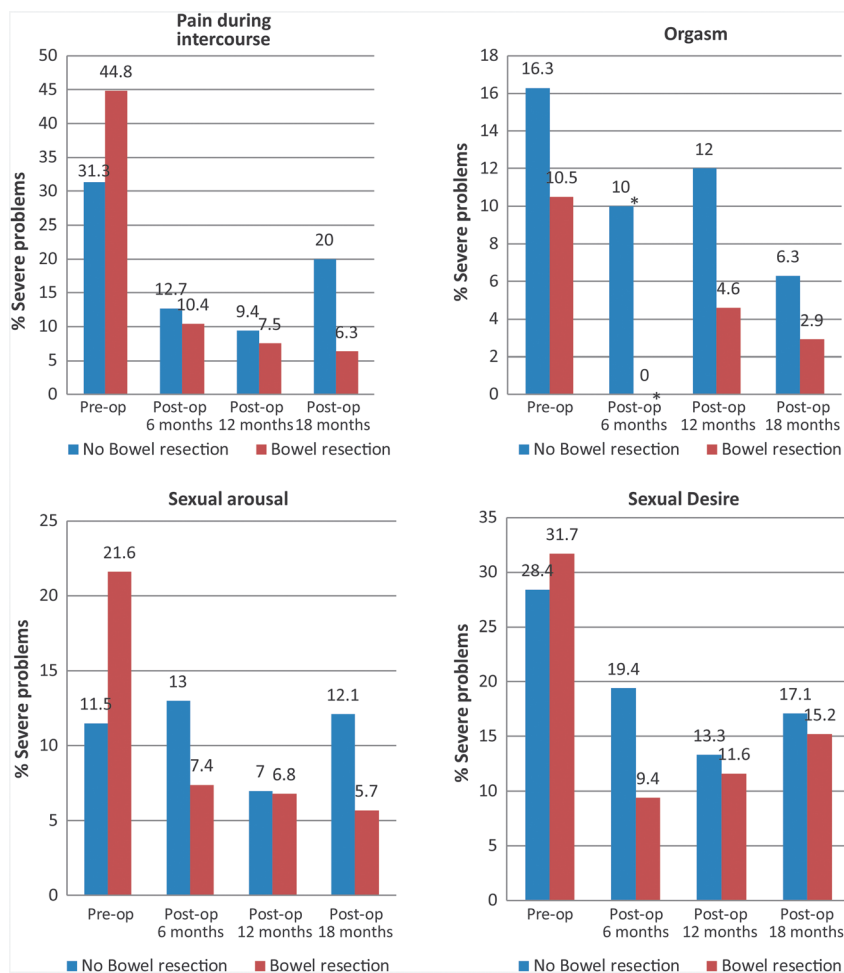


Figure 4 The proportion of women with severe problems (score of 2 on SSFS) concerning pain during intercourse, orgasm problems, sexual arousal and sexual desire over time. The only significant difference found was a higher proportion of women who indicated a severe problem with orgasm in the no bowel resection group (10%; $P < 0.05$; represented by * in the graph) compared with the bowel resection group (0%).

showed clinically significant levels of depression at the preoperative stage. A number of studies (Low *et al.*, 1993; Waller and Shaw, 1995; Lorenzatto *et al.*, 2006; Eriksen *et al.*, 2008) have investigated the psychological characteristics of patients with endometriosis, although most of these studies have been carried out in patients with pain, and have yielded contradictory findings in relation to depression levels. Furthermore, there is a body of evidence that confirms that endometriosis impairs health-related quality of life (Nnoaham *et al.*, 2011), especially in domains of pain, psychological and social functioning (Gao *et al.*, 2006).

Concerning relationship satisfaction and depression levels after surgery for endometriosis, our study provides novel and reassuring information. Depression levels decreased after the surgical intervention, to a stronger extent for the women in the bowel resection group, with a lower proportion of moderate to severe levels of depressive symptoms, compared with the women in the no bowel resection group. Meuleman *et al.* (2013) found in their prospective report of the same patient population as in this study that both groups were preoperatively comparable regarding demographic and clinical characteristics, and indication for surgery. However, the bowel resection group contained more women

with severe DIE based on bowel symptoms, clinical signs, preoperative imaging and preoperative staging of endometriosis and had a significantly higher mean rAFS score than the no bowel resection group (Meuleman *et al.*, 2013). Therefore, it is possible that the women in the bowel resection group experience a greater difference in depression, relationship satisfaction and sexual functioning after surgery compared with the situation before surgery, because they had more severe symptoms before surgery. It is also possible that the patients in the bowel resection group, who are undergoing more extensive surgery than those in the no bowel resection group, perceive more caregiver support and experience more intensive follow-up due to the nature of their surgery and that this validates their suffering and experience and may in turn reduce levels of depression. In other patient populations such as post-partum depression (Ray and Hodnett, 2001; Lumley *et al.*, 2004), social support was found to reduce depressive symptoms,

Patients in this study who underwent extensive surgery with bowel resection for endometriosis experienced better or at least similar improvements in sexual functioning than those who underwent surgery without bowel resection. These reassuring findings are not surprising considering

that the surgery for endometriosis reduces the levels of pain (Meuleman et al., 2013), which can be expected to benefit sexual functioning both psychologically and physiologically. The post-operative reduction in levels of pain during intercourse will undoubtedly also have influenced the other, more multifactorial, domains of sexual functioning (desire, arousal and orgasm). There was, contrary to earlier statements (Davalos et al., 2007), a significant improvement in orgasm problems in the bowel resection group 6 months after surgery when compared with the preoperative time point, and this improvement remained during the 12 and 18 month follow-up period. Finally, the instrument used in this study was able to target not only the presence of sexual dysfunction (in terms of pain during intercourse, desire, arousal and orgasm) but also the severity of the dysfunction as indicated by high levels of distress for the patient, the partner and in the interpersonal field. This assessment provides a more in-depth and clinically more useful approach as it allows professionals to target those patients who can benefit from clinical intervention.

The quality of sexual life after medical or surgical treatment for endometriosis has not been thoroughly investigated, but the literature points towards improved sexual functioning after surgery (Garry et al., 2000; Abbott et al., 2003; Lyons et al., 2006; Ferrero et al., 2007). Garry et al. (2000) found in a prospective study that the excision of endometriotic lesions significantly improves the quality of sexual functioning at a 4 month follow-up. Sexual functioning was measured in the 75 consecutively recruited patients with a sexual activity questionnaire developed by Thirlaway et al. (1996). The same group of authors confirmed these observations in a post-operative follow-up after 5 years (Abbott et al., 2003). Lyons et al. (2006) performed fertility sparing laparoscopic surgery with bowel resection on seven consecutive endometriosis patients and found that the quality of life improved after a 12 month follow-up and sexual activity scores increased for pleasure, were unchanged for sexual habit and decreased for sexual discomfort. Finally, Ferrero et al. (2007) reported, in an observational prospective cohort study of 68 women with endometriosis (including 59 women with rAFS III or rAFS IV endometriosis) and suffering from deep dyspareunia, a significantly improved quality of sex life and decreased prevalence and intensity of deep dyspareunia 6 and 12 months after laparoscopic excision.

Study limitations and strengths

This study has a number of limitations that should be taken into account when interpreting the results. First, though the initial response rate was good, responses dropped over the time of follow-up (12 and 18 months). However, the clinical medical files of those women who did not complete the questionnaires at 12 and 18 months did not show any significant differences concerning pain problems (deep dyspareunia, dysmenorrhea and chronic pain) compared with the women who did fill out these questionnaires at 12 and 18 months. This reduces the possible risk of (positive) bias in the results and indicates that the respondents to the questionnaires represent an 'average' endometriosis population. Therefore, the results obtained in this study appear to be valid. We hypothesize that non-response during the study is probably related to external factors (such as time, effort, length of questionnaires, etc.), but this hypothesis needs to be confirmed in future research. Nonetheless, generalizations to other study populations based on the follow-up data at 12 and 18 months should be interpreted with caution. Secondly, an additional

analysis showed a significant positive effect of a pregnancy after surgery in both groups (bowel resection and no bowel resection) regarding levels of depression but not relationship satisfaction. It is important to note that the levels of depression were in the mild range of depressive symptoms both for pregnant and not pregnant women so the clinical relevance of these findings should be interpreted with caution. Furthermore, a bias may influence this analysis which was based on women with both follow-up data on pregnancy outcome and BDI and DAS measurements and not the total of women with an active child wish. Further data can be provided on request.

This study also has a number of strengths. This study investigated a realistic cohort of endometriosis patients mostly presenting with a combination of pain symptoms and infertility (active or passive child wish). Both pain and infertility can have a profound impact on psychological functioning, but the causal relationship between these variables was not the focus of this study. The complex associations between endometriosis, pain and infertility should be further investigated in longitudinal studies. Nonetheless, this study indicates that psychological and sexual functioning is improved after surgery in women with moderate to severe endometriosis with or without bowel resection.

In conclusion, the findings of the present study show that radical, but fertility sparing surgery with or without bowel resection in a multidisciplinary setting for the treatment of endometriosis results in comparable and good psychological outcomes concerning depression levels, relationship satisfaction and sexual functioning. Endometriosis is a complex condition and the focus should not be on a one-dimensional end-organ gynaecological outcome but should take into account the role of psychological factors in pain related outcomes (Martin et al., 2011) and, to this end, more prospective data are needed on sexual functioning to confirm our results as there is clearly a scarcity of research in this field as reported previously (De Cicco et al., 2010; Meuleman et al., 2011b).

Authors' roles

U.V. (Psychologist, researcher): analysis and interpretation of data; writing and revising the manuscript. C.M. (Reproductive Surgeon of the multidisciplinary surgical endometriosis team): conception and design of study, acquisition of data. C.T. (Reproductive Surgeon, surgical assistant of C.M.): acquisition of data and interpretation of data; revising the article; final approval. A.D., A.W. (Colorectal Surgeon of the multidisciplinary surgical endometriosis team): acquisition of data and interpretation of data; final approval. B.C. (Urologist of the multidisciplinary surgical endometriosis team): acquisition of data; revising the article; final approval. I.V. (Head of the Department of Gynaecology, co-promoter of the study): interpretation of data; final approval. P.E. (Sexologist and researcher) analysis and interpretation of data; revising the article; final approval. T.D. (Coordinator of the Leuven University Fertility Center, promoter of the study): analysis and interpretation of data; revising the article; final approval.

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Conflict of interest

None of the authors have a conflict of interest regarding this study.

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