

Endometriosis Quality of Life Cohort Study: Long-term Impact of Radical Laparoscopic Excision of Endometriosis

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Abstract

Objectives: The objectives of this study were to determine if radical laparoscopic excision of endometriosis (RLEE) improves long-term outcomes in the quality of life (QOL) and symptomatology experienced by women with the disease. Secondary objectives include recurrence and reoperation rates and impact on fertility.

Materials and Methods: Prospective observational cohort study Patients who underwent surgical management of histologically confirmed endometriosis completed pre- and postoperative QOL questionnaires.

Results: Baseline preoperative scores on QOL questionnaires were lower than the population norms. Overall, 63.0% of patients improved their global health scores, and 57.5% of patients improved their health state scores from baseline to the most recent follow-up. On the Short Form-12 questionnaire, 63% of patients improved their physical and/or mental scores. Overall improvement was shown in Visual Analog Scale pain scores in menstrual pain (79.2% improved, median improvement 3, $P < 0.001$, $n = 72$), noncyclical pelvic pain (64.4% improved, median improvement 2, $P < 0.001$, $n = 73$), dyschezia (63.9% improved, median improvement 2, $P < 0.001$, $n = 72$), and dyspareunia (65.6% improved, median improvement 1, $P = 0.002$, $n = 64$ pairs). There was a significant reduction in discomfort 1–2 years after primary surgery among sexually active patients ($n = 23$, pre- vs. postmedian score 4 vs. 2, $P = 0.005$). Repeat surgery was required in 36% of patients and 77.1% of those wishing to, achieved a successful pregnancy.

Conclusion: RLEE significantly improves global health scores, with this improvement lasting up to 10 years following index surgery. It is also suggested that this management option has the capability of improving fertility outcomes in women with endometriosis.

Keywords: Endometriosis, fertility, pain scores, quality of life, radical laparoscopic excision

INTRODUCTION

Endometriosis occurs when endometrial-like tissue grows outside the uterus and leads to an inflammatory response in the pelvis.^[1] The pathogenesis of endometriosis is poorly understood and it can manifest in a broad array of clinical presentations that do not necessarily correlate with the severity of disease as defined by surgical staging.^[1] Symptoms of pelvic pain, dysmenorrhea, dyschezia, dyspareunia, and

subfertility associated with a diagnosis of endometriosis have been demonstrated to significantly impact on all domains of a woman's health, including physical, psychosocial, and sexual health.^[2]

Epidemiological data demonstrate that the prevalence of endometriosis is approximately 11%^[3-6] and is the most

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common cause of chronic pelvic pain in women.^[4] On an individual level, this translates to overall poor quality of life (QOL) in women living with endometriosis^[4] and a subsequent increasing economical burden on the health-care system, with data showing a rising rate of hospitalizations of women with endometriosis.^[5]

Endometriosis has been identified as a significant public health issue.^[5] Currently, there is limited long-term data assessing QOL parameters following surgical management of endometriosis with radical laparoscopic excision.

Objectives

The primary objective of the study was to determine if radical laparoscopic excision of endometriosis (RLEE) improves long-term outcomes in the QOL and symptomatology experienced by women with the disease. Secondary objectives included recurrence and re-operation rates and impact on fertility.

MATERIALS AND METHODS

Participants

This prospective observational cohort study was carried out at a Gynaecological Endoscopy Surgical Unit at a Western Australian Tertiary Hospital in Perth, Western Australia. Patients who were planned for surgical management of suspected endometriosis between January 2004 and January 2010 were recruited to participate in the study and given a preoperative questionnaire. A total of 103 patients completed the questionnaire. Of these, 88 patients had a confirmed histological diagnosis of endometriosis and were included in the study. One patient had a planned laparotomy and abdominal hysterectomy as the primary surgery and was excluded from the analysis. Postoperative questionnaires were then distributed to those participants who had completed the preoperative questionnaire and who had a confirmed histological diagnosis of endometriosis. Pre- and postoperative data were available on 81 (94%) patients who had at least one follow-up appointment after surgery.

Materials

The questionnaires comprised validated QOL instruments, including the generic Short Form-12 questionnaire (SF-12), the Euro Quality of Life Questionnaire (EQ-5D), the Global Health Score, the Sexual Activity Questionnaire (SAQ), and the Visual Analog Scale (VAS).

The SF-12 assesses physical and mental functioning, providing a score called the physical and mental component score. The higher the score, the better the physical and mental health of the patient.

The EQ-5D assesses the physical functioning and self-assessment of the patient in five dimensions – mobility,

self-care, usual activity, pain/discomfort, and depression/anxiety. A Health State Index Score of 1.0 is the highest achievable, indicating the most optimal health state. The Global Health Score was represented as a thermometer-like scale of 0–100, which the patient marked at a point indicating how she felt on that particular day, with 0 being the lowest health imaginable and 100 being the best health state. The Global Health Score was chosen as a good measure of baseline health status, as it has a smaller ceiling effect and broader coverage of health-related QOL dimensions in comparison to the Health State Score.^[7]

The SAQ collected data related to the frequency (habit scores), pleasure, and discomfort associated with sexual intercourse. Habit scores were recorded on a scale of 0–3. A positive difference in the score after surgery indicates an increase in the frequency of sexual activity and a negative score indicates a decrease in sexual activity.

The VAS for pain was based on four different types of pain – menstrual, noncyclical pelvic pain, dyspareunia, and dyschezia. This was based on the 10-point Likert scale, with 0 representing no pain and 10 representing the worst imaginable pain.

Surgery

The endoscopy unit operated on all patients during the study period. This unit comprised four consultant gynecologists trained in advanced endoscopic surgery and three laparoscopic fellows. A colorectal surgeon worked closely with the team. Preoperative intravenous pyelogram, pelvic ultrasound, barium contrast enema, and magnetic resonance imaging were ordered for preoperative planning depending on the expected complexity of each case, based on clinical evaluation. All patients were given preoperative bowel preparation.

A detailed assessment of the extent of endometriosis was made at laparoscopy and assigned a revised American Fertility Society (AFS) classification score. All aspects of the operative procedure were documented, including additional tests such as tubal patency and bladder and bowel integrity tests. RLEE was carried out based on a standardized technique as described by Garry *et al.*^[8] All tissue samples were sent for histopathology to confirm diagnosis. Details of blood loss, postoperative hospital stay, and all intra- and postoperative complications were recorded.

Follow-up

Patients were contacted by phone to follow-up on postoperative outcomes. If phone calls were unsuccessful in reaching the participants, e-mails and short message service were utilized. Participants were encouraged to provide additional information regarding any subsequent medical, hormonal or surgical treatment for endometriosis following their RLEE in the study period. In addition, details of fertility desires and associated

treatments that were not included within the questionnaires were also sought in this follow-up.

Ethics

The study was conducted in accordance with the Declaration of Helsinki and was approved by King Edward Memorial Hospital Ethics committee with (approval number: 928/EW). Informed consent was obtained from all participants.

Statistics

Continuous data were summarized with medians, interquartile ranges (IQR), ranges (R), and means and standard deviations (SD) depending on the normality of data distributions. Categorical data were summarized with frequency distributions. Univariate comparisons between pre- and postoperative outcomes including QOL data, VAS data, and SAQ outcomes were compared using the Wilcoxon signed-rank test or paired *t*-test. Comparisons between pre- and postoperative measures were made within prespecified time intervals of 3–5 months, 6–11 months, 1–2 years, 2–5 years, 5–10 years, and more than 10 years of follow-up. QOL scales included the EQ-5D Health State Score and Global Health Score, and the SF-12 physical and mental well-being component scores. Linear mixed models were used to analyze repeated measures of EQ-5D and SF-12 scores with time and baseline health measure (high vs. low) modeled as fixed effects with a time-by-baseline measure interaction to assess changes over time by the severity of baseline score. The cutoff used to define “high” or “low” baseline health measure was the sample mean of the EQ Global Health Score.

All QOL models were adjusted for age at menarche, age at surgery, and time since surgery and assessed for other possible influential factors at baseline such as subfertility, dysmenorrhea

affecting QOL, duration of symptoms, endometriosis of ovaries, fallopian tubes, urethra, bladder or bowel, and AFS score. Procedures at primary surgery including resection of endometriosis, ablation and stripping were assessed, as well as repeat surgery for endometriosis categorized as <10 years and >10 years after primary surgery. Multiple pair-wise comparisons were maintained at an overall alpha error rate of 0.05 using the Bonferroni correction. Estimated marginal means and 95% confidence intervals (CI) were reported. SPSS statistical software (version 25, Armonk, NY, USA: IBM Corp) was used for data analysis. All hypothesis tests were two sided and $P < 0.05$ was considered statistically significant unless otherwise stated.

RESULTS

The majority of patients were followed up for 2–5 years (range = 3 months–17 years) with a median of 3 years (range = 1–5 years). There were 35 (43%) patients who had follow-up 10 or more years after the primary surgery [Figure 1]. Seventy-four patients had conservative laparoscopic surgery. Seven patients had total hysterectomies as their primary surgery; six were performed laparoscopically and one was converted to laparotomy secondary to bowel involvement. These seven patients were excluded from further analysis.

The mean age at surgery was 30.5 years (SD = 6.1). The primary indication for surgery was pain (66%, $n = 49$), followed by subfertility (10%, $n = 7$), and ovarian endometrioma (8%, $n = 6$). The median revised AFS score at surgery was 35 (IQR: 7–54, R: 1–118). 35% ($n = 26$) of patients were classified as Stage IV [Table 1].

	Questionnaires			
	EQ-5D	SF-12	Pain scores	SAQ
Pre-surgery	N=73	N=71	N=66-73	N=74
3-5 months	N=27	N=25	N=22-27	N=27
6-11 months	N=35	N=36	N=33-35	N=36
1-2 years	N=36	N=34	N=31-36	N=36
2-5 years	N=41	N=38	N=34-48	N=41
5-10 years	N=15	N=15	N=13-15	N=15
10+ years	N=31	N=31	N=32	N=32

Figure 1: Flow chart showing the number of participants responding to each questionnaire at baseline (presurgery) and at each follow-up time point after surgery. EQ-5D: Euro quality of life questionnaire, SF-12: Short Form-12 questionnaire, SAQ: Sexual activity questionnaire

Table 1: Participant history, preoperative symptoms, and intraoperative findings (*n*=74)

Participant history and preoperative symptoms	<i>n</i> (%)
Age at menarche (years), mean (SD)	12.9 (1.4)
Age at onset of symptoms (years), mean (SD)	25.7 (7.0)
Age at painful periods (years), mean (SD)	18.3 (6.2)
Dysmenorrhea affecting life	61 (82.4)
Nonmenstrual pelvic pain	48 (64.9)
Dyschezia	42 (56.8)
Sexually active currently	54 (73.0)
Dyspareunia	40 (54.1)
Fertility an issue	43 (58.1)
Infertility >12 months	24 (32.4)
Previous hormonal treatment (OCP <i>n</i> =28; GnRH <i>n</i> =11; progesterone=8)	36 (48.6)
Previous surgical treatment	24 (32.4)
Endometrioma excision	7 (9.5)
Previous laparoscopy	61 (82.4)
Number of laparoscopies, median (IQR); range	1 (1–2); 1–10
Primary indication for surgery	
Pain	49 (66.2)
Infertility	7 (9.5)
Endometrioma	6 (8.1)
Unknown	12 (16.2)
Symptoms present	
Pain	60 (81.1)
Infertility	24 (32.4)
Endometrioma	21 (28.4)
Preoperative investigations	
Barium enema	34 (45.9)
IVP	29 (39.2)
MRI	3 (4.1)
AFS score, median (IQR); range	35 (7–54); 1–118
Stage I (minimal)	10 (13.5)
Stage II (mild)	11 (14.9)
Stage III (moderate)	19 (25.7)
Stage IV (severe)	26 (35.1)
Unknown	8 (10.8)
Intraoperative findings	
Age at operation (years), mean (SD)	30.5 (6.1)
Entry technique	
Closed (Veress)	55 (74.3)
Open (Hasson)	6 (8.1)
Subcostal (Palmer's point)	1 (1.4)
VisiPort	1 (1.4)
Unknown	11 (14.9)
5 mm suprapubic ports	
1	3 (4.1)
2 or more	60 (81.1)
10 mm suprapubic ports	
1	59 (79.7)
2 or more	1 (1.4)
Endometriosis involved	
Ovaries	41 (55.4)
Fallopian tubes	15 (20.3)

Contd...

Table 1: Contd...

Participant history and preoperative symptoms	<i>n</i> (%)
Pouch of Douglas	52 (70.3)
Ureter	7 (9.5)
Bowel	35 (47.3)
Bladder	7 (9.5)
Procedure performed	
Resection endometriosis	54 (73.0)
Ureterolysis	36 (48.6)
Bowel dissection	34 (45.9)
Stripping of endometrioma (s)	23 (31.1)
Ablation of endometrioma (s)	7 (9.5)
Cystoscopy	14 (18.9)
Operative time (min), median (IQR); range	105 (75–150); 2–270
Blood loss (mL), median (IQR); range	200 (100–400); 0–2000
Hospital stay (days), median (IQR); range	2 (1–3); 1–10

Data represent *n* (%) unless otherwise stated. Percentages may not sum to 100% due to missing data. OCP: Oral contraceptive pill, GnRH: Gonadotropin-releasing hormone, IVP: Intravenous pyelogram, MRI: Magnetic resonance imaging, AFS: American Fertility Society, IQR: Interquartile range, SD: Standard deviation

Resection of peritoneal endometriosis was performed in 73% (*n* = 54). Ureterolysis and bowel dissection were required in 49% (*n* = 36) and 46% (*n* = 34) of patients, respectively [Table 1]. Stripping and ablation of endometrioma(s) were performed in 31% and 10% of patients, respectively. Cystoscopy at the end of surgery was performed in 19% of patients (*n* = 14). The median operative time was 105 min (IQR: 75–150, R: 2–270 min). No antiadhesion barriers were used, as they were unlicensed in the state of Western Australia at the time. One patient who underwent a bowel resection recorded a 2 L intraoperative estimated blood loss and required a blood transfusion. There were no major postoperative complications. The median length of hospital stay was 2 days (IQR: 1–3, R: 1–10 days). There were seven patients who remained in the hospital for longer than 4 days, all of whom had multiple endometriosis sites treated during surgery. One patient stayed for 8 days (large intraoperative blood loss) and another for 10 days, both of whom had bowel resections performed during surgery [Table 1].

Baseline scores and population norms for quality of life outcomes

Preoperatively, the mean EQ-5D Health State Score and Global Health Score were approximately 1 and 2 SDs below the population norms, respectively. The SF-12 physical and mental well-being component scores were approximately 0.5 and 1 SD below the population means, respectively.

Table 2 shows summaries of baseline QOL, pain, and sexual activity scores for the cohort of patients alongside population norms and ranges [Table 2].

Table 2: Population norms and sample cohort baseline scores for quality of life outcomes

	Population norm, mean (SD); score range	Sample Cohort baseline score, mean (SD); range
EQ-5D		
Global Health Score	78.23 (17.35) ^a ; 0–100	60 (21.4); 5–95
Health State Score	0.90 (0.14) ^a ; <0–1	0.64 (0.30); –0.38–1
SF-12		
Physical component	50 (10) ^b ; 0–100	44 (9.7); 22–67
Mental component	50 (10) ^b ; 0–100	40 (10.7); 17–64
	Population norm (score range)	Sample Cohort baseline score, median (IQR); range
VAS pain scores		
Period pain	0–10	8 (7–9); 3–10
Pelvic pain	0–10	5 (3–8); 0–10
Dyschezia	0–10	5 (2–7); 0–10
Dyspareunia	0–10	5 (3–7); 0–10
Sexual activity		
Pleasure	0–18	12 (9–15); 2–18
Discomfort	0–6	4 (2–5); 0–6
Frequency	0–3	1 (0–1); 0–3

^aEQ-5D global health and health state scores for females.^[6] ^bPhysical and mental well-being component composite scores were designed so that a representative sample of the US population would have a mean score of 50 and a SD of 10.^[19,20] QOL: Quality of life, EQ-5D: Euro QOL questionnaire, SF-12: Short Form-12 Questionnaire, VAS: Visual Analog Scale, SD: Standard deviation, IQR: Interquartile range

Quality of life outcomes

Euro Quality of Life Global Health Score

Overall, 63.0% of patients improved their health scores from baseline to the most recent follow-up. In univariate analysis, improvement in Global Health Score from baseline was observed for 1–5 years postoperatively [Table 3].

In adjusted analysis, an improvement from baseline in the health score for up to 10 years after surgery was observed in patients who had lower preoperative scores. Adjusted mean improvement in scores ranged from 34 to 47 at each time point up to 10 years compared with baseline ($P < 0.007$), whereas patients with higher preoperative scores did not significantly change over the follow-up period. Other influential characteristics included age at menarche ($P = 0.004$), with earlier menarche correlating with lower scores, and repeat surgery before 10 years following primary surgery ($P = 0.024$) correlated with lower health scores. All other factors assessed were not statistically significant ($P > 0.05$). A very wide variation in scores at 120+ months was observed.

Euro Quality of Life Health State Index Score

Overall, 57.5% of patients improved their health state scores from baseline to the most recent follow-up. Univariately, an

improvement in health state scores was observed 1–2 years after surgery ($P < 0.001$) but not at any other time point [Table 3]. In adjusted analysis, improvement from baseline health state scores from 1 to 2 years after surgery was observed in patients who had lower preoperative scores (mean improvement = 0.34, 95% CI = 0.04–0.63, and $P = 0.014$), whereas patients with higher preoperative scores did not significantly change over the follow-up period. Other influential characteristics included age at menarche ($P = 0.029$), with earlier menarche correlating with lower scores. All other factors assessed were not statistically significant ($P > 0.05$).

Short Form-12 questionnaire

Overall, 63% of patients improved their physical and/or mental scores from baseline to the most recent follow-up. Thirty-two patients (45%) improved on both physical and mental components. There was physical improvement observed at 6–11 months (mean = 6.1 months, $P < 0.001$); however, no other improvement was observed over any period. No improvement in mental well-being was observed at any time point [Table 3]. No improvement from baseline was observed in the physical or mental components of the SF-12 at any follow-up time in the adjusted analysis.

Table 4 pre- and postoperative comparisons of Euro QOL global health scores, health state index scores, and SF-12 physical and mental components at each follow-up time point.

Visual Analog Scale pain scores

There was an overall improvement from preoperative scores to the most recent follow-up for menstrual pain (79.2% improved, median improvement 3, $P < 0.001$, $n = 72$), noncyclical pelvic pain (64.4% improved, median improvement 2, $P < 0.001$, $n = 73$), dyschezia (63.9% improved, median improvement 2, $P < 0.001$, $n = 72$), and dyspareunia (65.6% improved, median improvement 1, $P = 0.002$, $n = 64$ pairs).

In univariate analysis, there was an improvement in menstrual pain (all follow-up times), pelvic pain (up to 10 years), dyschezia (up to 2 years postsurgery and 10 + years), and dyspareunia (6 months–2 years) [Table 4].

Table 4 pre- and postoperative comparisons of period pain, pelvic pain, dyschezia, and dyspareunia scores at each follow-up time point.

Sexual Activity Questionnaire

Comparisons between baseline and follow-up time points for composite components of the SAQ among sexually active patients are presented in Table 2. There was a significant reduction in discomfort 1–2 years after primary surgery among sexually active patients ($n = 23$, pre- vs. postmedian score 4 vs. 2, $P = 0.005$). No significant changes in the pleasure or frequency components of the questionnaire were found.

Table 3: Pre- and postoperative comparisons of Euro quality of life global health scores, health state index scores, and SF-12 physical and mental components at each follow-up time point

	<i>n</i>	Preoperative score, mean (SD)	Postoperative score mean, (SD)	Difference ^a mean (95% CI)	<i>P</i> ^b
Global Health Score					
3–5 months	27	55 (21.2)	67 (20.2)	11.8 (1.1–22.5)	0.032
6–11 months	35	64 (18.4)	74 (15.0)	10.7 (2.7–18.7)	0.010
1–2 years	36	59 (21.3)	74 (19.3)	14.9 (7.8–22.1)	<0.001
2–5	41	59 (22.5)	73 (16.5)	14.5 (6.9–22.1)	<0.001
5–10 years	15	64 (20.1)	72 (12.4)	8.2 (–0.8–17.2)	0.072
10+ years	31	60 (18.8)	66 (16.9)	5.3 (–1.5–12.0)	0.122
Health State Index Score					
3–5 months	26	0.59 (0.35)	0.76 (0.30)	0.17 (0.02–0.32)	0.032
6–11 months	34	0.69 (0.29)	0.75 (0.27)	0.06 (–0.07–0.18)	0.342
1–2 years	36	0.59 (0.33)	0.81 (0.21)	0.22 (0.11–0.33)	<0.001
2–5	41	0.65 (0.29)	0.75 (0.27)	0.11 (0.01–0.21)	0.039
5–10 years	15	0.63 (0.36)	0.85 (0.13)	0.22 (0.02–0.42)	0.034
10+ years	31	0.68 (0.31)	0.67 (0.33)	–0.01 (–0.12–0.10)	0.867
SF-12 physical					
3–5 months	25	42 (9.9)	47 (9.7)	5.4 (–0.4–11.2)	0.068
6–11 months	36	45 (8.4)	51 (8.5)	6.1 (3.2–9.0)	<0.001
1–2 years	34	46 (8.1)	47 (10.1)	1.6 (–2.9–6.1)	0.470
2–5	38	43 (10.3)	46 (10.5)	2.9 (–1.6–7.3)	0.196
5–10 years	15	45 (8.8)	46 (10.4)	0.7 (–5.9–7.2)	0.833
10+ years	31	44 (9.1)	47 (8.8)	2.7 (–2.0–7.4)	0.256
SF-12 mental					
3–5 months	25	39 (10.5)	47 (10.6)	7.7 (1.0–14.5)	0.027
6–11 months	36	39 (11.3)	44 (12.5)	4.1 (–1.5–9.7)	0.144
1–2 years	34	41 (11.0)	44 (12.2)	2.8 (–3.6–9.1)	0.383
2–5	38	40 (9.5)	44 (10.6)	3.8 (–0.9–8.4)	0.107
5–10 years	15	38 (11.6)	45 (12.6)	6.8 (–3.6–17.3)	0.184
10+ years	31	42 (11.4)	44 (10.0)	1.6 (–3.9–7.2)	0.552

^aNegative score difference means the condition has worsened since baseline, ^b*P* values represent comparisons between pre- and postoperative scores using paired *t*-tests. *P*<0.007 is statistically significant when the Bonferroni correction is applied. SF-12: Short Form-12 Questionnaire, SD: Standard deviation, CI: Confidence interval

Repeat surgery

Thirty-six percent (*n* = 27) of women required repeat surgery for recurrence of endometriosis following their primary surgery. At the 10 or more years follow-up time period, 9 women had undergone total hysterectomies (6 laparoscopically, 3 open) since their primary surgery. Other surgeries performed at the 10 or more years follow-up on 20/32 women (62.5%) were laparoscopic removal of endometriosis (*n* = 12), endometrioma (*n* = 7), ovaries (*n* = 4), and pelvic clearance (*n* = 4). Open surgeries included removal of endometriosis (*n* = 2), ovaries (*n* = 5), ovarian cyst (*n* = 2), bowel surgery (*n* = 6), and pelvic clearance (*n* = 1).

AFS Stage IV at primary surgery was not associated with repeat surgery for endometriosis (30.8% vs. 25.0%, *P* = 0.607).

Fertility

A total of 35 patients expressed a desire to get pregnant including 25 who expressed this desire at the time of recruitment. At the time of the most recent follow-up, 27 of 74 patients (36.5%) had been pregnant at some time

after primary surgery. Of patients expressing a desire to become pregnant, 77.1% (*n* = 27) achieved a successful pregnancy either naturally (*n* = 19) or with *in-vitro* fertilisation (IVF) (*n* = 8). Data on the timing of pregnancies and/or repeat surgeries if they were performed were incomplete.

DISCUSSION

Limited studies have highlighted the long-term impact of endometriosis from a holistic perspective of the patient as she moves through her reproductive years. This QOL study has the longest follow-up time frame following RLEE in an Australian population, with comprehensive outcome measures encapsulating a women's overall health, including physical, mental, and social health. Patients who had lower baseline QOL health scores showed a significant improvement following surgery up to 10-year follow-up. There was statistically significant improvement in physical symptoms, including menstrual pain, noncyclical pelvic pain, dyschezia, and

Table 4: Pre- and postoperative comparisons of period pain, pelvic pain, dyschezia and dyspareunia scores at each follow-up time point

	<i>n</i>	Preoperative score median (Q1–Q3); minimum–maximum	Postoperative score median (Q1–Q3); minimum–maximum	Difference ^a median (Q1–Q3); minimum–maximum	<i>n</i> (%) improved	<i>P</i> ^b
Period						
3–5 months	26	8 (7–9); 4–10	6 (4–7); 2–10	2 (0–4); –0.5–7	19 (73.1)	<0.001
6–11 months	34	8 (7–9); 4–10	6 (3–7); 0–10	2 (1–4); –2–9	27 (79.4)	<0.001
1–2 years	33	8 (7–9); 3–10	4 (3–7); 0–10	3 (1–6); –3–8	28 (84.8)	<0.001
2–5 years	38	8 (7–9); 3–10	4 (3–8); 0–10	3 (0–6); –2–10	28 (73.7)	<0.001
5–10 years	14	8 (6–10); 5–10	5 (3–8); 0–9	3 (1–5); –1–8	12 (85.7)	0.003
10+ years	30	8 (7–9); 5–10	2 (0–6); 0–9	6 (1–8); –1–10	24 (80.0)	<0.001
Pelvic						
3–5 months	27	5 (3–8); 1–8	2 (0–6); 0–10	1 (0–3); –4–7	19 (70.4)	0.002
6–11 months	35	6 (4–8); 0–10	2 (1–7); 0–9	2 (–1–4); –4–9	25 (71.4)	<0.001
1–2 years	36	5 (4–8); 0–10	2 (0–4); 0–9	2 (1–5); –3–10	31 (86.1)	<0.001
2–5 years	41	5 (4–7); 0–9	3 (0–6); 0–10	2 (0–4); –8–9	29 (70.7)	<0.001
5–10 years	15	6 (2–8); 0–8	2 (1–4); 0–8	2 (0–5); –2–8	11 (73.3)	0.005
10+ years	31	5 (3–7); 1–10	3 (0–6); 0–8	2 (–1–4); –6–10	17 (54.8)	0.013
Dyschezia						
3–5 months	26	6 (2–8); 0–10	1 (0–3); 0–9	3 (0–5); –4–10	18 (69.2)	0.001
6–11 months	35	5 (2–8); 0–10	1 (0–4); 0–10	2 (0–5); –4–10	25 (71.4)	<0.001
1–2 years	36	5 (2–7); 0–10	1 (0–3); 0–8	3 (0–5); –3–10	27 (75.0)	<0.001
2–5 years	40	4 (2–7); 0–10	2 (0–6); 0–10	2 (–1–4); –7–10	23 (57.5)	0.024
5–10 years	15	7 (5–7); 0–10	3 (2–4); 0–7	3 (–2–7); –3–9	11 (73.3)	0.027
10+ years	30	5 (3–7); 0–10	1 (0–3); 0–7	3 (0–5); –4–10	20 (66.7)	<0.001
Dyspareunia						
3–5 months	22	3 (1–8); 0–10	3 (1–5); 0–10	1 (0–3); –6–8	12 (54.5)	0.048
6–11 months	33	6 (3–7); 0–10	3 (1–7); 0–10	1 (0–4); –4–9	22 (66.7)	0.007
1–2 years	30	4 (2–7); 0–9	2 (0–4); 0–9	1 (0–5); –4–7	21 (70.0)	0.008
2–5 years	32	4 (3–7); 0–9	4 (1–7); 0–9	1 (–2–3); –5–8	17 (53.1)	0.108
5–10 years	13	5 (1–6); 0–10	4 (2–7); 0–8	2 (0–3); –7–4	9 (69.2)	0.075
10+ years	27	5 (3–7); 0–9	3 (0–5); 0–8	1 (–1–4); –5–6	17 (63.0)	0.044

^aNegative score difference means the condition has worsened since baseline, ^b*P* values represent comparisons between pre- and postoperative scores using Wilcoxon signed-rank tests. *P*<0.007 are statistically significant when the Bonferroni correction is applied

dyspareunia; however, there was no improvement evident in mental health scores in this study.

Notably, we have demonstrated significant improvement in QOL parameters and symptom control following RLEE, which is consistent with previous similar studies.^[3,8,9] Garry *et al.*^[8] assessed comparable outcome measures on quality of life and symptomatology with results and conclusions showing significant improvement in RLEE with acceptable morbidity associated with surgery. However, this was in a smaller sample size (57 patients) with only a short follow-up time of 4 months.^[8] Similarly, Abbott *et al.*^[9] showed comparable results in a sample size of 135 with follow-up of 2–5 years. Dubernard *et al.*^[3] also looked at QOL parameters following surgical management of endometriosis and showed positive outcomes; however, this study had a more directed focus with the study population only including patients who had colorectal resection for bowel involvement of endometriosis. Similarly, Tarjanne *et al.* also showed improvement in pain scores following radical excision of rectovaginal endometriosis specifically.^[10]

Few studies have investigated the reoperation rate following RLEE as the index surgical treatment for the condition.^[11,12] The figures quoted in the literature for the reoperation rate are inconsistent with large variability, from as low as 5% to as high as 51%, likely as a result of the differences in research methods and follow-up duration of each of the studies.^[9,13,14] In the present study, the reoperation rate was calculated at 36%, which appears lower than that of comparable studies. Patients lost to follow-up who may have had repeat surgery elsewhere may account for this lower rate. Supplementary treatment with hormonal suppression has also not been taken into account. Cheong *et al.*^[13] quoted a reoperation rate of 51%, which was demonstrated through a retrospective observational study for 10 years. The primary influencing factors for reoperation were age and fertility, followed by improvement of symptoms. Shakiba *et al.*^[12] showed a high reoperation rate specifically for patients who underwent wide local excision of endometriosis as their index surgery. In comparison, hysterectomy was associated with a significantly lower reoperation rate.

A large proportion of patients who expressed a desire to fall pregnancy achieved this (77%). Of those, 70% ($n = 19$) conceived spontaneously and 30% ($n = 8$) with IVF assistance. Stepniewska *et al.*^[15] demonstrated significant improvement in spontaneous conception rates following laparoscopic segmental bowel resection in a population of patients with colorectal endometriosis and subfertility. Cumulative pregnancy rates were 58% in women <30 years of age and 45% in women aged 30–34 years. Yu *et al.*^[16] showed no associations among the bilaterality of ovarian endometriomas, ovarian reserve, and pregnancy outcomes in IVF/intracytoplasmic sperm injection cycles; however, some studies have shown impaired ovarian reserve.^[17] Furthermore, Fujii *et al.*^[18] demonstrated that patients with Stage III/IV endometriosis who underwent conservative laparoscopic surgery had a postoperative pregnancy rate of 70% ($n = 28$), with 24 (85.7%) conceiving through nonassisted reproductive technology interventions. Improved fertility outcomes are likely a result of restoration of pelvic anatomy, reduction in symptoms including dyspareunia resulting in increased sexual activity, and reduction in proinflammatory markers in the pelvis postsurgery. In addition, restoration in pelvic anatomy will make ovaries more accessible and therefore aid in the success of egg retrieval in circumstances of IVF. It could be hypothesized that results in fertility outcomes following RLEE could be similar to that following bowel resection as shown by Stepniewska *et al.*^[15]; however, further research into this is required.

There are several limitations of this study. First, many of the patients in the initial study group had a prior diagnosis of endometriosis from diagnostic ultrasound and/or laparoscopy, or previous surgical treatment, therefore, resulting in recruitment bias. The nature of prior surgery may have also influenced the outcomes of the index surgery of this study.

Postsurgical follow-up time frames were extremely variable in this study, ranging from 3 months to 17 years, making the data heterogeneous and statistically difficult to analyze. Subsequently, the follow-up response rate to questionnaires was also reduced, from 82% initially to 43% for follow-up. Nonetheless, this is a reasonable figure given many patients from the follow-up group of >10 years having potentially moved address permanently without informing the hospital of a forwarding address. Some of these underwent subsequent surgeries in other hospitals interstate, and therefore, details of these were unavailable.

As this was an observational study, there was no power calculation in this study to quantify the statistical significance of the results. While this study used a variety of instruments for QOL assessment, a disease-specific questionnaire would have strengthened the quality of data generated.

CONCLUSIONS

This study has concluded that radical laparoscopic radical excision of endometriosis significantly improves global health scores, with this improvement lasting up to 10 years following index surgery. It is, therefore, a viable and accepted treatment option for the management of endometriosis with results showing success in improving the impact of symptoms and the QOL of women living with the condition. This study has also suggested that this management option has the capability of improving fertility outcomes in women with endometriosis who are family planning.

Future research should be focused on identifying specific population groups in who are likely to derive maximum benefit from this type of surgical management of endometriosis – whether that be with aims of achieving a successful pregnancy or improving overall physical, mental, and social health in the long-term, and ultimately reducing the burden of disease on an individual, national, and global level.

The results of this study are important and relevant for both primary care and specialist physicians who manage patients with endometriosis. Counseling of management options should include consideration of early referral to a laparoscopic gynecological surgeon for these patients who may benefit from radical laparoscopic excision. With tailored treatment, which may include radical laparoscopic excision, we are contributing to improving QOL outcomes in women living with endometriosis.

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Author contributions

RM contributed to the analysis and interpretation of the data of the follow up cohort study and authored the follow up cohort study manuscript and the revision and final approval of the same. JG helped in acquisition of data, contributed to the data analysis, interpretation and revision of the manuscript of the follow up cohort study. EN helped in the analysis and interpretation of the follow up cohort study DD helped in conception and design, analysis and interpretation of both the initial prospective study and the follow up cohort study KM helped in conception and design, acquisition of data, analysis and interpretation of the data of the initial prospective study

and contributed to the final approval of the manuscript for the follow up cohort study. EW contributed to the writing and revision of the final manuscript. KK, BM, RG and RH conceived and designed the analysis conception of the prospective study and the revision and final approval of the follow up cohort manuscript. All authors have read and agreed to the final version of the manuscript.

Data availability statement

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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Conflicts of interest

There are no conflicts of interest.

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