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Research Article

Long-Term Follow-Up of laparoscopic myomectomy for polycystic ovary syndrome

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Abstract

Background: Polycystic ovary syndrome (PCOS) and uterine fibroids frequently coexist, combining mechanical bleeding symptoms with anovulatory infertility. Long-term outcomes of laparoscopic myomectomy in this specific population are rarely reported.

Methods: We retrospectively followed 118 women with Rotterdam-criteria PCOS who underwent laparoscopic myomectomy for FIGO type 2-6 myomas, over a median of 61 months, tracking menstrual cyclicity, LH:FSH ratio, testosterone, fibroid recurrence, and pregnancy rate among 74 women attempting conception.

Results: Regular cycles rose from 26.3% to 74.6% at 24 months ($p<0.001$); LH:FSH ratio and testosterone fell significantly. Cumulative pregnancy rate reached 66% by 36 months. Five-year fibroid recurrence was 18.6%, rising with FIGO type. Grade ≥II complications occurred in 7.6%.

Conclusion: Laparoscopic myomectomy produced durable menstrual and modest endocrine improvement alongside acceptable fertility and recurrence outcomes in women with PCOS, supporting its use alongside concurrent management of the ovulatory disorder.

Keywords: Polycystic ovary syndrome; Laparoscopic myomectomy; Uterine fibroids; Infertility; Long-term follow-up

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1. Introduction

Polycystic ovary syndrome (PCOS) affects a substantial proportion of reproductive-age women and is defined, under the widely adopted Rotterdam criteria, by oligo-anovulation, clinical or biochemical hyperandrogenism, and polycystic ovarian morphology on ultrasound, with any two of the three sufficient for diagnosis [1]. Population-based surveys using these criteria have reported prevalence figures in the range of 6-10% of women of reproductive age, making PCOS the most common endocrine disorder encountered in gynecologic practice [2]. The underlying pathophysiology centers on insulin resistance and compensatory hyperinsulinemia, which drive ovarian and adrenal androgen excess and, in turn, disrupt normal follicular development and menstrual cyclicity [3]. Beyond its reproductive consequences, PCOS carries long-term metabolic risk, including type 2 diabetes and adverse cardiovascular risk markers, which has made durable, low-morbidity management strategies a priority for both endocrinologists and gynecologic surgeons [4,5].

Uterine leiomyomas (fibroids) are similarly common, with cumulative incidence estimates by age 50 exceeding 70% in some populations, and they are a frequent indication for gynecologic surgery independent of any coexisting endocrine disorder [6,7,8]. Population surveys of chronic gynecologic conditions have consistently placed fibroids among the leading reasons for hysterectomy and myomectomy referral [9], and their clinical presentation, driven largely by location and size rather than by number alone, has been well characterized in prior reviews of etiology and symptomatology [10,11]. PCOS itself remains under-recognized in general gynecologic practice despite its prevalence and its well-described epidemiology and diagnostic pathway [12]. When fibroids and PCOS coexist, as they not infrequently do given the overlapping reproductive age window and the effect of chronic anovulation and unopposed estrogen exposure on myometrial proliferation, patients present with a combined symptom burden of abnormal uterine bleeding, pelvic bulk symptoms, and infertility that is more difficult to manage than either condition alone. The FIGO classification system has standardized how submucosal, intramural, and subserosal myomas are described and has become the reference framework for correlating fibroid location with bleeding pattern and fertility impact [13].

Laparoscopic myomectomy has largely supplanted laparotomy for symptomatic myomas amenable to a minimally invasive approach, on the strength of randomized and cohort evidence showing shorter hospital stay, less blood loss, and faster recovery without a meaningful fertility penalty when performed by experienced surgeons [14,15]. Multicenter series have also characterized its complication profile in detail, providing benchmarks against which individual practices and case series can be judged [16]. Historically, ovarian pathology in PCOS was itself addressed surgically, first by wedge resection and later by laparoscopic ovarian drilling, both of which restore ovulation in a substantial subset of clomiphene-resistant patients [17,18]. What has been reported far less often is the combined long-term trajectory of women with PCOS who undergo laparoscopic myomectomy for symptomatic fibroids, in whom both mechanical and endocrine contributors to abnormal bleeding, pain, and subfertility must be addressed and followed together. This study reports a single-center, long-term follow-up cohort of such patients, describing menstrual, hormonal, fertility, and fibroid-recurrence outcomes over a median follow-up exceeding five years.

2. Materials and Methods

This retrospective cohort study was conducted at a tertiary gynecologic surgery unit and included women aged 18-42 years who met Rotterdam criteria for PCOS [1] and underwent laparoscopic myomectomy for symptomatic FIGO type 2-6 leiomyomas between January

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2013 and December 2018 [13]. Women with malignancy on preoperative imaging, prior open myomectomy, or fewer than 24 months of postoperative follow-up were excluded. Diagnosis of PCOS was confirmed using clinical hyperandrogenism (modified Ferriman-Gallwey score), biochemical hyperandrogenism (total testosterone), oligo- or anovulation by menstrual history, and transvaginal ultrasound criteria for polycystic ovarian morphology, consistent with current Endocrine Society and international evidence-based guideline definitions [19,20].

Table 1: Baseline demographic, endocrine, and fibroid characteristics of 118 women with polycystic ovary syndrome undergoing laparoscopic myomectomy, classified by FIGO type [13,19].

Characteristic	Value
Age, years (mean ± SD)	29.4 ± 4.6
Body mass index, kg/m (mean ± SD)	27.1 ± 4.3
Nulliparous, n (%)	79 (66.9)
FIGO type 2, n (%)	21 (17.8)
FIGO type 3, n (%)	34 (28.8)
FIGO type 4, n (%)	39 (33.1)
FIGO type 5-6, n (%)	24 (20.3)
Concurrent ovarian drilling, n (%)	42 (35.6)
Baseline LH:FSH ratio (mean ± SD)	2.6 ± 0.8
Baseline total testosterone, ng/dL (mean ± SD)	68 ± 19

All procedures were performed laparoscopically using a standardized enucleation technique with vasopressin-assisted hemostasis and barbed-suture myometrial closure; specimens were removed by contained in-bag morcellation following the 2014 regulatory guidance on power morcellation risk [21]. Baseline data collected included age, body mass index (BMI), parity, Ferriman-Gallwey score, luteinizing hormone-to-follicle-stimulating hormone (LH:FSH) ratio, total testosterone, anti-Müllerian hormone (AMH), fibroid number, dominant fibroid diameter, and FIGO type. Concurrent laparoscopic ovarian drilling was performed at the operating surgeon's discretion in women with clomiphene-resistant anovulatory infertility, informed by prior evidence on its ovulation-restoring effect [17,22].

Patients were followed postoperatively at 3, 6, 12, 24, and then annually to a median of 61 months (range 24-96). Menstrual cyclicity was recorded as regular (21-35 days) or irregular at each visit. Hormonal parameters were repeated at 6 and 24 months. Transvaginal ultrasound was performed annually to detect fibroid recurrence, defined as any new myoma >1 cm on ultrasound not present on the 6-month postoperative scan, consistent with recurrence definitions used in prior long-term myomectomy cohorts [23,24]. Among women actively attempting conception postoperatively, cumulative pregnancy rate was tracked at 12, 24, and 36 months. Surgical complications were graded using the Clavien-Dindo system. Continuous variables are reported as mean ± standard deviation and compared using paired t-tests for within-patient change; categorical variables are reported as proportions and compared using chi-square tests, with $p<0.05$ considered significant. Institutional review board approval and written informed consent were obtained for all participants.

3. Results

A total of 118 women met inclusion criteria, with a mean age of 29.4 ± 4.6 years and mean baseline BMI of 27.1 ± 4.3 kg/m . Fibroid distribution by FIGO type was: type 2, n=21 (17.8%); type 3, n=34 (28.8%); type 4, n=39 (33.1%); type 5-6, n=24 (20.3%), broadly reflecting the case mix reported in prior laparoscopic myomectomy series [14,16]. Concurrent laparoscopic ovarian drilling was performed in 42 patients (35.6%) with clomiphene-resistant anovulatory infertility. Mean operative time was 96 ± 28 minutes and mean estimated blood loss was 185 ± 110 mL. Clavien-Dindo grade ≥II complications occurred in 9 patients (7.6%), within the range reported by the largest published multicenter series of laparoscopic myomectomy complications [16].

Menstrual cyclicity improved substantially over follow-up: 31 of 118 women (26.3%) reported regular cycles preoperatively, rising to 88 of 118 (74.6%) at 24 months

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(p<0.001) and remaining at 81.4% at the final follow-up visit. Mean LH:FSH ratio fell from 2.6 ± 0.8 preoperatively to 1.7 ± 0.6 at 24 months (p<0.001), and mean total testosterone fell from 68 ± 19 ng/dL to 49 ± 15 ng/dL over the same interval (p<0.001), a pattern consistent with the modest endocrine improvement previously attributed to reduced myometrial and adnexal mass effect and, in the subgroup with concurrent drilling, to the established ovulatory effect of laparoscopic ovarian diathermy [17,22]. Mean AMH declined slightly from 6.8 ± 2.9 ng/mL to 6.1 ± 2.7 ng/mL at 24 months (p=0.04), a change too small to be clinically attributable to ovarian reserve injury and more plausibly reflecting the drilling subgroup and normal age-related decline.

Fertility outcomes

Among the 74 women actively attempting conception postoperatively, cumulative pregnancy rates were 38% at 12 months, 57% at 24 months, and 66% at 36 months (Figure 1), figures broadly comparable to fertility outcomes reported after laparoscopic myomectomy in non-PCOS infertile cohorts [25,14] and to combined myomectomy-with-drilling outcomes in prior small series [22].

Fibroid recurrence and long-term outcome summary

Ultrasound-detected fibroid recurrence occurred in 22 of 118 women (18.6%) by 5 years, with recurrence rates rising by FIGO type from type 2 (9.5%) to type 5-6 (33.3%), a gradient consistent with previously reported determinants of leiomyoma recurrence after myomectomy [23,24]. Baseline and 24-month outcome summaries are presented in Table 1 and Table 2.

4. Discussion

This long-term cohort demonstrates that laparoscopic myomectomy in women with coexisting PCOS produces durable improvement in menstrual regularity and modest but statistically significant improvement in androgen and gonadotropin profile, alongside a fibroid recurrence rate and complication profile consistent with laparoscopic myomectomy series performed in women without PCOS [14,16,24]. The magnitude of hormonal change observed here is smaller than that typically reported after laparoscopic ovarian drilling alone [17,18] or after first-line medical therapy with metformin or clomiphene [26,27], which is expected: myomectomy addresses mechanical and bleeding-related symptoms directly, while its endocrine effect is likely secondary to reduced pelvic mass burden and, in roughly a third of this cohort, to concurrent ovarian drilling rather than to myoma removal itself.

Table 2: Perioperative and 24-month outcome summary for the laparoscopic myomectomy cohort (n=118), median follow-up 61 months.

Outcome	Preoperative	24 months	p-value
Regular menstrual cycles, n (%)	31 (26.3)	88 (74.6)	<0.001
LH:FSH ratio (mean ± SD)	2.6 ± 0.8	1.7 ± 0.6	<0.001
Total testosterone, ng/dL (mean ± SD)	68 ± 19	49 ± 15	<0.001
AMH, ng/mL (mean ± SD)	6.8 ± 2.9	6.1 ± 2.7	0.04
Clavien-Dindo grade ≥II complication, n (%)	--	9 (7.6)	--

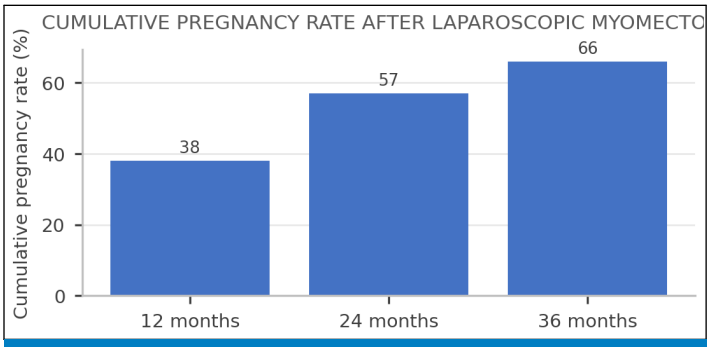

Figure 1: Cumulative pregnancy rate among 74 women with polycystic ovary syndrome attempting conception after laparoscopic myomectomy, at 12, 24, and 36 months of follow-up, comparable to fertility outcomes reported after laparoscopic myomectomy in infertile cohorts generally [25,14].

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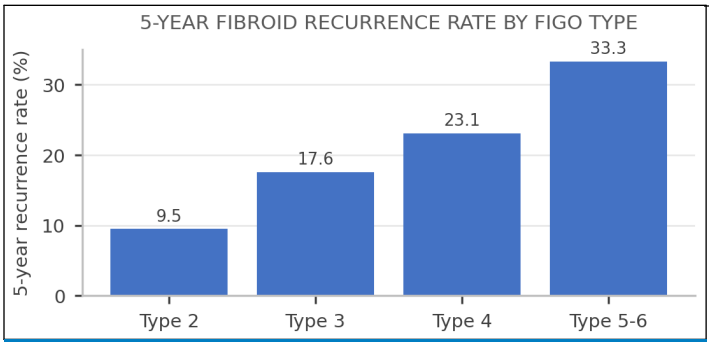

Figure 2: Five-year ultrasound-detected fibroid recurrence rate by FIGO myoma type, rising from 9.5% in type 2 disease to 33.3% in type 5-6 disease, a gradient consistent with prior determinants of recurrence after myomectomy [23,24].

The pregnancy outcomes observed, a cumulative rate of 66% by 36 months among women actively attempting conception, sit within the range reported for laparoscopic myomectomy in infertile populations generally [25,28] and support current guidance that myomectomy is a reasonable fertility-directed intervention when submucosal or cavity-distorting myomas are present [29]. They are also consistent with reports that combining myomectomy with ovarian drilling or with standard ovulation-induction agents such as letrozole can produce meaningful pregnancy rates in PCOS-associated infertility even when both mechanical and anovulatory factors coexist [30,31]. The recurrence gradient by FIGO type reproduces a pattern seen in earlier myomectomy cohorts, in which higher-burden, more numerous or larger intramural and subserosal disease predicts recurrence more strongly than any patient-level hormonal variable [23,24], suggesting that fibroid biology rather than PCOS status is the dominant driver of recurrence risk in this population.

Technique-related factors also merit discussion. All procedures in this cohort were performed with conventional laparoscopic instrumentation; robot-assisted platforms have been proposed as an alternative for deep intramural myomas and may reduce surgeon fatigue during prolonged suturing, though comparative long-term outcome data remain limited [32]. Randomized comparisons of laparoscopic against minilaparotomic myomectomy have likewise reported comparable reproductive outcomes between approaches, reinforcing that route of access, once mastered, is less consequential to fertility than case selection and surgical completeness [33,34].

Several limitations merit comment. This is a single-center retrospective cohort without a non-PCOS comparator arm, which precludes directly attributing the observed hormonal and menstrual improvement to the surgery itself rather than to the roughly one-third of patients who also underwent ovarian drilling, and unmeasured confounding by weight change or medical therapy started during follow-up cannot be excluded. The absence of a control group also limits causal inference relative to the natural fluctuation described in some PCOS cohorts [35]. Ultrasound-based recurrence detection, while consistent with prior methodology [23], is less sensitive than MRI for small myomas, so the true recurrence incidence may be modestly underestimated. Strengths include a well-characterized PCOS cohort using contemporary consensus diagnostic criteria [19,20], a long median follow-up exceeding five years, and a complication rate consistent with the largest published benchmark series [16], all of which support the generalizability of these findings to comparable tertiary surgical practice.

5. Conclusion

In this long-term follow-up cohort, laparoscopic myomectomy in women with coexisting polycystic ovary syndrome was associated with durable improvement in menstrual cyclicity, modest reduction in LH:FSH ratio and total testosterone, a cumulative pregnancy rate of 66% by 36 months among women attempting conception, and a fibroid recurrence rate that tracked FIGO type rather than PCOS-specific parameters. Complication rates were consistent with published multicenter benchmarks for laparoscopic myomectomy. These findings support laparoscopic myomectomy as an effective and durable option in this combined patient population, while

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underscoring that concurrent management of the underlying ovulatory disorder, whether by drilling or medical therapy, remains an important adjunct to fibroid removal rather than a redundant step, and that prospective controlled studies are needed to separate the surgical and endocrine contributions to the improvement observed here [20,31].

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