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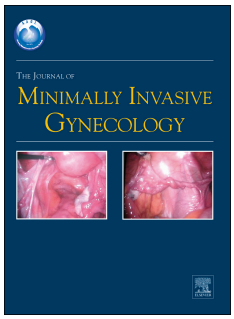

Laparoscopic myomectomy: A single centre retrospective review of 514 patients

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PII: S1553-4650(17)30042-0

DOI: 10.1016/j.jmig.2017.01.008

Reference: JMIG 3041

To appear in: *The Journal of Minimally Invasive Gynecology*

Received Date: 6 December 2016

Revised Date: 6 January 2017

Accepted Date: 7 January 2017

Please cite this article as: Bean EMR, Cutner A, Holland T, Vashisht A, Jurkovic D, Saridogan E, Laparoscopic myomectomy: A single centre retrospective review of 514 patients, *The Journal of Minimally Invasive Gynecology* (2017), doi: 10.1016/j.jmig.2017.01.008.

Laparoscopic myomectomy: A single centre retrospective review of 514 patients

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Disclosure for conflicts of interest:

AC received honoraria from Johnson and Johnson, Olympus, Karl Storz, hospitality from Stryker and consultancy fee from Espiner. ES received honoraria from Johnson and Johnson, Olympus and Gedeon Richter and consultancy fee from Gedeon Richter.

Precis

This is a retrospective review of 514 consecutive cases of laparoscopic myomectomy carried out by members of the minimal access surgery team at University College London Hospital between January 2004 and December 2015.

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Keywords:

Leiomyoma, myomectomy, laparoscopy, morcellation, laparoscopic myomectomy

Abstract

STUDY OBJECTIVE: To review surgical outcomes and histopathological findings following laparoscopic myomectomy by a team at a university teaching hospital.

DESIGN: This was a retrospective review of consecutive cases of laparoscopic myomectomy carried out by members of our minimal access surgery team between January 2004 and December 2015.

DESIGN CLASSIFICATION: Canadian Task Force Classification II-3

SETTING: University Teaching Hospital

PATIENTS: Women undergoing laparoscopic myomectomy

INTERVENTIONS: Laparoscopic myomectomy

MEASUREMENTS AND MAIN RESULTS: We collected women's demographic data, clinical histories and surgical outcomes, including complication rates and the incidence of undiagnosed uterine malignancy. 514 women were booked for laparoscopic myomectomy during the study period. 512/514 [99.6% (95% CI 99.05 – 100.15)] of procedures were successfully completed. Two cases were converted to open surgery: one because of suspected uterine malignancy and another due to bowel injury at initial entry. The median number of myomas removed at laparoscopy was one (range 1 12, mode of 1). The median size of the largest myoma removed at each procedure was 70mm (range 10 - 200 mm), as assessed subjectively by the operating surgeon. The median blood loss was 73ml (range 5 to 3000ml. The median length of stay in hospital was 2 nights (range 0-24 nights). Breach of the uterine cavity occurred in 50/514 [9.7% (95% CI 7.17 – 12.29)] of cases. Electro-mechanical morcellation was used in 496/514

[96.5% (95% CI 94.9 – 98.1)] of patients. 18/514 [3.5% (95% CI 1.91 – 5.09)] women suffered significant complications: blood loss >1000ml (n=15), bowel injury (n=1), bladder injury (n=1), small bowel obstruction secondary to port site hernia (n=1). There were no cases of undiagnosed uterine malignancies following myoma morcellation.

CONCLUSION: Laparoscopic myomectomy can be conducted with a low rate of major complications and, in our experience, the chance of discovering occult malignancy is very low.

Introduction

Uterine myomas are the most common benign tumours of the female genital tract, with a lifetime risk of approximately 70-80% before menopause (1).

They are clinically apparent in up to 25% of women and can cause significant morbidity, including prolonged or heavy menstrual bleeding, pelvic pressure, pain or subfertility (2). Removal of myomas is frequently performed in symptomatic women who wish to retain their uterus via the hysteroscopic or abdominal route.

Laparoscopic myomectomy was first performed in 1977(3, 4). In comparison to traditional open myomectomy, the laparoscopic approach is associated with less postoperative pain, lower rate of postoperative fever and shorter hospital stay (5). However, this may be at the expense of longer operating times. Other potential advantages of the laparoscopic approach include a quicker recovery time with a more rapid return to work and activities of daily living (6).

The success of laparoscopic myomectomy is defined as a procedure carried out by minimally invasive approach, without need for conversion to open surgery, which results in a complete removal of fibroids selected for surgical excision, without any major complications..Laparoscopic completion of the procedure without serious complications,, depends on the selection criteria which are more strict compared to those for open surgery. Laparoscopic approach is preferable in women with a smaller number of myomas, whilst open surgery remains the operation of choice for women with large multiple myomas.

Following the concerns of morcellation of undiagnosed leiomyosarcoma, the need to establish the risk of this occurring and its subsequent effect on life expectancy has been highlighted (7). Subsequent to the two statements by the

FDA (United States Food and Drug Administration) in April and November 2014, which discouraged the use of electro-mechanical morcellation in the majority of women due to the potential risk of spreading occult uterine sarcoma, centres across the world have been encouraged to publish their surgical outcomes (8,9).

One of the key issues in ensuring successful laparoscopic myomectomy is patient selection. There are currently no generally agreed selection criteria to identify women who are suitable for laparoscopic myomectomy. In this report we give an analysis of our experience with laparoscopic myomectomy in our tertiary referral minimally invasive surgical unit.

The primary aim of the study was to assess the success of laparoscopic myomectomy. Secondary aims were to evaluate the complication rates and the risk of undiagnosed uterine malignancy.

Methods

This is a retrospective review of consecutive cases of laparoscopic myomectomy performed by members of our minimal access surgery team in a 12 year period between January 2004 and December 2015.

Cases were identified from the clinical notes, hospital operating theatre records, consultant diaries and histopathology database, and cross-referenced by name and hospital number to avoid duplicate entries. Data were collected on patient demographics (age, parity and menopausal status), presenting symptoms, pre-operative imaging findings (number, size and location of myomas), operative details (number and size of myomas removed, complications, intra-operative blood loss, if breach of the endometrial cavity occurred and whether electro-mechanical morcellation was required for tissue extraction), post-operative

outcomes (duration of inpatient stay, incidence and nature of complications) and histological diagnosis.

All women underwent clinical examination and pre-operative imaging by ultrasound or MRI.

There were no clearly defined selection criteria but in most cases the procedure was offered to pre-menopausal women with ≤3 intramural/submucous myomas and a dominant myoma measuring 5cm to 12cm in diameter. The selection criteria for subserous myomas were more relaxed both in terms of the number and size of myomas, provided that there was enough room in the abdominal cavity to safely introduce and maneuver laparoscopic instruments.

The findings on preoperative ultrasound suggestive of uterine malignancy were: irregularly shaped tumours, blurred margins, signs of necrosis, peritoneal deposits and inability to visualize the endometrial cavity. Seventeen women were referred during the study period to the gynaecological oncology team with possible uterine sarcoma and 12 (70.6%) of these women had this diagnosis confirmed on histological diagnosis following open surgery.

Laparoscopic myomectomies were performed using a similar technique under general anaesthesia in all cases. The urinary bladder was catheterised and a simple uterine manipulator was used. Most cases had four abdominal ports including an umbilical port for the telescope, two lateral ports and a suprapubic port, which was later used for morcellation. Patients with very large uteri/myomas had an epigastric port instead of the suprapubic port. The epigastric port was used for the telescope in these cases. 20 international units of synthetic vasopressin diluted in 20 mls of saline was injected into the myometrium as standard practice for all cases. Incisions to remove myomas were planned according to the location and size of myomas. Three different types of energy source

were used to make the incisions. This merely reflects changes in technology and availability. Initially monopolar diathermy was used. We then progressed to use either ultrasound energy(Ethicon Harmonic Scalpel®, Johnson & Johnson) or ultrasound with integrated bipolar energy (Olympus THUNDERBEAT™). A combination of energy device and mechanical instruments were used to enucleate myomas. If the endometrial cavity was opened, it was repaired first using monofilament absorbable sutures, before suturing the myometrium with absorbable traditional or barbed sutures. The serosa was closed separately and a barrier or fluid with anti-adhesion properties was used in selected cases. The myomas were morcellated using a single use electric morcellator (Ethicon Gynecare Morcellex Sigma® Johnson & Johnson, or Kebomed LiNA Xcise™). Skin incisions $\geq$10 mm were closed separately, including suturing of the rectus sheath. The amount of blood lost during surgery was determined semi-quantitatively by the operating surgeon. In all women, the material aspirated from the abdominal cavity, which consisted of irrigation fluid, myoma fragments and blood, was collected in suction containers and the volume was measured using a graduated volume scale. The total amount of blood loss was based on this objective measurement. There was no routine postoperative monitoring of haemoglobin or haematocrit and this was left to the lead surgeon's discretion.
The urinary catheter was removed on the first or second postoperative day, and patients were allowed home if they felt well and were able to empty their bladder completely.

Statistical analysis

Data were stored securely on a password protected EXCEL™ spreadsheet (Microsoft Corporation, Seattle, USA) with adherence to standards of good clinical practice in research to ensure patient confidentiality. Statistical analysis was performed using SPSS software (SPSS Inc., Chicago, IL, USA). Demographic characteristics of included patients

are expressed as median (range) and proportions are expressed as percentages with 95% confidence intervals.

Ethical approval

Ethical approval was sought from and approved by the local research ethics committee who deemed that full ethical approval was not required as the project was considered to be solely service evaluation. Such projects do not require ethical review by an NHS or Social Care Research Ethics Committee or management permission through the NHS R&D office. Under these circumstances, there was no need to submit applications to the NHS Research Ethics Committee (REC) or NHS/HSC R&D office (www.hra.nhs.uk).

Results

During the study period, from January 2004 to December 2015, a total of 903 women underwent myomectomy. 514 [57.2% (CI 53.97 – 60.43)] of these women were scheduled for laparoscopic myomectomy. At the start of the study, the proportion of myomectomies performed laparoscopically was less than 20%, in the following years the majority of myomectomies were performed laparoscopically with a ratio of approximately 1.5:1 (Figure 1).

The median age of women scheduled for laparoscopic myomectomy was 38 years (range 17 - 66). 393/514 [76.5% (95% CI 72.8 - 80.2)] were nulliparous and 121/514 [23.5% (95% CI 19.8 - 27.2)] parous. 4/514 [0.8% (95% CI 0.02 – 1.54)] women were post-menopausal. The presenting symptoms are shown in Table 1.

The procedure was successfully completed laparoscopically in 512/514 [99.6% (CI 99.05 – 100.15)] Two cases were converted to open surgery: one because of suspected malignancy, which proved to be a uterine leiomyosarcoma on histological examination and another due to bowel injury at the initial entry.

Details of the pre-operative findings and intra-operative data are shown in Table 2.

The median time lapse between pre-operative imaging and timing of surgery was 113 days (range 0 – 1807).

The location of the dominant fibroid removed was posterior in 158/514 [31% (95% CI 26.71 – 34.69)], anterior in 124/514 [24% (95% CI 20.4 – 27.8)], lateral in 96/514 [19%(95% CI 15.3 – 22.1)], fundal in 73/514 [14% (95% CI 11.18 – 17.22)] and pedunculated in 57/514 [11% (95% CI 8.38 – 13.82)] women.

Electro-mechanical morcellation was not used during laparoscopic myomectomy for 16/514 [3.1% (95% CI 1.61 -4.61)] women, in whom the myoma measured less than two cm in diameter. During some more recent cases, the technique of a surgical containment bag (Morcellation containment system ECOSAC, Espiner Medical Ltd ™) was used for tissue extraction. The purpose of this was to ensure contained morcellation, complete removal of the specimen and reduce the risk of disseminating tissue within the peritoneal cavity.

The median length of hospital admission was 2 nights (range 0 – 24).

Complications

Overall there were 18 significant complications in the study group of 514 patients, which are displayed in Table 3. This gives an overall complication rate of 3.5% (95% CI 1.91 – 5.09).

Of the 15 women who had blood loss >1000ml, one woman had open surgery because of suspected malignancy, which proved to be a uterine leiomyosarcoma. Of the 14 women who had laparoscopic myomectomy and a blood loss >1000 mls, four [28.6% (95% CI 4.9 – 52.3) required a blood transfusion. The size, number and location of fibroids were similar in the 14 women who had an intraoperative blood loss of >1000 mls and the overall group.

In the woman that developed a port site hernia, this occurred through the 15mm suprapubic port site which was also used for morcellation, despite routine closure of the rectus sheath.

Histology

In 511/514 [99.4% (95% CI 98.73 – 100.07)] of the cases, histology confirmed benign leiomyoma. Two patients who had a laparoscopic procedure had a histological diagnosis of smooth muscle tumour of uncertain malignant potential (STUMP). One, who had no desire for future fertility, underwent hysterectomy. The histology revealed adenomyosis and benign leiomyomas, with no evidence of malignancy. The second had a CT and MRI, which were both normal and subsequent in vitro fertilisation and has had one successful birth. The third patient underwent conversion to open myomectomy, without morcellation, as the fibroid looked suspicious at initial inspection. Suspicion was raised on inspection of the mass, due to absence of a clear plane between the fibroid and the surrounding

myometrium, lack of a pseudocapsule, hypervascularity and the soft friable consistency of the tumour. She underwent open excision of the uterine mass, histology revealed a malignant leiomyosarcoma and post-operative imaging revealed distant metastases. One patient re-attended with worsening symptoms of menorrhagia one year after laparoscopic myomectomy. A pelvic ultrasound scan showed a large non-suspicious looking uterine mass. However, there was a clinical suspicion of malignancy due to the rapid growth of the uterine mass. The patient had no desire to retain fertility and underwent an open abdominal hysterectomy. Histology revealed a leiomyosarcoma. The original histology was reviewed and confirmed the initial diagnosis of a benign leiomyomas.

One patient, who had a single 10cm posterior intramural myoma removed when aged 37, without breach of the endometrial cavity or use of in-bag morcellation, was re-referred to the gynaecology unit seven years following her laparoscopic myomectomy, due to increasing abdominal pressure symptoms and urinary frequency. An ultrasound revealed 16 uterine myomas, including a 10cm pedunculated right lateral myoma. She chose to undergo a total abdominal hysterectomy. At laparotomy, she was found to have a 15cm parasitic myoma arising from the bladder wall and a 10cm right broad ligament myoma. During resection of the myomas, the bladder was opened and closed by primary repair and the decision was made to abandon the hysterectomy. Histology confirmed leiomyoma. Follow up ultrasound diagnosed four parasitic myomas, which measured five to ten centimetres in largest diameter and were arising from the right lateral port site and other distant peritoneal surfaces. As the patient was relatively asymptomatic, she chose to continue conservative management.

One women developed intrauterine adhesions following laparoscopic myomectomy with a breach of uterine cavity and developed an intramural pregnancy which was successfully treated medically with methotrexate.

Discussion

We report one of the largest single centre series on laparoscopic myomectomy to date (10). All the cases were performed by experienced surgeons, including consultants and senior trainees. Procedures were performed by two consultant experts in minimally invasive surgery (ES and AC), either by themselves, senior trainees or consultants under their direct supervision during the entire study period. This series appears to have a low complication rate similar to other published series of laparoscopic myomectomy (Table 4). The largest multicenter case series reported to date by Sizzi et al showed a major complication rate of 2.02% [38/2050 (95% CI 1.4 – 2.6)] in their series of 2050 laparoscopic myomectomies, which is similar to 3.5% [18/514 (95% CI 1.91 – 5.09)] in this series of 514 patients. The number and size of myomas in their report were similar to our case series. Sizzi et al reported a laparo-conversion rate of 6/2050 cases [0.3% 995% CI 0.06 – 0.54)] and one case of hysterectomy due to excessive bleeding. These outcomes are similar to our laparo-conversion rate of 2/514 [0.39% (95% CI -0.15 – 0.93)] and no patients requiring conversion to hysterectomy (11). Dubuisson et al reported a conversion rate of 16/213 [7.5% (95% CI 3.96 – 11.04)], which was correlated with the size of the myoma and three times more likely for anterior myomas compared with posterior or fundal location. Their recommendation was that laparoscopic myomectomy is a reliable technique but should only be proposed when a myoma is less than 8cm and there are not more than two myomas to be removed (12). Our series included larger myomas (mean 70mm, range 10 – 200mm) than the cut-off proposed by Dubuisson et al and had a lower laparo-conversion rate. Over time, advances in laparoscopic imaging, energy sources and suture

technology, especially ultrasound energy sources and barbed sutures in more recent years, have aided the safety and efficacy of laparoscopic surgery. This has enabled a reduction in overall operating time and facilitated development of more complex laparoscopic surgery. . This may have resulted in our lower conversion and complication rates than other series.

One of the key issues in ensuring successful laparoscopic myomectomy is patient selection. Our case series shows that myomas of all locations in greater number and size can be successfully and safely removed at laparoscopy with an acceptable complication rate. There are no universally accepted selection criteria published for women in whom laparoscopic myomectomy is planned. As part of patient selection, it is invaluable to have detailed mapping of the fibroids by pre-operative imaging. This will also ensure that the myomas are more effectively localized and removed at laparoscopic surgery, in the absence of tactile examination, and will help avoid persistent myomas.

Table 4 shows data presented from other large case series of laparoscopic myomectomy. It shows the median age of the patients, size and number of myomas safely removed. The median age of patients ranged from 31.7 to 40.33 years, similar to 38 years in this series. The median number of myomas removed at laparoscopic myomectomy ranged from 1.0 to 3.5 and the median size of myomas removed ranged from 4 to 7.8cm. These figures are similar to the median of one myoma excised, with a median size of 70mm in our series. Table 5 shows reported complications associated with laparoscopic myomectomy. The literature is varied in the style and completeness in which complications have been reported. The majority of studies reporting their experience of laparoscopic myomectomy are based on patient data that has been collected retrospectively and are therefore subject to recall bias. Only six studies reported their overall complication rate, which ranged from

2.08 to 11.1%, compared to 3.5% (95% CI 1.91 – 5.09) in our series. Twelve studies reported their laparo-conversion rate to open surgery, which ranged from 0.1% to 29% of cases, compared to 0.39% (95% CI -0.15 – 0.93) in our series. Only one death was reported following laparoscopic myomectomy. The median estimated blood loss ranged from 90 to 384ml and median length of stay from 0.58 to 5 days in hospital, which is similar to the 73ml estimated blood loss and two nights median length of stay in our series. Only three studies reported findings of unexpected malignancy, which ranged from 0.1 to 0.4% of cases, similar to the 0.2% of cases in our series. The frequency in which the uterine cavity was opened was reported by six studies and ranged from 0.02 to 11.7% of cases, compared to 9.7% in our series.

In a series of 128 patients who underwent myomectomy, Campo et al showed that women were more likely to conceive after laparoscopic treatment of myomas compared with an open procedure (laparoscopy versus laparotomy: OR 14.062, 95% CI: 1.40–141.15) (13).

The FDA discouraged the use of electro-mechanical morcellation in April 2014 (8). The American Association of Gynecologic Laparoscopists (AAGL) and The European Society for Gynaecological Endoscopy (ESGE) released statements advising caution when considering morcellation in the postmenopausal age group. (34,35,36). Four of our patients were post-menopausal and requested myoma removal instead of hysterectomy. Pelvic ultrasound evaluation of the myometrium was reassuring and the maximum myoma size ranged from 30 to 80mm in diameter. Histological examination in these four women showed benign leiomyoma.

The two cases in which histology revealed a STUMP, were both pre-menopausal women aged 37 years and 39 years, who had myomas measuring 60mm in diameter. The woman

who had a suspicious uterine mass that underwent open excision and histology proved to be a leiomyosarcoma, was 32 years old with no risk factors for malignancy and a 100mm myoma on ultrasound.

Some have suggested pre-operative histological diagnosis prior to laparoscopic myomectomy in women who have risk factors for malignancy before morcellation is considered (37). In order to obtain a tissue sample, without risking dissemination of cells into the peritoneal cavity, a transcervical approach can be considered. This is carried out under ultrasound or CT guidance, to ensure accurate location of the biopsy and to minimise risk to other structures, including the uterine serosa. Although the potential for trans-tubal passage of cells remains, the risk of intra-peritoneal spread is reduced with this method (38).

Another alternative is to contain the morcellation process to reduce the risk of spreading malignancy with the concept of a contained morcellation bag (39). We utilised a bag for five of our cases. The adoption of such a system is not yet established but may potentially remove the risk of dissemination at morcellation (40, 41). In addition the rare reported complication of iatrogenic peritoneal leiomyomatosis might be avoided (42).

It is generally considered that thorough lavage and meticulous care in extraction of all myoma fragments should follow laparoscopic myomectomy before completion of surgery. If a myoma appears suspicious at the time of fertility sparing surgery for, it would be reasonable to carry out an open myomectomy rather than to continue laparoscopically, which may reduce the risk of dissemination. In those patients where fertility preservation is not desirable and a uterine mass appears suspicious, a hysterectomy should be considered. In this study, there was one case of parasitic myomas found following

laparoscopic myomectomy. However, the literature suggests that this diagnosis may not become apparent for several decades following the primary procedure, so longer term follow up is required to demonstrate the incidence in this study group.

It is important to consider the chance of interval sarcoma in previously assumed benign myomas. There was one case of interval sarcoma following laparoscopic myomectomy in this series. Signs that should raise suspicion of interval sarcoma include the onset of symptoms suspicious of malignancy, irregular or heavy vaginal bleeding, new onset of pressure symptoms, unexplained fever, weight loss, early satiety or systemic illness.

Conclusion

Our study confirms that laparoscopic myomectomy is an important addition to gynaecological surgery. Once the practice is established, the number of myomectomies performed by laparoscopic technique exceeds those done by open surgery.
In experienced hands, laparoscopic myomectomy is safe and effective, with a low complication rate of less than 10%.
In this series, there were no cases of inadvertent morcellation of uterine sarcoma. However, morcellation criteria need to be in place to minimize the risk of this potential complication.

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Figure 1 Legend

Figure 1. Percentage of myomectomies performed by laparoscopic approach during the study period

Table 1: Indications for surgery (n=514)

Symptom	**N (%)**
Menorrhagia + Pelvic pain	134 (26.1)
Menorrhagia	86 (16.7)
Pelvic pain	84 (16.3)
Infertility	44 (8.6)
Menorrhagia + Pressure symptoms	25 (4.9)
Menorrhagia + Infertility	24 (4.7)
Pelvic pain + Infertility	15 (2.9)
Pressure symptoms	15 (2.9)
Pelvic pain + Pressure symptoms	14 (2.7)
Recurrent miscarriage	2 (0.4)
Infertility + Pelvic pain	2 (0.4)
(Menorrhagia, Infertility, Pelvic pain, Pressure symptoms)	69 (13.4)
Total	**514 (100%)**

Table 2: Pre-operative ultrasound findings and intra-operative data

Number of uterine myomas on ultrasound	*2 (1 – 13)
Diameter of dominant myoma measured on pre-operative ultrasound (mm)	*70 (10 - 214)
Number of uterine myomas removed at procedure	*1 (1 – 12)
Size of largest myoma removed at procedure as assessed subjectively by the operating surgeon (mm)	*70 (10 – 200)
Blood loss (ml)	*73 (5 – 3000)
Breach of endometrial cavity	**50/514 [9.7% (7.17 – 12.29)]
Power morcellation	**496/514 [96.5% (94.91 – 98.09)]
In bag morcellation	**5/514 [1% (0.12 – 1.82)]

** median (range)*

*** n [% (95% Confidence interval)]*

Table 3: Significant complications

COMPLICATION		**n [% (95% CI)]**
Intra-operative complications	Bladder injury	1/514 [0.2% (-0.19 – 0.57)]
	Bowel injury	1/514 [0.2% (-0.19 – 0.57)]
	Blood loss >1000ml	15/514 [2.9% (1.46 – 4.38)]
Wound complications	Port site hernia with bowel obstruction	1/514 [0.2% (-0.19 – 0.57)]

Table 4 : Large published case series of laparoscopic myomectomy

	n =	Age, mean ± SD (range) [IQR]	Myomas removed, Median number ± SD (Range)	Size of myoma removed, cm, Median ± SD [IQR] (Range)	Estimated blood loss, ml, Median ± SD (Range)	Length of stay, Nights, Median ± SD (Range)
Sizzi 2007 (11) * M	2050	36.12 ± 5.35	2.26 ± 1.8 (1 - 15)	6.40 ± 2.6 (1-20)	-	1.99 ± 0.9
Kumakiri 2008 (14) *S	1334	33.6 ± 3.4	3.5 ± 3.6 (2.8 - 4.2)	6.61 ± 1.88 (62.6 - 69.2)	115.2 ± 225.1	-
Paul 2010 (15) * S	1001 **	32.62 (19-57)	1.97 (1 - 17)	1 - 20	248 (20 - 1000)	1.5 (1 - 5)
Malzoni 2006 (16) * M	982	-	2.23 (1 - 8)	6.72 ± 2.71 (1 - 20)	-	2.02 ± 0.61
Sandberg 2016 (17) * S	731 ***	40.33 ± 7.28	3.54 ± 4.10	-	181.54 ± 342.02	0.58 ± 1.00
Koo 2015 (18)	523	31.7 ± 3.5 [31.4, 32.0]	single 64.8% multiple 35.2%	4.9 ± 2.5 [4.7, 5.1] (1 - 15)	162.5 ± 156.2	3.2 ± 1.5
Serracchioli 2006 (19)	514	33.69 +- 3.61	2.55 ± 1.78	5.44 ± 2.46	-	-
Yoo 2007 (20)	512	33.0 (22 - 50)	1.0 (1 - 10)	-	125 (50 - 1000)	4.0 (1 - 11)
Sinha 2008 (21) * S	505	34.36 ± 5.706	1.85 ± 5.706	5.86 ± 3.3	90 (40 - 2000)	24.64 ± 5.45 hours
Radosa 2012 (22)	451****	A: 50.1 ± 7.4; B: 33.6 ± 4.6	A: 1.7 ± 1; B: 1.9 ± 1.6	A: 4.5 ± 1.9; B 4.82 ± 2.2	-	A: 5 ± 1.5; B: 4.4 ± 1
Saccardi 2014 (23)	444	36.7 ± 6.4	-	7.6 ± 2.7	184.1 ± 233.5	2.54 ± 1.1
Landi 2001 (24)	368	-	-	-	384.14 ± 324.8	2.89 ± 1.3
Altgassen 2006 (25)	351	34.5 ± 4.6	1 (1 - 14)	5.3	-	-
Rosetti 2007 (26)	332	35.47 ± 4.8	2.23 ± 1.7 (1 - 8)	6.02 ± 2.71 (1 - 20)	-	2.0 ± 0.57
Chen 2005 (27)	300	-	-	(4 - 20)	300	-
Tinelli 2012 (28)	235	36.5 ± 4.3 (28 - 43)	-	6.6 ± 3.5 (4 - 10)	118 ± 27.9	*****
Dubuisson 1996 (12)	213	-	-	-	-	-
Mettler 2005 (29)	178	-	-	4 (3 - 10)	-	2 ± 0.5
Malzoni 2003 (30)	144	-	1.6	7.8 (5 - 18)	-	2.6 (2 - 5)
Marret 2004 (31)	126	-	-	-	226 ± 320	3.6 ± 1.3
Nezhat 1998 (32)	114	38 (25 - 51)	3	5.9	200 (25 - 1200)	(<24hours - 4 days)
Dessolle 2001 (33)	88	36.1 ± 2.1	1.7 ± 0.6 (1 - 4)	6.2 ± 1.8	-	3.0 ± 1 (1 - 10)

*S = single centre; *M = multicentre
** 87% morcellation, 13% mini-laparotomy/colpotomy
*** 388 laparoscopic, 342 robotic
**** A = peri/postmenopausal; B = premenopausal
***** 203 (86.3%) patients were discharged <48h after surgery (2 - 4 days)

Table 5: Reported complications associated with laparoscopic myomectomy in other published case series

	n =	Unexpected Malignancy, n (%)	Failure to complete surgery, n (%)	Hysterectomy, n (%)	Laparo-conversion rate, n (%)	Breach of uterine cavity, n (%)	Overall Complication Rate, n (%)	Minor Complication, n (%)	Major Complication, n (%)	Intraoperative complication, n (%)	Postoperative complication, n (%)	Haemorrhage, n (%)	Blood Transfusion, n (%)	Haematoma formation, n (%)	Bladder injury, n (%)	Bowel injury, n (%)	Acute Kidney Injury, n (%)	Death, n (%)
Sizzi 2007 (11) *M	2050	2 (0.09)	7 (0.34)	2 (0.10)	6 (0.29)	-	225 (11.1)	187(9.1)	38(2.02)	-	-	14(0.68)	3 (0.15)	10(0.48)	-	1 (0.04)	1 (0.04)	-
Kumakiri 2008 (14) *S	1334	-	-	-	-	13(11.7)	-	-	-	-	-	-	-	-	-	-	-	-
Paul 2010 (15) *S	1001**	1 (0.10)	-	-	1 (0.10)	-	72(7.16)	45(4.54)	26(2.62)	-	-	1 (0.1)	10 (1.0)	2 (0.20)	3 (0.30)	0	-	1 (0.10)
Malzoni 2006 (16) *M	982	-	-	-	13(1.29)	-	-	-	3 (0.31)	-	-	-	-	-	-	-	-	-
Sandberg 2016 (17) *S	731***	-	-	1 (0.14)	8 (1.09)	-	-	-	-	-	-	-	3 (0.41)	-	-	1 (0.14)	-	-
Serracchioli 2006 (19)	514	-	-	-	-	10(0.19)	-	-	-	-	-	-	-	-	-	-	-	-
Yoo 2007 (20)	512	-	-	-	-	8 (1.6)	52(10.2)	-	-	-	-	-	7 (1.4)	-	1 (0.20)	1 (0.20)	-	-
Sinha 2008 (21) *S	505	2 (0.40)	-	1 (0.20)	1 (0.20)	35 (6.9)	-	-	-	-	-	-	31(6.14)	1 (0.20)	-	-	-	-
Radosa 2012 (22)	451****	-	-	-	1 (0.22)	1 (0.02)	-	-	3 (0.67)	A: 3(3.5) B: 7(1.9)	-	-	3 (0.67)	1 (0.22)	1 (0.22)	3 (0.67)	-	-
Saccardi 2014 (23)	444	-	-	-	6 (1.35)	-	-	-	-	-	-	-	2 (0.45)	-	-	-	-	-
Landi 2001 (24)	368	-	-	-	-	-	-	-	-	12(3.34)	-	-	10 (2.7)	-	-	-	-	-
Altgassen 2006 (25)	351	-	1 (0.28)	1 (0.28)	1 (0.28)	-	9 (2.6)	-	-	9 (2.60)	20(5.70)	2 (0.57)	2 (0.57)	2 (0.57)	-	3 (0.85)	-	-
Rosetti 2007 (26)	332	-	-	-	3 (0.90)	-	-	-	-	0	2 (0.60)	-	0	-	-	1 (0.30)	1 (0.30)	-
Tinelli 2012 (28)	235	-	-	-	-	-	-	-	-	-	0	-	0	1 (0.40)	-	-	-	-
Dubuisson 1996 (12)	213	-	-	-	16(7.51)	-	8 (3.8)	-	-	-	-	-	-	-	-	-	-	-
Mettler 2005 (29)	178	-	-	-	-	-	-	-	-	-	-	-	-	2 (1.1)	-	-	-	-
Malzoni 2003 (30)	144	-	-	-	2 (1.39)	-	3 (2.08)	-	-	-	-	-	1 (0.70)	-	-	-	-	-
Marret 2004 (31)	126	-	-	-	37(29.4)	-	-	-	-	-	-	-	0	-	-	-	-	-
Dessolle 2001 (33)	88	-	-	-	-	3 (3.4)	-	-	0	-	-	-	0	-	-	1 (1.14)	-	-

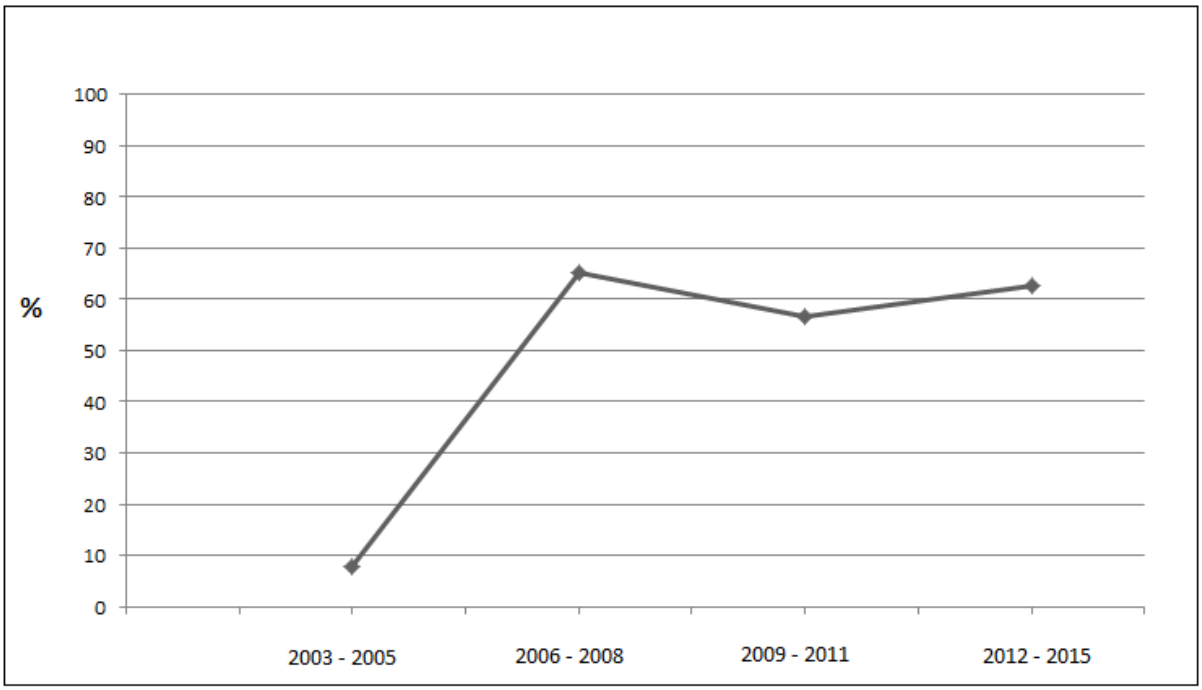
*S = single centre; *M = multicentre

** 87% morcellation, 13% mini-laparotomy/colpotomy

*** 388 laparoscopic, 342 robotic

**** A = peri/postmenopausal; B = premenopausal

Figure 1:



Precis

This is a retrospective review of 514 consecutive cases of laparoscopic myomectomy carried out by members of the minimal access surgery team at University College London Hospital between January 2004 and December 2015.