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Review

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Myomectomy Benefits, Risks, Long-Term Outcomes, and Effects on Fertility and Pregnancy Outcomes: A Literature Review

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Abstract

Objective: Abdominal myomectomy is the mainstay for women with intramural fibroids who want to conceive. Informed choice, discussion on alternatives, and consent for surgery are essential prior to the procedure. Women with fibroids need to understand the potential long-term complications and future implications, including the effects of fibroids or myomectomy on fertility and pregnancy outcomes. This article offers evidence-based information for informing women about the consequences and benefits of myomectomy and other treatments.
Methods: Using thesaurus terms, articles in English since 2012, on PubMed, Embase (OVID), and MEDLINE® (ProQuest) databases were retrieved via the National Institute for Health and Care Excellence Healthcare Databases Advanced Search interface. Myomectomy outcomes, risks, complications, fertility, and rare complications later in pregnancy were reviewed.
Results: Ninety-two articles were chosen. They covered topics relevant to this review. Duplicate articles, those not related to this review, or with low numbers of cases in retrospective studies were excluded. When fibroids affect reproductive age women, myomectomy's surgical and reproductive outcomes have significant benefits, compared to relatively severe but uncommon complications. Myomectomy-related long-term reintervention is higher than for hysterectomy, but short-term outcomes for pain and bleeding are comparable to hysterectomy.
Conclusions: Myomectomy (laparoscopic or open) is safe. Benefits are greatest for reproductive-age women with fibroids. Surgical and reproductive outcomes of myomectomy have benefits, compared to relatively few severe but uncommon complications. This review article of all the potential benefits, risks, and complications can help surgeons inform patients appropriately and reduce potential litigation. (J GYNECOL SURG 39:151)

Keywords: fibroids, leiomyoma, myomectomy, laparoscopic surgery, pregnancy, fertility.

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In the August 2023 issue of *Journal of Gynecologic Surgery* (vol. 39, no. 4; pp. 151–157), the article entitled ''Myomectomy Benefits, Risks, Long-Term Outcomes, and Effects on Fertility and Pregnancy Outcomes: A Literature Review'' has been updated on October 31, 2023 after first online publication of July 25, 2023 to reflect Open Access, with copyright transferring to the author(s), and a Creative Commons License (CC-BY) added (http://creativecommons.org/licenses/by/4.0).

Introduction

UTERINE FIBROIDS (UTERINE LEIOMYOMATA) affect quality of life (QoL) of a significant proportion of women, are dependent on their ethnicity and geography, and commonly cause heavy menstrual periods. Fibroids are associated with pelvic pain, and bladder symptoms such as increased frequency of micturition and back pain. Fibroids contribute to subfertility and complications in pregnancy.

Uterine fibroids may affect women from their teenage to postmenopausal years but are usually more symptomatic during the 30s and 40s. Pelvic pain and heavy menstrual bleeding (HMB) can have multiple etiologies, including adenomyosis, which is common in multiparous women and women over age 40. Adenomyosis contributes to symptomatology in women with concomitant leiomyomas.[1]

Fibroids are usually classified as submucosal (when the fibroid affects the inner part of the uterine cavity), intramural (when the fibroid mainly affects the muscular part of the uterine cavity) and subserosal (when the fibroid originates in the uterus but grows outside the uterus). Despite a comprehensive FIGO [International Federation of Gynaecology and Obstetrics] classification, extensive or detailed classifications are neither necessary nor reproducible other than for submucosal fibroids (Type 0/1/2). What matters most clinically are the patient's complaints, the size and location of the fibroids, the patient's age, and her fertility desires.

Myomectomy (surgical removal of the fibroids) can be performed via a hysteroscopic approach (hysteroscopic mechanical morcellation and hysteroscopic resection of the fibroid) or via an abdominal approach (open myomectomy [OM], laparoscopic myomectomy [LM], or robotic(-assisted laparoscopic) myomectomy [RM]).

This article offers information to help clinicians and patients make evidence-based informed choices regarding the management of uterine fibroids. Risks and complications of OM and LM, including pregnancy-related complications, are reviewed. Alternative treatment options, including medical management, uterine-artery embolization (UAE), hysterectomy, and suppression of ovulation with gonadotropin-releasing hormone (GnRH) analogues, are outlined.

Methods

PubMed, Embase (OVID) and MEDLINE® (ProQuest) databases were searched for articles in English via the National Institute for Health and Care Excellence (NICE) Healthcare Databases Advanced Search interface, using thesaurus terms. The search focused on treatment outcomes and adverse events in relation to myomectomy, comparative outcomes, and QoL fertility benefits, and pregnancy complications after myomectomy.

Laparoscopic myomectomy became more common in most of the world during the twenty-first century, and studies focusing on the rare, but more-severe, complications of myomectomy such as placenta accreta and recurrence of fibroids have been published since 2012.

Ninety-two relevant articles were selected initially, including case series and systematic reviews, of which 57 covered the topics relevant to this review.

Why Myomectomy? What Are the Benefits?

Myomectomy is effective for reducing fibroid-related pain, HMB, dyspareunia, and bladder symptoms. The surgery also helps increase spontaneous as well as assisted conception and reduces the rate of miscarriage.[2]

A large number of studies confirm the reduction of fibroid-related symptoms following myomectomy.[3–6] One study comparing abdominal myomectomy with abdominal hysterectomy reported that overall symptom-severity scores were similar, but activity and energy/mood scores were significantly higher among myomectomy patients.[3]

A study by Laughlin-Tommaso et al.,[6] which included 1206 women (338 hysteroscopic, 519 laparoscopic and 349 abdominal myomectomies), demonstrated substantial improvement in short-term, health-related QoL and symptom-severity scores, regardless of the route of myomectomy.

Laparoscopic Versus Open Myomectomy

LM and OM are both safe and effective, but appropriate case selection is essential. LM decreases acute postoperative pain, offers faster postoperative recovery, produces minimal scar formation, and improves QoL.[7,8] RM is an alternative to straight-stick laparoscopy and offers technical advantages.

These include, a 3-dimensional view of the surgical field, wristed instrumentation mimicking hand movements, elimination of the fulcrum effect, motion scaling eliminating tremor, reduced operator fatigue, and better surgical ergonomics.[9–15] RM thus allows easier suturing and knot tying and enhanced surgical precision.[9–15]

Outcomes of LM are dependent on patient characteristics as well as the surgeon's experience and skills. OM will still be preferred, when a myoma is large and calcified or if there are concerns regarding morcellation (suspected malignancy). LM may still be challenging (without robotic support) when a fibroid is located in the lower segment of the uterus and on the lateral, rather than the anterior, myometrium.

LM may also be challenging when the number of fibroids is more than 7, which is defined as an extreme myoma burden by Jansen et al.[16] The researchers showed that myomectomy for extreme myoma burden is feasible using abdominal, laparoscopic, or robotic approaches; however, in LM and RM, increased myoma burden is associated with increased operative time, which affects the efficiency of theater utilization, and postoperative complications. In a study by Vargas et al.,[17] a total of 11,709 myomectomies were identified; 4673 (39.9%) were minimally invasive, 6997 (59.8%) were abdominal, and 39 (0.3%) were conversions. In that study, LM had 77% lower odds of having any complication, compared with abdominal myomectomy, specifically for rates of pulmonary complications, sepsis, urinary-tract infection, and bleeding. Operating time was predictive of complications for both minimally invasive and abdominal myomectomies. Despite the longer operative time, minimally invasive procedures lasting up to 270 minutes generally had superior 30-day outcomes.

In a review of surgical outcomes following LM, by Bean et al.,[18] among 514 patients, there were only 2 conversions, 15 patients had more than 1000 mL of blood loss, 1 patient had a bowel injury, and another patient had a bladder injury. There was also 1 postoperative complication of small-bowel obstruction. No malignancies were reported on histologic

examination. The researchers concluded that LM could be conducted with a low rate of significant complications, and that the chance of discovering occult malignancy was rare.

During LM, single-layer closure is not usually advised, as the risk of uterine rupture may be slightly more than with conventional 2- or 3-layer closures. Today, laparoscopic closure by STRATAFIX^{tm} sutures is commonly used and is considered safe, with multiple-layer closure being used as standard practice. Barbed-suture closure reduces total operative/suturing time and suturing difficulty facilitating laparoscopic myomectomy.[19,20]

The safety of injecting vasopressin during myomectomy is well-established. During laparoscopic myomectomy, 40–60 mL of vasopressin (a 20-international-units vial mixed with 200 mL of normal saline) can be injected between the pseudocapsule and the myoma every 20 minutes.[21] Saline can also be injected into the same space for hydro-dissection.

Prophylactic intravenous antibiotics at the induction of anesthetic is routine. There is no evidence to give postoperative antibiotic coverage following myomectomy. A venous-thromboembolism risk assessment and provision of prophylaxis if required, is mandatory for every patient per NICE guidelines for both LM and OM.

Several systematic reviews and meta-analyses assessed the short-term surgical outcomes of RM, compared to LM and OM. Pundir et al.[15] and Iavazza et al.[9], concluded that, overall, the short-term surgical outcomes of RM were superior to OM but there was no significant difference compared to LM, while Wang et al.[10] reported better short-term outcomes with RM, compared to both OM and LM. All 3 studies showed that, compared to OM, RM had a lower estimated blood loss (EBL) and need for blood transfusion, and a shorter length of hospital stay. Pundir et al.[15] reported a similar risk of complications, while Iavazzo et al.[9] and Wang et al.[10] reported a lower rate of complications with RM, compared to OM. All 3 studies reported RM taking a longer operating time, compared to OM. Conversion to laparotomy/OM was more likely in LM, compared to RM.[9,10] EBL and complication rates were lower in RM than in LM.[10]

Morcellation and Related Risks

In laparoscopic surgery, removing the fibroids from the peritoneal cavity is challenging, and morcellation of the fibroids may be required. Morcellation of the fibroid and its potential risks must be discussed with the patient prior to LM.[22]

Morcellation of the fibroids

Different types of morcellation can be performed to remove the fibroids. Although the risk of occult malignancy being present within the fibroid and dissemination of malignancy during myomectomy is low,[23] care should be taken in postmenopausal patients and those with rapidly growing fibroids.[18,24–26] Laparoscopic mechanical or electric-power morcellation have risk of incidental damage to visceral organs. Manual morcellation can be performed vaginally or through minilaparotomy. Morcellation can be uncontained or contained within a retrieval bag but contained in such a bag is relatively safe. For small myomas, endobags are used during morcellation to avoid dissemination, but for large myomas, morcellation containment bags are available.

Patients must be well-informed about the risks of morcellation. Other risks of morcellation of a fibroid or uterus, which can be potentially severe and lethal, are bowel injury, splenic injuries, and mortality due to internal organ damage.[22,27]

Alternative routes of removal of modest fibroids should be considered, including minilaparotomy and via the posterior vaginal fornix.

Long-term complications of myomectomy

Long-term complications include regrowth of fibroids, recurrence of fibroid symptoms, and pregnancy-related complications. Chronic pelvic pain may persist or arise anew. Most studies suggest that myomectomy helps relieve pelvic pain if the pain is secondary to the presence of the fibroids but, if there is coexisting pathology, such as endometriosis or adenomyosis, the pain may persist.

Recurrence following myomectomy

The risk of recurrence of fibroids after myomectomy is significant, and it depends on multiple factors. The cumulative probability of reoperation for recurrent leiomyoma was 6.7% at 5 years and 16% at 8 years in one study.[27] That same study concluded that the risk of recurrence of leiomyoma was linked to age, the number of leiomyomas before myomectomy, and preoperative uterine size. In another study on LM, recurrence was much higher, especially with the laparoscopic approach.[29] The cumulative risk of recurrence was 4.9% at 24 months and 21.4% at 60 months postoperatively.[29] Recurrence is uncommon if a patient is older than age 45 and is perimenopausal, compared age 30 or younger. In a meta-analysis study of 2566 patients, recurrence risk was higher when there were more than 5 leiomyomas before the operation.[30]

For women who are older than age 40 or who have completed their families, the need for removal of multiple fibroids requiring extended surgical time and increased risk of blood transfusion should be balanced against hysterectomy as a long-term solution.

Several small retrospective studies have reported long-term outcomes following RM, including recurrence of fibroid symptoms, fertility problems, and pregnancy complications. In a retrospective survey, 81.3% of 107 patients who had RM within the last 12 months reported being symptom-free but only 62.9% of 133 patients who had RM more than 3 years ago reported this.[31] In a retrospective cohort study of 134 patients, there was no significant difference among RM, LM, and OM in terms of either the need for additional fibroid surgery including hysterectomy, bleeding patterns, use of fertility treatment, pregnancy rates, miscarriage rate or onset of menopause.[32] Furthermore, in their meta-analysis, Wang et al.[10] reported no significant difference in terms of fertility between RM and LM. Thus, based on these small retrospective studies, RM has comparable long-term fertility and pregnancy outcomes to LM and OM.

Pregnancy, Fibroids, and Myomectomy

The serious adverse effects on conception or pregnancy following myomectomy are:

1. Uterine-cavity adhesions decreasing fertility and impairing the outcome of *in-vitro* fertilization (IVF)
2. Miscarriage
3. Torsion and degeneration presenting with abdominal pain
4. Preterm labor
5. Uterine-scar dehiscence or uterine rupture during pregnancy or labor
6. Placental accreta when the placenta adheres to the previous myomectomy scar.

Spontaneous pregnancy following myomectomy is the ideal outcome in a young woman, but it depends on age, ovarian reserve, race, and previous pregnancy outcomes.

Age and ovarian reserve are interrelated. In the current authors' practice, ovarian reserve is assessed with anti-Müllerian hormone before myomectomy in any patient older than age 35. Understanding ovarian reserve helps when counseling a patient regarding method of conception (spontaneous or assisted) post myomectomy.

Fibroids contribute to subfertility by various mechanisms in addition to obstruction of the uterine cavity.[33] Women who have fibroids (with or without myomectomy history) have reduced chances of conception, compared to women who have never had a fibroid.[34] It is challenging to decide whether to remove the fibroid unless the fibroid is large (> 4 cm) or submucosal. For women who have recurrent miscarriages and have large fibroids, there is evidence of increased risk of miscarriage if a fibroid affects the cavity.[35–37]

There is a consensus to remove uterine-cavity fibroids before planning assisted reproductive techniques, such as IVF, as endorsed in many Fertility Treatment Guidelines.[34.] In the case of intramyometrial fibroids, the current authors remove these fibroids only if a patient has problems, such as subfertility and preterm labor or recurrent miscarriages, and the myometrial fibroid is >4 cm.

Another complication, which is challenging to quantify, is myomectomy-related adhesions within the endometrial cavity. They can, however, be treated easily by hysteroscopic division if a woman is aiming for future conception, but these endometrial adhesions following myomectomy can also recur.

One study by Lee Lebovitz et al.[38] showed that the overall clinical pregnancy rate following myomectomy was 58% (74 women), with the most-successful conceptions within a younger age group. The study also showed that African American women have lower pregnancy rates (24.3%), compared with Caucasian women (63.5%). Another study showed that, of 469 women who underwent myomectomy, 152 conceived following surgery, but only 110 pregnancies ended in live births after 24 weeks.[39]

Several small retrospective studies have reported pregnancy rates in women who wished to conceive following RM of 46.6% of 15 women ($n=15$),[32] 50.8% ($n=63$),[31] 52.8% ($n=53$),[40] 75% ($n=16$),[41] and 77.8% ($n=9$).[42]

In general, pregnancy with fibroids or after myomectomy is considered ''high risk,'' with increased risks of malpresentation, cesarean section, and preterm labor.[43] Observational studies have also shown that uterine leiomyoma is a risk factor for placental abruption.[44]

Fibroids can undergo degeneration, or rarely, torsion in pregnancy. Fibroid degeneration can present with persistent, prolonged pain with nausea and vomiting or acute abdominal pain in pregnancy.

Uterine-scar dehiscence in pregnancy following myomectomy is a well-reported complication, similar to scar dehiscence and scar rupture following cesarean section but with a lower incidence.[45] Gambacorti-Passerini et al.,[46] demonstrated in their systematic review that trial of labor after myomectomy is associated with an ~ 1 in 50 risk of uterine rupture. These researchers found 1034 pregnancies in 11 studies, resulting in 756 deliveries at more than 24 weeks. A trial of labor following myomectomy occurred in 56% (426), while 43% (330) had planned cesarean section. Of the 756 deliveries, there were 7 cases of uterine rupture (0.93%), with 2 cases during the trial of labor (0.47%) and 5 cases before the onset of labor (1.52%). This was possibly due to the fact that women who had a high risk of uterine rupture had planned cesarean sections.

Few studies sought to differentiate the reasons for uterine rupture. King et al.[47] only allowed those women ($n=32$) whose uterine cavity was not breached during myomectomy to choose vaginal birth, preferring planned cesarean section if the cavity had been breached. There was 1 uterine rupture while undergoing the vaginal route of birth and none in patients who had planned cesarean sections.

Of the 110 pregnant women mentioned by Gambacorti-Passerini et al.[39] who had previous myomectomy and delivered after 24 weeks of pregnancy, 73 (66.4%) of them had planned labor and 24 (21.8%) planned cesarean sections. Sixty-six (90.4%) of the women who labored successfully accomplished vaginal delivery with no uterine rupture cases, which is better than risk of uterine rupture during trial of labor after cesarean section.

Four studies, with a total of 49 pregnant patients who had RM reported no uterine ruptures,[32,40–42] while larger studies ($n=169$) each reported 1 case ($\sim$ 1%).[31,48]

There is still a debate regarding the mode of delivery depending on the method of closure, the size of the fibroid removed, whether the endometrial cavity was breached, and patient characteristics. National or international registries of myomectomy and pregnancy after myomectomy will be required to answer this question finally, and societies and professional organizations should be encouraged to work together to resolve this dilemma.

Placenta accreta following myomectomy

A serious, but uncommon, complication in pregnancy following myomectomy is placental accreta and its associated morbidity. This risk should be discussed before myomectomy with patients who are planning pregnancy.

An transvaginal scan can predict placenta accreta in early pregnancy.[49] The evidence available from the literature suggests that placenta accreta is not as common after a myomectomy as in previous cesarean section scars.[45,50]

This does not appear to be affected by the route of myomectomy. Abnormal placentation has been reported in 2.2%–5.2% of 169 cases following robotic myomectomy.[31,48]

Postpartum hemorrhage and other complications after myomectomy

Patients with fibroids and those who have had myomectomy have a higher risk of postpartum hemorrhage

(bleeding at the time of delivery or cesarean section). In 1 review by Gimovsky et al.,[51] 367 patients who had previous myomectomy were compared with 33,635 patients who did not. Patients who had myomectomy had a higher risk of intraoperative blood transfusion during cesarean section (9/367) and an increased risk of other poor hemostatic measures during labor or cesarean section/cesarean hysterectomy (1.4%, 5/367). In addition, 2 post-myomectomy patients had bowel injuries, and a cesarean hysterectomy was performed in 5 patients, which is a very high percentage, compared to other studies or the current authors' experience. Therefore, discussing complications, such as difficulties encountered during lower-segment cesarean section following myomectomy in women planning to conceive is essential.

Some Facts About Alternatives to Myomectomy

Alternatives to myomectomy include medical or hormonal treatment, hysterectomy, and UAE. Hormonal treatment—including oral progestogens and intrauterine devices, such as a levonorgestrel-releasing intrauterine system (LNG-IUS)[52]—is ideal for women with small fibroids who have menorrhagia. GnRH analogues produce good symptom relief although often, this is a temporary treatment.

NICE Guideline (in 2018) on HMB stated that a LNG-IUS or hormonal treatment is most useful if fibroids are small (< 4 cm).[52] Hormonal treatment is not acceptable for a patient who plans a pregnancy, and the side-effects (including bloating, mood effects, and intermenstrual bleeding) can be bothersome. Hormonal treatment with progesterone or GnRH analogues are temporary but good symptom relievers.

GnRH analogues by injection, nasal spray, or orally reduce the size of the fibroids and may be ideal treatments for small fibroids in perimenopausal women. GnRH injections are effective but temporary and need add-back to reduce the side-effects.[2,53] GnRH oral analogues have been available in some countries with combined estradiol, or estradiol, and progesterone has shown decreased HMB and decreased anemia.[2,53]

Ulipristal acetate was not available for routine preoperative shrinkage of fibroids at the time this article was written but is now available for fibroids not suitable for other treatments, provided liver function remains normal in patients.[54]

If a patient has completed her family, hysterectomy—the definitive treatment for HMB—is the best choice, but chronic back pain may persist after total hysterectomy, and women must be advised of this when being counseled. Patient satisfaction following myomectomy and hysterectomy are almost the same.[3] Stratifying by surgical route demonstrated similar short-term reduction of fibroid-related symptoms for laparoscopic hysterectomy and LM. Factors that should be considered for myomectomy or hysterectomy depend on the patient's desires, need for morcellation, operative time, and age of the patient, given the possible recurrence of fibroids.

Morcellation has additional risks, adds surgical time and cost to both LM and subtotal hysterectomy, and clinicians need to bear this in mind when planning procedures and counseling women.

UAE is another option available to patients with fibroids, and some women prefer this option as it avoids a general anesthetic and preserves the uterus. This procedure, however, is associated with a risk of persistent pelvic pain, as well as a small risk of needing surgical intervention in the immediate postprocedure time. There is a risk of emergency hysterectomy after UAE as a result of fibroid necrosis, which results in heavy bleeding and severe acute pain. In the longer-term, further surgical intervention is required in 10%–20% of cases.[55]

In a study by Davis et al.,[56] of 35,631 women, following abdominal ($n = 8018$), laparoscopic ($n = 4845$), and hysteroscopic ($n = 941$) approaches, myomectomy had a more-favorable outcome with less reintervention, compared to both UAE ($n = 4629$) and endometrial ablation (EA; $n = 17{,}198$). Myomectomy had the lowest 12-month reintervention rate (4.2%), followed by UAE (7.0%), then by EA (12.4%; both $p < 0.001$ relative to myomectomy). Estimates of 5-year reintervention rates were 19% overall for myomectomy (17%, 28%, and 20% for abdominal, hysteroscopic, and laparoscopic, respectively), 33% for EA, and 24% for UAE.

A systematic review and meta-analysis of treatments for fibroids by Sandberg et al.,[5] included 17,789 women and examined reintervention risk after the initial procedure at 60 months. There was a risk of reintervention of 12.2% for myomectomy and 53% for high-intensity-focused ultrasound myolysis, and a 14% risk for UAE.

UAE is not ideal for patients who are planning to have more children.[49] UAE is associated with a higher risk of complications in pregnancy, including premature deliveries and fetal growth restriction, and is not recommended for women planning to have children.[57] Chronic pelvic pain is another complication of UAE with numbness, new pain, or not resolving.

Conclusions

Fibroids can be treated in many ways, including conservatively, but myomectomy and hysterectomy result in good long-term outcomes for women, in comparison to no treatment and alternative therapies. Myomectomy, like hysterectomy, improves QoL and reduces HMB, but the procedure has consequences, including fibroid recurrence. Fibroids, themselves, cause problems associated with fertility and pregnancy, and fibroids treated by myomectomy may alleviate some of these concerns prior to IVF.

RM, is a safe and effective alternative to both LM and OM in terms of short- and long-term outcomes but accessibility and cost can be limiting.[13,15,58,59] Better-quality studies are required to compare the long-term outcomes of these myomectomy techniques.

Alternative treatment options to myomectomy, including no treatment, must be discussed with patients, including medical management, UAE, and hysterectomy.

Patients should be counseled appropriately about the risk of complications, and benefits of each approach, and should be provided with evidence-based information, including the implications of the approaches on future pregnancy.

Authors' Contributions

Dr. Gnanachandran as the lead author of this review, together with Dr. Penketh, conceptualized it and supervised preparation of the article as well as reviewing it.

Drs. Banzal and Athauda were responsible for the literature review, article preparation, review of the references, and proofreading.

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References

1. Brucker SY, Huebner M, Wallwiener M, et al. Clinical characteristics indicating adenomyosis coexisting with leiomyomas: A retrospective, questionnaire-based study. Fertil Steril 2014;101:237.e1.
2. Niaz R, Saeed M, Khan H, et al. Efficacy and safety of oral GnRH antagonists in patients with uterine fibroids: A systematic review. J Obstet Gynaecol Can 2022;44:1279.
3. Nicholson WK, Wegienka G, Zhang S, et al. Short-term health-related quality of life after hysterectomy compared with myomectomy for symptomatic leiomyomas. Obstet Gynecol 2019;134:261.
4. Mohr-Sasson A, Machtinger R, Mashiach R, et al. Long-term outcome of MR-guided focused ultrasound treatment and laparoscopic myomectomy for symptomatic uterine fibroid tumors. Am J Obstet Gynecol 2018;219:375.e1.
5. Sandberg EM, Tummers FHMP, Cohen SL, et al. Re-intervention risk and quality of life outcomes after uterine-sparing interventions for fibroids: A systematic review and meta-analysis. Fertil Steril 2018;109:698.
6. Laughlin-Tommaso SK, Lu D, Thomas L, et al. Short-term quality of life after myomectomy for uterine fibroids from the COMPARE-UF Fibroid Registry. Am J Obstet Gynecol 2020;222:345.e1.
7. Mallick R, Odejinmi F. Pushing the boundaries of laparoscopic myomectomy: A comparative analysis of perioperative outcomes in 323 women undergoing laparoscopic myomectomy in a tertiary referral centre. Gynecol Surg 2017;14:22.
8. Bhave Chittawar P, Franik S, Pouwer AW, et al. Minimally invasive surgical techniques versus open myomectomy for uterine fibroids. Cochrane Database Syst Rev 2014;10:CD004638.
9. Iavazzo C, Mamais I, Gkegkes ID. Robotic assisted vs laparoscopic and/or open myomectomy: Systematic review and meta-analysis of the clinical evidence. Arch Gynecol Obstet 2016;294:5.
10. Wang T, Tang H, Xie Z, et al. Robotic-assisted vs. laparoscopic and abdominal myomectomy for treatment of uterine fibroids: A meta-analysis. Minim Invasive Ther Allied Technol 2018;27:249.
11. Flyckt R, Coyne K, Falcone T. Minimally invasive myomectomy. Clin Obstet Gynecol 2017;60:252.
12. Catenacci M, Flyckt RL, Falcone T. Robotics in reproductive surgery: Strengths and limitations. Placenta 2011;32(suppl3):S232.
13. Jayakumaran J, Patel SD, Gangrade BK, et al. Robotic-assisted laparoscopy in reproductive surgery: A contemporary review. J Robot Surg 2017;11:97.
14. Lonnerfors C. Robot-assisted myomectomy. Best Pract Res Clin Obstet Gynaecol 2018;46:113.
15. Pundir J, Pundir V, Walavalkar R, et al. Robotic-assisted laparoscopic vs abdominal and laparoscopic myomectomy: Systematic review and meta-analysis. J Minim Invasive Gynecol 2013;20:335.
16. Jansen LJ, Clark NV, Dmello M, et al. Perioperative outcomes of myomectomy for extreme myoma burden: Comparison of surgical approaches. J Minim Invasive Gynecol 2019;26:1095.
17. Vargas MV, Larson KD, Sparks A, et al. Association of operative time with outcomes in minimally invasive and abdominal myomectomy. Fertil Steril 2019;111:1252.e1.
18. Bean EM, Cutner A, Holland T, et al. Laparoscopic myomectomy: A single-center retrospective review of 514 patients. J Minim Invasive Gynecol 2017;24:485.
19. Gardella B, Dominoni M, Iacobone AD, et al. What Is the role of barbed suture in laparoscopic myomectomy? A meta-analysis and pregnancy outcome evaluation. Gynecol Obstet Invest 2018;83:521.
20. Tinelli R, Litta P, Angioni S, et al. A multicenter study comparing surgical outcomes and ultrasonographic evaluation of scarring after laparoscopic myomectomy with conventional versus barbed sutures. Int J Gynaecol Obstet 2016;134:18.
21. Alomar O, Abu-Zaid A, Jamjoom MZ, et al. Prophylactic vasopressin to reduce intraoperative blood loss and associated morbidities during myomectomy: A systematic review and meta-analysis of 11 controlled trials. J Gynecol Obstet Hum Reprod 2022;51:102485.
22. Odejinmi F, Aref-Adib M, Liou N, et al. Rethinking the issue of power morcellation of uterine fibroids: Is morcellation the real problem or is this another symptom of disparity in healthcare provision? In Vivo 2019;33:1393.
23. Pados G, Tsolakidis D, Theodoulidis V, et al. Prevalence of occult leiomyosarcomas and atypical leiomyomas after laparoscopic morcellation of leiomyomas in reproductive-age women. Hum Reprod 2017;32:2036.
24. AAGL. AAGL practice report: Morcellation during uterine tissue extraction. J Minim Invasive Gynecol 2014;21:517.
25. Sizzi O, Manganaro L, Rossetti A, et al. Assessing the risk of laparoscopic morcellation of occult uterine sarcomas during hysterectomy and myomectomy: Literature review and the ISGE recommendations. Eur J Obstet Gynecol Reprod Biol 2018;220:30.
26. Merzougui S, Soleymani M, Malhas R, et al. Laparoscopic myomectomy: A retrospective review of 94 patients. BJOG 2019;126(S2):102 [In: Category–Gynaecological Endoscopy: Top Scoring Abstracts of the RCOG World Congress, London, UK, June 17–19, 2019].
27. Glaser LM, Friedman J, Tsai S, et al. Laparoscopic myomectomy and morcellation: A review of techniques, outcomes, and practice guidelines. Best Pract Res Clin Obstet Gynaecol 2018;46:99.
28. Yoo EH, Lee PI, Huh CY, et al. Predictors of leiomyoma recurrence after laparoscopic myomectomy. J Minim Invasive Gynecol 2007;14:690.
29. Radosa MP, Owsianowski Z, Mothes A, et al. Long-term risk of fibroid recurrence after laparoscopic myomectomy. Eur J Obstet Gynecol Reprod Biol 2014;180:35.
30. Ming X, Ran XT, Li N, et al. Risk of recurrence of uterine leiomyomas following laparoscopic myomectomy com-

pared with open myomectomy. Arch Gynecol Obstet 2020; 301:235.
31. Pitter MC, Srouji SS, Gargiulo AR, et al. Fertility and symptom relief following robot-assisted laparoscopic myomectomy. Obstet Gynecol Int 2015;2015:967568,
32. Flyckt R, Soto E, Nutter B, et al. Comparison of long-term fertility and bleeding outcomes after robotic-assisted, laparoscopic, and abdominal myomectomy. Obstet Gynecol Int 2016;2016:2789201.
33. Metwally M, Raybould G, Cheong YC, et al. Surgical treatment of fibroids for subfertility. Cochrane Database Syst Rev 2020;1:CD003857.
34. Sarıdoğan E. Management of fibroids prior to *in vitro* fertilization/intracytoplasmic sperm injection: A pragmatic approach. J Turk Ger Gynecol Assoc 2019;20:55.
35. Sunkara SK, Khairy M, El-Toukhy T, et al. The effect of intramural fibroids without uterine cavity involvement on the outcome of IVF treatment: A systematic review and meta-analysis. Hum Reprod 2010;25:418.
36. Christopoulos G, Vlismas A, Salim R, et al. Fibroids that do not distort the uterine cavity and IVF success rates: An observational study using extensive matching criteria. BJOG 2017;124:615.
37. Erden M, Uyanik E, Polat M, et al. The effect of ≤6 cm sized noncavity-distorting intramural fibroids on *in vitro* fertilization outcomes: A systematic review and meta-analysis. Fertil Steril 2023;119:996.
38. Lebovitz O, Orvieto R, James KE, et al. Predictors of reproductive outcomes following myomectomy for intramural fibroids. Reprod Biomed Online 2019;39:484.
39. Gambacorti-Passerini ZM, Penati C, Carli A, et al. Vaginal birth after prior myomectomy. Eur J Obstet Gynecol Reprod Biol 2018;231:198.
40. Huberlant S, Lenot J, Neron M, et al. Fertility and obstetrical outcomes after robot-assisted laparoscopic myomectomy. Int J Med Robot 2020;16:e2059.
41. Tusheva OA, Gyang A, Patel SD. Reproductive outcomes following robotic-assisted laparoscopic myomectomy (RALM). J Robot Surg 2013;7:65.
42. Cela V, Freschi L, Simi G, et al. Fertility and endocrine outcome after robot-assisted laparoscopic myomectomy (RALM). Gynecol Endocrinol 2013;29:79.
43. Klatsky PC, Tran ND, Caughey AB, et al. Fibroids and reproductive outcomes: A systematic literature review from conception to delivery. Am J Obstet Gynecol 2008;198: 357.
44. Jenabi E, Ebrahimzadeh Zagami S. The association between uterine leiomyoma and placenta abruption: A meta-analysis. J Matern Fetal Neonatal Med 2017;30:2742.
45. Gyamfi-Bannerman C, Gilbert S, Landon MB, et al. Risk of uterine rupture and placenta accreta with prior uterine surgery outside of the lower segment. Obstet Gynecol 2012;120:1332.
46. Gambacorti-Passerini Z, Gimovsky AC, Locatelli A, et al. Trial of labor after myomectomy and uterine rupture: A systematic review. Acta Obstet Gynecol Scand 2016;95: 724.
47. King N, Friedman J, Glaser L, et al. Pregnancy outcomes after vaginal trial of labor following myomectomy. J Minim Invasive Gynecol 2018;25(7[suppl]):S84.
48. Pitter MC, Gargiulo AR, Bonaventura LM, et al. Pregnancy outcomes following robot-assisted myomectomy. Hum Reprod 2013;28:99.
49. Karlsen K, Hrobjartsson A, Korsholm M, et al. Fertility after uterine artery embolization of fibroids: A systematic review. Arch Gynecol Obstet 2018;297:13.
50. Kim J, Movilla P, Lager J. Association between myomectomy and placenta accreta spectrum. J Minim Invasive Gynecol 2019;26(7[suppl]):S85.
51. Gimovsky AC, Frangieh M, Phillips J, et al. Perinatal outcomes of women undergoing cesarean delivery after prior myomectomy. J Matern Fetal Neonatal Med 2020;33: 2153.
52. National Institute for Healthcare and Excellence. Heavy Menstrual Bleeding: Assessment and Management. NICE guideline. March 14, 2018; updated May 24, 2021. Online document at: www.nice.org.uk/guidance/ng8 Accessed June 10, 2023.
53. Moroni RM, Martins WP, Ferriani RA, et al. Add-back therapy with GnRH analogues for uterine fibroids. Cochrane Database Syst Rev 2015;3:CD010854.
54. European Medicines Agency. Ulipristal Acetate 5Mg Medicinal Products. 2021. Online document at: www.ema.europa.eu/en/medicines/human/referrals/ulipristal-acetate-5mg-medicinal-products Accessed; May 11, 2021.
55. Amoah A, Quinn SD. Uterine-preserving treatments or hysterectomy reintervention after myomectomy or uterine artery embolisation: A retrospective cohort study of long-term outcomes. BJOG 2023;130:823.
56. Davis MR, Soliman AM, Castelli-Haley J, et al. Reintervention rates after myomectomy, endometrial ablation, and uterine artery embolization for patients with uterine fibroids. J Women Health (Larchmt) 2018;27:1204.
57. Das M, Tulandi T. UAE is not recommended for women wishing to conceive. In: Reidy R, Hacking N, McLucas B. eds.) Radiological Interventions in Obstetrics and Gynaecology. Berlin: Springer, 2014:143.
58. Behera MA, Likes CE, Judd JP, et al. Cost analysis of abdominal, laparoscopic, and robotic-assisted myomectomies. J Minim Invasive Gynecol 2012;19:52.
59. Nash K, Feinglass J, Zei C, et al. Robotic-assisted laparoscopic myomectomy versus abdominal myomectomy: A comparative analysis of surgical outcomes and costs. Arch Gynecol Obstet 2012;285:435.

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