ORIGINAL RESEARCH

# Indications for and Techniques of Microwave Ablation of Uterine Fibroids in Patients Seeking to Conceive

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*Received September 6, 2026; revision requested October 9, 2026; accepted December 4, 2026*

***Objective:*** To investigate the indications and techniques of microwave ablation for uterine fibroids in fertility-seeking patients, and to evaluate its safety and pregnancy outcomes.

***Methods:*** This prospective study analyzed 1,600 patients who underwent percutaneous microwave ablation, stratified by fertility desire. For the fertility-seeking group, protective interventions including intrauterine and pelvic saline isolation, as well as vaginal fornix support, were implemented. Patients were followed up to assess pregnancy rates, ovarian reserve (AMH), and obstetric outcomes.

***Results:*** Menstrual patterns, sex hormone levels, and AMH values showed no significant changes post-ablation. Among 104 patients intending to conceive, 78 achieved successful pregnancy (75.0%), resulting in 52 healthy live births. Higher pregnancy success rates were observed in patients with FIGO type 0-IV fibroids and those ≤ 8 cm in diameter. Standardized protective measures effectively prevented thermal injury to the endometrium, serosa, and vaginal mucosa. Patients are advised to use contraception for 3-6 months post-procedure and attempt conception once the fibroid shrinks to ≤ 4 cm and uterine cavity morphology improves.

***Conclusion:*** For fertility-seeking patients, FIGO types 0-6 uterine fibroids measuring ≤ 8 cm in diameter represent favorable indications. Adjunctive techniques during ablation, notably intrauterine catheter-mediated hydrodissection and artificial ascites, effectively preserve the structural integrity of the endometrium, uterine serosa, and ovaries.

***Key words:*** Microwave ablation; Uterine fibroids; Fertility; Indications; Pregnancy

Advanced Ultrasound in Diagnosis and Therapy 2026; 04: 259-263 DOI: 10.26599/AUDT.2026.250035

Leiomyomas are estrogen-dependent benign tumors with a prevalence of 20%-30% in women of reproductive age [1]. They can cause infertility, miscarriage, or preterm birth, and symptomatic patients require intervention before conception [2,3]. Traditional myomectomy effectively removes lesions but involves significant surgical trauma, creates uterine scar tissue, requires a long recovery period, and carries a

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risk of uterine rupture during pregnancy [4]. For older women seeking pregnancy, the 1-2 years postoperative recovery period reduces patient acceptance. Percutaneous microwave ablation (MWA) has been clinically applied for 20 years and has proven effective in shrinking fibroids and improving or eliminating symptoms [4-10]. Some patients who were infertile due to fibroids have achieved pregnancy after ablation [11,12], demonstrating that MWA may become a new therapeutic option to preserve uterine integrity and improve fertility. However, thermal ablation of fibroids, especially submucosal and intramural types, carries risks of damaging the endometrium, uterine serosa, or even the ovaries. The structural integrity of these components is crucial for successful conception and favorable pregnancy outcomes. Therefore, accurate indication selection and precise procedural techniques are critical for achieving satisfactory outcomes in fertility-seeking patients. This study investigates these aspects to provide evidence-based recommendations.

## Materials and Methods

### *Study population*

Patients who underwent percutaneous MWA for uterine fibroids between January 2012 and January 2026 were included. Inclusion criteria: (1) aged 20-47 years; (2) uterine fibroids associated with heavy menstrual bleeding, abdominal pain, compression symptoms, infertility, or miscarriage; (3) voluntary consent for MWA. Exclusion criteria: (1) genital malignancy; (2) severe coagulation disorders; (3) FIGO type VII fibroids. All enrolled patients were randomly divided into a fertility-seeking group (Group A) and a non-fertility-seeking group (Group B).

### *Methods*

Prior to ablation, all patients underwent pelvic ultrasound, plain and contrast-enhanced MRI, and serum estrogen/progesterone assays. Fertility-seeking patients also had ovarian reserve function (AMH) tested before and after ablation. Fibroid size and location were recorded. Using the FIGO classification system, fibroids were categorized as submucosal (FIGO 0, I, II), intramural (FIGO III, IV, V), and subserosal (FIGO VI, VII). Menstrual cycle and duration were recorded. Follow-up at 3, 6, 9, and 12, 24 months post-ablation included assessment of fibroid volume, E2, FSH, AMH levels, and ongoing pregnancy status and outcomes.

### *Equipment*

KY-2000 Microwave Generator (Nanjing Kangyou Medical Technology Co., Ltd.); Siemens Acuson 128 Ultrasound System (4-5 MHz transducer).

### *Procedure*

Under ultrasound guidance, a percutaneous microwave electrode was inserted into the lesion. Power was set at 40-60W [13]. Microwave irradiation was monitored in real-time and stopped when the hyperechoic thermal ablation zone reached the predetermined boundary.

Protective measures for Group A:

1. Submucosal fibroids: A double-lumen balloon catheter was inserted into the uterine cavity via the vagina [14], and sterile saline was continuously infused to separate and protect the endometrium (Fig. 1).

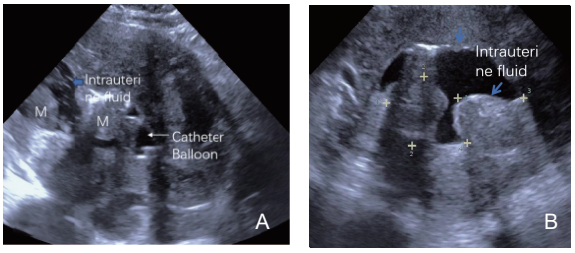



**Figure 1** (A) Grayscale ultrasound Images during microwave ablation: an intrauterine catheter balloon, submucosal fibroid (M), and sterile saline solution (Intrauterine fluid). (B) Grayscale ultrasound Images before the start of microwave ablation: Sterile saline solution in the uterine cavity; clearly visible endometrium (Arrow); submucosal fibroids (M)

2. Intramural and subserosal fibroids: Prior to ablation, an 18G cannula needle was used to rapidly inject sterile saline into the pelvis, creating a water isolation barrier around the uterus (Fig. 2).

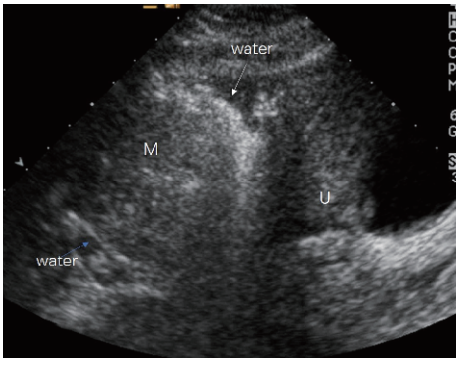



**Figure 2** Grayscale ultrasound images uterine fibroids (M) and intra-abdominal artificial ascites (water) in microwave ablation. U: uterus

3. A gauze ball was placed in the vaginal fornix to support the uterus and create a physical barrier between the cervix and vagina, preventing thermal injury from ascending heat.

4. Submucosal fibroids were completely ablated, especially at the pedicle; intramural fibroid ablation preserved serosal integrity.

5. For patients on GnRHa therapy, ablation was scheduled only after menses resumed normally.


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Menstrual status, ovarian function, AMH, uterine amenorrhea, conception, and pregnancy outcomes were recorded and compared between groups to evaluate the efficacy of protective measures and the rationality of indication selection.

## Statistical Analysis

Data were analyzed using SPSS software. Continuous variables are presented as mean ± SD, and categorical variables as percentages.

## Results

From January 2012 to January 2026, 1,600 patients with complete follow-up data were analyzed. Baseline characteristics are shown in table 1. Except for 3 cases in Group B with thermal endometrial injury, all patients resumed normal menstrual flow within the month following ablation, with normal volume and cycle. Pre- and post-ablation E2 and FSH levels showed no significant changes between or within groups ($P \geq 0.05$). In Group A, pre-ablation AMH averaged 2.72 (range 0.15-5.35), and 3 months post-ablation averaged 2.74 (range 0.17-5.58), with no significant difference ($P \geq 0.05$).

Among 104 patients in Group A with ongoing pregnancy plans, 78 conceived successfully (75.0%), resulting in 80 pregnancies. Twelve cases (14 pregnancies) were electively terminated due to lack of pregnancy planning. Thirteen patients experienced spontaneous miscarriages between 8-13 weeks gestation (including 2 cases of vanishing twin syndrome in multifibroid patients). One patient delivered a preterm infant at 26 weeks due to placental abruption. Fifty patients successfully delivered 52 healthy infants (including 2 sets of twins), all at term or near-term, with no cases of uterine rupture. Successful conceptions included 42 single and 36 multifibroid cases (2-9 fibroids, largest mean diameter 11.3 cm). Overall fibroid ablation rate was ≥ 80%. Among the 78 successful conceptions, 9 had primary infertility, and 8 had prior failed myomectomy or HIFU with recurrence. Table 2 shows the relationship between fibroid parameters and pregnancy outcomes in patients who successfully conceived after ablation. Figure 3 Pre- and post-ablation ultrasound and MRI images of a representative case

The 26 non-conceiving patients included 10 with tubal occlusion; 4 with AMH ≤ 0.05; 1 with recurrent multifibroids post-surgery (largest FIGO III, 11.3 cm, reduced to 7.3 cm post-ablation, failed 4 IVF cycles); 8 with large multifibroids (FIGO III-IV, 9.8-12.0 cm, reduced to 6.9 cm, failed timed intercourse); and 3 with FIGO I fibroids (5.6 cm) where partial expulsion and residual tissue occurred.

## Discussion

### *Indication selection for fertility-seeking patients*

The impact of fibroids on fertility depends on location, size, and number. Evidence shows a significant location-dependent variation [11]. Submucosal fibroids distort the cavity and severely impair implantation, reducing pregnancy rates by 50%-70%. Therefore, intervention before conception is mandatory. FIGO 0-I fibroids are often completely expelled post-ablation, relieving endometrial compression and improving conception. FIGO II fibroids shrink into intramural locations, relieving cavity distortion. Intramural fibroids (FIGO III-IV) do not protrude into the cavity but ≥ 4 cm

**Table 1** Baseline data for patients

| Grouping | N | Age (Y) | Mean diameter of fibroids cm×⁻±SD | Uterine Amenorrhea | Vaginal Mucosal Burns | Irregular periods after ablation |
|---|---|---|---|---|---|---|
| A group | 220 | 34.6 ± 10.5 | 5.54 ± 1.89 | 0 | 0 | 0 |
| B group | 1380 | 35.7 ± 10.0 | 7.54 ± 1.78 | 4 | 1 | 4 |
| *P* value | | $P \geq 0.05$ | $P \geq 0.05$ | $P \geq 0.05$ | $P \geq 0.05$ | $P \geq 0.05$ |

**Table 2** the relationship between fibroid parameters and pregnancy outcomes

| Classification of Fibroids | Mean diameter of fibroidscm | Number of Successful Pregnancies N | Induced Abortion N | Spontaneous Abortions N | Deliveries N |
|---|---|---|---|---|---|
| Submucosal | 4.6<br>2.7-7.3 | 7 | 2 | 2 | 3 |
| Intramural | 5.7<br>(4.3-12) | 63 | 11 | 11 | 36 |
| Subserosal | 6.0 (3-12) | 10 | 1 | 1 | 15 |
| Single | | 54 | 13 | 11 | 36 |
| Multiple | | 26 | 1 | 3 | 18 |
| Total number of cases | | 80 | 14 | 14 | 54 |

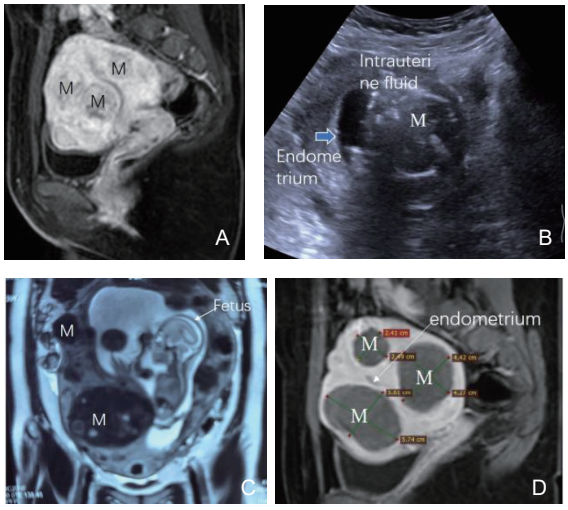



**Figure 3** (A) Grayscale ultrasound images multiple uterine fibroids (M): Submucosal fibroids deforming the uterine cavity prior to microwave ablation; (B) Grayscale ultrasound images intrauterine water isolation during microwave ablation of submucosal fibroids, clearly showing the endometrium; (C) Grayscale ultrasound images enhanced MRI of the same patient 3 days after microwave ablation of multiple uterine fibroids: The fibroids show no contrast enhancement, indicating necrosis, and the twisted and deformed endometrium has resolved; (D) An MRI images without contrast 13 weeks of gestation following microwave ablation in a patient with multiple uterine fibroids shows the fetus (fetus) and a necrotic uterine fibroid (M). The patient delivered a healthy infant via cesarean section in the third trimester.

can cause cavity deformation or compress perimembranous vessels, reducing blood flow and impairing implantation. Cervical or cornual locations may cause mechanical obstruction. Our data show high pregnancy success with intramural fibroids, supporting ablation. However, fibroids > 10 cm had lower success rates; surgical myomectomy is recommended. Subserosal fibroids (FIGO VI-VII) rarely affect the cavity. Large ones carry risks of growth, degeneration (especially red degeneration), and miscarriage during pregnancy. Intervention is only indicated for symptomatic or proven fibroid-related infertility/recurrent miscarriage. Asymptomatic, small fibroids without cavity impact should be observed.

### *Timing of ablation*

MWA causes coagulative necrosis, followed by tissue absorption, cavity restoration, and improved vascularity. However, if large fibroids do not shrink sufficiently (< 4 cm for submucosal, or significant relief for intramural), pregnancy rates remain low. Therefore, ablation is recommended for fibroids ≥ 5 cm to ensure adequate shrinkage. For patients requiring ART, egg retrieval should precede ablation to avoid hormone-driven residual fibroid regrowth during controlled ovarian stimulation.

### *Clinical efficacy of protective measures*

Group A (with protective measures) had significantly lower rates of endometrial and vaginal thermal injuries compared to Group B, confirming the effectiveness of these techniques. They should be standardized for fertility-seeking patients. Ovarian function is critical for conception [15]. When ovaries are adhesed or adjacent to the uterus, heat diffusion must be minimized. The thermal field should avoid ovarian tissue. For fibroids near ovaries, "pulsed" ablation or shortened duration, combined with artificial ascites/water isolation, leverages heat shock protein protection and thermal insulation to safeguard ovaries. All patients except the 3 with severe endometrial injury resumed normal menses, indirectly confirming ovarian safety. Hormone levels and AMH monitoring were normal [12]. Saline injection effectively visualizes ovarian position and separates it from FIGO VI fibroids, preventing thermal damage.

### *Timing for conception post-ablation*

Necrotic tissue requires time for absorption, and uterine structure needs time for remodeling. Conception in our cohort occurred 1-24 months post-ablation, suggesting that pregnancy is safe once the fibroid shrinks to ≤ 4 cm and the cavity architecture improves. Patients are advised to use contraception for 3-6 months post-ablation, with regular follow-up. When optimal shrinkage and cavity restoration are achieved, conception can be attempted. GnRH-a may be used adjunctively to shrink residual tumor tissue.

## Conclusion

Microwave ablation offers a safe and effective treatment option for uterine fibroids in women seeking pregnancy. Strict indication selection is crucial: determining the optimal size thresholds for surgical myomectomy vs. MWA across FIGO types. For single or multiple fibroids, 5-8 cm lesions yield higher post-ablation pregnancy rates. FIGO classification should guide intervention timing: submucosal fibroids require proactive intervention; subserosal fibroids 5 < size can be observed; intramural fibroids ≤ 8 cm is highly suitable. During ablation, meticulous protection of the endometrium, serosa, and myometrial wall thickness is paramount. Conception is recommended 3-6 months post-procedure once the fibroid shrinks to ≤ 4 cm and the uterine cavity is anatomically restored.

## Acknowledgment

We thank the associate editor and the reviewers for their useful feedback that improved this paper.

## Authors' Contributions

Jing Zhang conceived of and designed the study, Microwave Ablation

Treatment of Patients and Drafting of the Article; Bingsong Zhang drafted the manuscript and performed statistical design and analysi; Jing Wang carried out the data collections, Xiaoliang Lin, Xuejuan Dong, Xiaoguang Qi and Xianchun Ou Participate in the data collection; and Xinyao WU acquired and interpreted of the data for the work. All authors contributed to editorial changes in the manuscript. All authors read and approved the final manuscript.

## Funding

National Natural Science Foundation of China (81071156).

## Data Availability

Not applicable.

## Declarations

### *Ethics approval and consent to participate*

The institutional review board approval was obtained and all patients were informed and signed consent. The study protocol was approved by the Ethics Committee of the First Medical Center of the PLA General Hospital.

### *Conflict of interest*

The authors have no conflict of interest to declare.

### *Consent for publication*

Not applicable.

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