

# Short-term results of magnetic resonance imaging-guided focused ultrasound surgery for patients with adenomyosis: symptomatic relief and pain reduction

The objective of this study was to evaluate the degree of symptomatic relief obtained after treatment with magnetic resonance-guided focused ultrasound surgery in patients with adenomyosis. Quality of life and pain assessment questionnaires from 35 women, collected on the day of treatment and up to 6 months after treatment, indicated that the treatment was safe and there was a significant reduction in symptoms. (Fertil Steril® 2011;95:1152–5. ©2011 by American Society for Reproductive Medicine.)

**Key Words:** MRgFUS, adenomyosis, focused ultrasound, thermal ablation

During the past several years, the application of magnetic resonance-guided focused ultrasound surgery (MRgFUS) for the treatment of symptomatic uterine fibroids has been established as safe and effective, indicating fibroid shrinkage and symptom alleviation in diverse ethnic populations (1–3). Recently, it has been reported that this technology has also been successfully applied to patients suffering from adenomyosis (4–6). Magnetic resonance imaging (MRI) is a valuable diagnostic tool, which may be used to differentiate between uterine fibroids and adenomyosis. The images can also help distinguish between focal adenomyosis (where the general shape is oval) and the diffuse type (which appears as diffuse widening of the endometrial–myometrial junctional zone) (7).

Patients suffering from adenomyosis report symptoms such as dysmenorrhea and menorrhagia (8, 9). Adenomyosis is often treated with hysterectomy (10), which is the definitive treatment.

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Thus, the extent of this disease can be estimated by its prevalence in hysterectomy specimens, which may vary between 15% and 25% (11, 12). However, minimally invasive treatment options have been used with various degrees of success (13, 14). Adenomyosis is also regularly observed in patients wishing future childbearing, thus requiring a more conservative approach (15).

In the current study we analyzed a series of consecutive patients with adenomyosis and sought to retrospectively evaluate the degree of symptomatic relief as well as alterations in pain levels after MRgFUS treatment. Patients came for a clinical examination reporting severe symptoms of bleeding or dysmenorrhea. After their diagnosis, interested patients were referred to undergo a screening MRI examination. Our institutional review board provided approval for the study. All patients were counseled on the nature of the procedure and all provided informed consent for this form of treatment.

In all 37 eligible patients were consecutively treated between November 2006 and November 2008. Two treatments were terminated at the onset of the procedure because of an insufficient thermal increase seen at the target and unmanageable abdominal pain. These patients were, therefore, not further evaluated. The remaining 35 patients underwent a complete treatment, and were scheduled to be followed for a period of 6 months after treatment.

The mean age and body mass index (BMI) of the 35 Korean women treated with MRgFUS were  $42 \pm 6$  years (mean  $\pm$  SD; range 27–51 years) and  $22.2 \pm 2.1$  kg/m<sup>2</sup> (range 18–27 kg/m<sup>2</sup>). One patient was perimenopausal, whereas the remaining patients were still in their premenopausal hormonal state. The mean uterine volume (calculated using the prolate ellipse equation) was  $430 \pm 230$  cc, and the ratio between the junctional zone to the myometrial zone was  $0.88 \pm 0.13$ . When observing the comorbidity of fibroids, 25 patients were found to have pure adenomyosis, whereas the remaining 10 patients had a concurrent myoma. Twenty-one of the patients were diagnosed with focal adenomyosis, and the remaining 14 patients had diffuse adenomyosis. For 19 of the patients, treatment was performed during the first half of their menstrual cycle (days 0–13), whereas 14 patients were treated



The menstrual pain levels were also monitored throughout the study, showing considerable reduction (from a baseline mean of  $8.5 \pm 2.2$  to  $5.9 \pm 2.5$  3 months later;  $P < .001$ ). Pain intensity continued to decrease, reaching  $4.7 \pm 2.3$  ( $P < .001$ ) by the 6-month follow-up.

We analyzed the results focusing on three distinct baseline factors: the type of adenomyosis, the presence of fibroids, and the timing of the treatment in relation to the menstrual cycle (Table 1). There was no significant difference between the subgroups at baseline. The comparisons at baseline included all treated patients ( $n = 35$ ); however, similar results were obtained when looking only at the baseline values of the group of patients who eventually completed the study ( $n = 28$ ) (data not shown). In addition, the difference between the baseline values of the symptom severity score and those obtained after 6 months did not result in a significant change when stratified between all three modes of analysis. However, when comparing the difference in the pain score, the change for the group of patients with focal adenomyosis ( $4.5 \pm 1.7$  points on the visual analogue scale) was significantly more than that of the diffuse adenomyosis group ( $2.8 \pm 1.6$ ;  $P = .02$ ). Although the group that was treated in the first half of the menstrual period appeared to have a greater reduction in their pain score ( $4.4 \pm 1.5$ ), compared with the group that was treated during the second part of the menstrual period ( $2.9 \pm 2.3$ ), the difference was not statistically significant ( $P = .08$ ). We speculate that because there is decreased blood perfusion during the follicular phase, the thermal treatment was slightly more effective for those patients treated at that stage.

Minimally invasive techniques are increasingly being offered to patients. The MRgFUS treatment modality allows safe uterine fibroid treatments (20). Unlike ultrasound-guided high intensity-focused ultrasound treatments, which have limited visualization during the course of the treatment and lack of knowledge on the temperature reached at the focus of the energy delivery (21, 22),

MRgFUS uses real-time thermal images to provide accurate tissue thermal responses as well as real-time anatomical images. The former allows the physician operating the MRgFUS system to perform the necessary protocol adjustments in case the appropriate temperature levels are not reached. The latter provides the physician with an indication of whether the patient or an internal organ has shifted in comparison with the planned location.

The current study demonstrated that clinical improvement for symptomatic adenomyosis treated with MRgFUS is achievable within a short period of time. It was reassuring that no adverse events were recorded during the treatments or during the follow-up period. In this report we focused on the change of patient symptoms (bulk and bleeding) as exhibited by the symptom severity score, and found that there was a constant decrease in patients' symptoms throughout the course of the follow-up period. In addition, as dysmenorrhea is common for patients suffering from adenomyosis, the systematic tracking of the patients' pain levels was emphasized, resulting in the outcome that patients with focal adenomyosis experience a greater decrease in their pain intensity.

In addition, although statistically insignificant, patients who were treated in the first half of their menstrual period reported less menstrual pain during their follow-up visits, possibly due to reduced blood perfusion, which contributed to the more efficient heat accumulation during the treatment.

A limitation of this study was the relatively short follow-up period. A longer follow-up is required to provide physicians and patients with more information on the sustainability of this form of treatment. In conclusion, it is encouraging to see that patients experience fast symptomatic relief, as well as a reduction in pain after MRgFUS treatment targeting uterine adenomyosis.

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## REFERENCES

- Hindley J, Gedroyc WM, Regan L, Stewart E, Tempany C, Hynynen K. MRI guidance of focused ultrasound therapy of uterine fibroids: early results. *AJR Am J Roentgenol* 2004;183:1713–9.
- Morita Y, Ito N, Hikida H, Takeuchi S, Nakamura K, Ohashi H. Non-invasive magnetic resonance imaging-guided focused ultrasound treatment for uterine fibroids—early experience. *Eur J Obstet Gynecol Reprod Biol* 2008;139:199–203.
- Stewart EA, Gostout B, Rabinovici J, Kim HS, Regan L, Tempany CMC. Sustained relief of leiomyoma symptoms by using focused ultrasound surgery. *Obstet Gynecol* 2007;110:279–87.
- Fukunishi H, Funaki K, Sawada K, Yamaguchi K, Maeda T, Kaji Y. Early results of magnetic resonance-guided focused ultrasound surgery of adenomyosis: analysis of 20 cases. *J Minim Invasive Gynecol* 2008;15:571–9.
- Rabinovici J, Inbar Y, Eylon SC, Schiff E, Hananel A, Freundlich D. Pregnancy and live birth after focused ultrasound surgery for symptomatic focal adenomyosis: a case report. *Hum Reprod* 2006;21:1255–9.
- Yoon S, Kim KA, Cha SH, Kim YM, Lee C, Na Y. Successful use of magnetic resonance-guided focused ultrasound surgery to relieve symptoms in a patient with symptomatic focal adenomyosis. *Fertil Steril* 2008;90:2018.e13–5.
- Byun JY, Kim SE, Choi BG, Ko GY, Jung SE, Choi KH. Diffuse and focal adenomyosis: MR imaging findings. *Radiographics* 1999; 19 Spec No:S161–70.
- Pelage J, Jacob D, Fazel A, Namur J, Laurent A, Rymer R. Midterm results of uterine artery embolization for symptomatic adenomyosis: initial experience. *Radiology* 2005;234:948–53.
- Levgur M. Diagnosis of adenomyosis: a review. *J Reprod Med* 2007;52:177–93.
- Levgur M. Therapeutic options for adenomyosis: a review. *Arch Gynecol Obstet* 2007;276:1–15.
- Raju GC, Naraynsingh V, Woo J, Jankey N. Adenomyosis uteri: a study of 416 cases. *Aust N Z J Obstet Gynaecol* 1988;28:72–3.
- Vercellini P, Parazzini F, Oldani S, Panazza S, Bramante T, Crosignani PG. Adenomyosis at hysterectomy: a study on frequency distribution and patient characteristics. *Hum Reprod* 1995;10:1160–2.
- McCausland V, McCausland A. The response of adenomyosis to endometrial ablation/resection. *Hum Reprod Update* 1998;4:350–9.
- Kitamura Y, Allison SJ, Jha RC, Spies JB, Flick PA, Ascher SM. MRI of adenomyosis: changes with uterine artery embolization. *AJR Am J Roentgenol* 2006;186:855–64.
- Devlieger R, D'Hooghe T, Timmerman D. Uterine adenomyosis in the infertility clinic. *Hum Reprod Update* 2003;9:139–47.
- Harding G, Coyne KS, Thompson CL, Spies JB. The responsiveness of the uterine fibroid symptom and health-related quality of life questionnaire (ufs-qol). *Health Qual Life Outcomes* 2008;6:99.
- Spies JB, Coyne K, Guaou G, Guaou N, Boyle D, Skyrnarz-Murphy K, Gonzales SM. The ufs-qol, a new disease-specific symptom and health-related quality of life questionnaire for leiomyomata. *Obstet Gynecol* 2002;99:290–300.
- Stewart EA, Rabinovici J, Tempany CMC, Inbar Y, Regan L, Gostout B. Clinical outcomes of focused ultrasound surgery for the treatment of uterine fibroids. *Fertil Steril* 2006;85:22–9.
- Fennessy FM, Tempany CM, McDannold NJ, So MJ, Hesley G, Gostout B. Uterine leiomyomas: MR imaging-guided focused ultrasound surgery—results of different treatment protocols. *Radiology* 2007;243:885–93.

20. Taran FA, Tempany CMC, Regan L, Inbar Y, Revel A, Stewart EA. Magnetic resonance-guided focused ultrasound (mrgfus) compared with abdominal hysterectomy for treatment of uterine leiomyomas. *Ultrasound Obstet Gynecol* 2009;34:572–8.
21. Yang Z, Cao Y, Hu L, Wang Z. Feasibility of laparoscopic high-intensity focused ultrasound treatment for patients with uterine localized adenomyosis. *Fertil Steril* 2009;91:2338–43.
22. Wang W, Wang Y, Tang J. Safety and efficacy of high intensity focused ultrasound ablation therapy for adenomyosis. *Acad Radiol* 2009;16:1416–23.