The effect of oral contraceptives on uterine contractility and menstrual pain: an assessment with cine MR imaging

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BACKGROUND: Low-dose oral contraceptives (OC) have been reported to control primary dysmenorrhea. Furthermore, a close relationship between dysmenorrhea and uterine contractions has been visualized with magnetic resonance imaging (MRI). This study aimed to use cine MR to demonstrate the effects of OC on myometrial contractility during menstruation and to associate the findings with dysmenorrhea. METHODS: MR studies were obtained of 21 healthy female volunteers (22–47 years old) taking OC, and 20 control women (24–39 years old) not taking OC. Cine- and static MR images were obtained with a 1.5 T magnet during menstruation. Uterine contractility was assessed by the presence of endometrial distortion on cine MR, the area of the mid-sagittal uterine myometrium, and the thickness of the subendometrial low-intensity area on static images. Dysmenorrhea were assessed via a questionnaire. RESULTS: A total of 21 OC users and 20 controls were included in the analysis. Endometrial distortion was significantly less prominent and the subendometrial low-intensity area was significantly thinner in the OC group. Furthermore in the OC group, the uterine myometrial area was larger (although not significantly) and the degree of assessed pain was significantly lower. CONCLUSIONS: Both cine- and static MR images demonstrate that myometrial contractility was relatively suppressed in OC users, which may represent one of the reasons explaining the reduced menstrual pain experienced by OC users.

Keywords: uterus; MR; oral contraceptives; uterine contraction

Introduction

Oral contraceptives (OC), although initially developed to prevent conception, represent the principal medication used to treat primary dysmenorrhea (Davis and Westhoff, 2001; Davis et al., 2005), with a recent randomized trial demonstrating that low- and medium-dose OC relieve dysmenorrhea pain in adolescent girls (Proctor et al., 2001; Davis et al., 2005). Although several mechanisms underlying the dysmenorrhea pain relief attained with OC have been reported, suppression of prostaglandin (PG) synthesis, leading to reduced uterine contractions, represents one of the most probable pathways (Akerlund, 1979; Chan and Dawood, 1980; Creatsas et al., 1990; Davis and Westhoff, 2001).

Myometrial contractions may serve to physically expel sloughing endometrial tissue from the uterus. Dysmenorrhea is thought to be caused by uterine contractions that result from increased PG production by the endometrium (Jolin and Rapkin, 2002). In addition, such contractions may result in decreased uterine wall blood flow (Palter and Olive, 2002). Recently, it has been shown with cine MRI that the degree of uterine contractions is related to the degree of pain during menstruation (Kataoka et al., 2005). Cine MRI is the serial acquisition of the same slice for several minutes, with subsequent display as a movie. Several morphological changes of the uterus, such as the thickness of the subendometrial layer of low-signal intensity, the degree of endometrial distortion and the area of the uterine myometrium, were reported to be closely associated with the degree of pain using cine MRI (Kataoka et al., 2005).

Given that OC lead to suppression of PG synthesis, menstrual uterine contractions in subjects taking OC are thought to be reduced compared with subjects not taking OC, leading to an improvement in dysmenorrhea. In other words, reduced contractility might suppress dysmenorrhea with the use of OC. This study was designed to visualize the effects of OC on myometrial contractility with cine MRI and to associate the findings with the degree of dysmenorrhea.

Materials and Methods

Study population

The protocol of this study was approved by the Ethics Committee of our institute. Written informed consent was obtained from all subjects.
A total of 25 healthy female volunteers of reproductive age (range: 22–47 years, mean: 32.4 years) and actively taking OC were recruited from two private hospitals specializing in obstetrics and gynecology (Ito Women’s Hospital and Fukuoka Women’s Clinic), three general hospital obstetrics and gynecology departments (Nihon Baptist Hospital, Kyoto Katsura Hospital and Kyoto Senbai Hospital) and volunteers at our institute from September 2002 to March 2004 (Table 1). A total of 14 of the 25 subjects were referred from gynecologists at the three private hospitals and an obstetrics and gynecology department at one of the general hospitals. OC were being administered for contraception to five subjects and for dysmenorrhea to nine subjects. These 14 subjects had already been determined to be physically normal by gynecologic examination and visually normal based on assessment with transvaginal ultrasound. Inclusion criteria for these 14 subjects referred from gynecologists were normal gynecologic examination and no abnormality on MRI. Exclusion criteria for the study were prior pelvic disease or lesion, other than dysmenorrhea. The other 11 subjects were volunteers working at one of the private hospitals or at our institute, voluntarily taking OCs so as to participate in this research project. The inclusion criteria of the 11 volunteers were as follows: no current gynecologic symptomatology, no history of gynecologic illness, normal MRI findings and a willingness to participate.

A total of 23 women not taking contraceptives (age range: 24–39 years, mean: 28.9 years) were included as a control group. These 23 subjects had been recruited from hospital staff members, medical students and graduate school students of our institute. Inclusion criteria were no history of gynecologic illness and no abnormal findings on pelvic MRI. Three of 23 women were parous. MRI of the control group was acquired for both this study at the investigators’ university from September 2003 to December 2004.

All MR studies of the OC and control groups were performed within two days after commencement of bleeding. The reason for selecting the first two days is that endometrial distortion and junctional zone (JZ) thickness are most prominent on the first or second, but not the third, day of bleeding (Kataoka et al., 2005). Scanning only on the first day would be preferable, since the MR findings and dysmenorrheal symptoms are most prominent on first day according to the previous report (Kataoka et al., 2005). However, from a practical point of view, the second day was included so that the dropout rate due to missed scans could be minimized as much as possible. No request was made to the volunteers to abstain from intercourse prior to MRI acquisition.

Subjects were excluded for incidental discovery of leiomyomata (two in the OC group, one in the control group) on MRI. In addition, due to inability to image within two days of the start of bleeding, two subjects in the control group and two subjects in the OC group were excluded from the analysis. In total, 21 women taking OC and 20 women not taking OC were included for analysis.

OC taken by the subjects were all combination pills containing both synthetic estrogen (ethinyl estradiol) and progestin (ethinyl diacetate, norgestrel or norethinfrone). Six types of drugs were used for the 21 subjects. All 21 subjects taking OC had a cycle length of 28 days. Estrogen and progesterone levels for each drug are shown in Table 2. A total of 13 women were taking Ange (Teikokuzoki-Sumitomo-Mochida, Japan): one for 2 years, two for 9 months, one for 6 months and 11 for three months. Four subjects were taking Triquilar (Schering Japan, Japan): one each for 4 years, 3 years, 1 year and 10 months. Two subjects were taking Ortho (Janssenkyowa-Mochida, Japan): one each for 2 years and 1 year. One subject each was taking Synphase (Pharmaecia-Tsumura, Japan) for 3 months and one subject was taking Duoluton (Nihon Schering, Japan) for 6 months. Ten women were experienced gravidas and eight women were parous. This data were acquired from September 2002 to April 2004.

### MR scanning protocols
MR studies were performed with a 1.5T magnet unit (Symphony; Siemens Medical Systems, Erlangen, Germany) with a phased-array coil. HASTE (half-Fourier acquisition single-shot turbo spin echo) techniques were used to obtain cine MRI. Under quiet respiration, a total of 60 serial images in the mid-sagittal plane of the uterus were obtained by HASTE (Echo time = 80 ms, FOV = 250 x 250 mm, slice thickness = 5 mm, matrix = 512 x 384, FA = 150°), every 3 s over 3 min in both groups. Two HASTE scans were performed for each subject in case of insufficient image quality of a single HASTE sequence. One of the two HASTE scans was randomly selected with a software program (SPSS version 11, Tokyo, Japan) for use in analysis. Sagittal Turbo spin-echo T2-weighted images (WI) (TR = 5470 ms, TE = 122 ms), sagittal spin-echo T1-WI (TR = 592 ms, TE = 15 ms), and axial HASTE images were obtained once for each examination to determine if there was any finding suggestive of an underlying disease, such as an endometrioma or uterine leiomyoma. Pre-medication, to include anti-cholinergic drugs, was not given to any subject.

All imaging was acquired under supervision of only one of the authors (A.K.).

### Table 1: Subjects included in the study

<table>
<thead>
<tr>
<th>OC users</th>
<th>Volunteers</th>
<th>Excluded</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Referred by gynecologist</td>
<td>(physically examined with TVUS)</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>Subjects</td>
<td>(no gynecologic symptom or history of gynecologic illness)</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>25</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4 (n = 2 leiomyoma, n = 2 failure of data acquisition)</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>21</td>
</tr>
<tr>
<td>Controls</td>
<td>Volunteers</td>
<td>Excluded</td>
<td>Total</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(n = 1 leiomyoma, n = 2 failure of data acquisition)</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>20</td>
</tr>
</tbody>
</table>

### Table 2: Quantitative breakdown of each OC and the number of subjects taking each OC

<table>
<thead>
<tr>
<th>OC</th>
<th>Estrogen (mg)</th>
<th>Type of progesterone</th>
<th>Progesterone (mg)</th>
<th>Subjects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Triquilar</td>
<td>0.040</td>
<td>levonorgestrel</td>
<td>0.050</td>
<td>4</td>
</tr>
<tr>
<td>Ange</td>
<td>0.030</td>
<td>levonorgestrel</td>
<td>0.125</td>
<td>13</td>
</tr>
<tr>
<td>Ortho</td>
<td>0.035</td>
<td>norethisterone</td>
<td>1.000</td>
<td>2</td>
</tr>
<tr>
<td>Synphase</td>
<td>0.035</td>
<td>norethisterone</td>
<td>0.500</td>
<td>1</td>
</tr>
<tr>
<td>Duoluton</td>
<td>0.050</td>
<td>norgestrel</td>
<td>0.500</td>
<td>1</td>
</tr>
</tbody>
</table>

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Image analysis

The following three points were evaluated as indicators of quantitative and qualitative assessments of uterine contractility, as established in a previously published report (Kataoka et al., 2005):

(i) the area of the myometrium;
(ii) the thickness of the subendometrial low-intensity area (JZ) and
(iii) the presence of endometrial distortion.

The present study utilized assessments and evaluations similar to a previous report, as described below (Kataoka et al., 2005).

Quantitative image evaluation

The mid-sagittal uterine myometrial area was measured on HASTE images to allow quantitative assessment of uterine contractility. The measurement was performed on the first of 60 images. The uterine corpus was defined as uterine tissue above the level of the internal os (Fig. 1A), according to a previous report (Kataoka et al., 2005). The endometrial area (Fig. 1B) was calculated on the mid-sagittal plane through the internal os. The myometrial area (Fig. 1C) in the uterine corpus was calculated by subtracting the endometrial area from the uterine corpus area using a satellite console of the MR unit. Measurement of the areas was performed by one radiologist.

The thickness of the subendometrial low-intensity area was quantitatively assessed in this study, although it had only been qualitatively evaluated in a previous report (Kataoka et al., 2005). The width of the subendometrial low-intensity area was measured at the midpoint of the length of the uterine corpus on the anterior wall, posterior wall and fundus in all 60 HASTE images. After such measurements were performed for all 60 HASTE images, the maximum thickness of the subendometrial low-intensity area was used for evaluation and divided into three categories as follows, in accordance with a previous report (Kataoka et al., 2005):

(i) less than half of the myometrial thickness;
(ii) greater than half, but less than the total myometrial thickness and
(iii) equal to the full myometrial thickness.

Qualitative image analysis

Qualitative image analysis was performed for evaluation of the presence of endometrial distortion. Endometrial distortion was defined as a squeezing of the endometrial configuration in the fundus (Fig. 1D,E). For qualitative analysis, the most prominent findings were selected as the final result. Image analysis was independently performed via visual inspection by two radiologists. After completing individual reviews, the radiologists jointly reviewed the images so as to achieve a consensus reading. Both of the readers evaluated MR findings without knowledge of the pain scores of the volunteers. MR images were evaluated at 15 times faster than real time for all the subjects.

In cases with considerable changes observed during the 3 min scan, i.e. findings that could potentially change evaluation categories, the most prominent findings were used for final evaluation, in accordance with the methodology of a previous study (Kataoka et al., 2005). Endometrial distortion was evaluated as: 0, absent; or 1, present.

Evaluation of pain

The degree of pain was verbally assessed by a questionnaire at the time of MR examination by one of the three investigators. Pain was scored on a 3-point verbal rating scale (1, none; 2, mild to moderate and 3, severe) modified from a previously described report (Kataoka et al., 2005). In the previous report, the pain score consisted of 4 grades (1, none; 2, mild; 3, moderate and 4, severe). Nonetheless, as the present study had a small sample number, the degrees “mild” and “moderate” were combined. Severe pain was defined as pain so strong that subjects would have used analgesics if they had not been recruited for the study, while mild to moderate pain was defined as pain that can usually be endured without analgesics. All subjects were asked to refrain from analgesic ingestion, despite severe pain, for at least 12 h prior to the MR examinations.

Statistical analysis

To evaluate the consistency of endometrial distortion on MRI, the concordance of the radiologists was evaluated with the Kappa correlation coefficient. The level of agreement was defined with the following kappa values: 0–0.20, poor; 0.21–0.40, fair; 0.41–0.60, moderate; 0.61–0.8, good and 0.81–0.99, almost perfect (Landis and Koch, 1977).

Inner myometrial thickness was compared for the OC and control groups with the Mann–Whitney test. Endometrial distortion was compared with the Chi-square test and uterine myometrial area was compared with the unpaired Student’s t-test, assuming equal variance. The degree of pain experienced by the two groups was compared with the Mann–Whitney test. Statistical significance was defined as P < 0.05.

The statistical power was estimated as the probability of detecting the observed difference in means or proportions between the control and OC groups at a two-sided significance level of 0.05 using a sample size of 20. When the original data were ordinal with three levels (degree of pain and thickness of inner myometrium), the data were converted to a binary scale by combining the two levels of smaller size so that the power was calculated based on a binominal distribution (Ingelfinger et al., 1987).

Results

In total, 21 women taking OC and 20 women not taking OC were included for analysis. In the OC group, MRI was acquired.
on the first day of bleeding in 8 subjects and on the second day in 15 subjects. In the control group, MRI was acquired on first day of bleeding in 9 subjects and on the second day in 12 subjects.

The JZ thickness was $>12$ mm, which is considered diagnostic of adenomyosis on MRI, in 8 of 21 OC users and 13 of 20 controls. Fluctuations in JZ thickness were observed in all subjects during the cine scans for 3 min, with a decrease in thickness to $<12$ mm.

For quantitative analysis, on the HASTE images, the measured uterine myometrial area was larger in the OC group ($18.9 \pm 3.4$ cm$^2$) than in the control group ($17.2 \pm 3.6$ cm$^2$), but this was not a statistically significant difference ($P=0.64$) (Table 3). However, the power to detect the observed difference was 0.42. In contrast, on HASTE images, the subendometrial low-intensity area was significantly thinner ($P=0.001$) in the OC group than in the control group and the power was 1. The subendometriallow-intensity area occupied more than half of the myometrium in only 13 of 21 examinations of the OC group, whereas in the control it occupied 18 of 20 examinations (Table 3) (Fig. 2).

For qualitative analysis, with regard to endometrial distortion, the Kappa coefficients for the two radiologists’ consistency in reporting endometrial distortion were 0.62 in the control group and 0.67 in the OC group. Accordingly, it can be concluded that there was good inter-observer agreement for MR detection of endometrial distortion in this study. Endometrial distortion was identified in 14 of 20 examinations in the control group and in only 3 of 21 examinations in the OC group, whereas in the control it occupied 18 of 20 examinations (Table 3) (Fig. 2).

Direct questioning of subjects revealed that all OC users and 10 of 20 normal volunteers did not usually suffer from dysmenorrhea. The fact that 10 of 20 normal volunteers had dysmenorrhea was an incidental observation (Table 4). The degree of experienced pain was significantly lower in the OC group compared with the control group ($P=0.012$) and power was 1 (Table 4). No OC group subject complained of severe menstrual pain, whereas 10 of the 20 controls reported severe menstrual pain.

Discussion

Uterine contractions are important, especially when considering uterine physiology. Nonetheless, previously uterine contractions could only be evaluated by invasive measurements of intrauterine pressure using a catheter inserted into the uterine cavity (Akerlund et al., 1979; Pulkkinen, 1983). Recent advances in MRI techniques have enabled non-invasive direct visualization of such myometrial contractions with cine MRI (Nakai et al., 2001, 2003; Kataoka et al., 2005). Uterine contractions are thought to be reflected as endometrial distortion with MRI, as well as increased contraction amplitudes and resting tone with intrauterine pressure measurements (Ekstrom et al., 1989; Kataoka et al., 2005). On MRI, the relationship between uterine contractility and dysmenorrhea has been evaluated using cine MRI (Kataoka et al., 2005). MRI has revealed that the degree of dysmenorrhea is significantly related to the degree of endometrial distortion (Kataoka et al., 2005). It has also been demonstrated that the thickness of the subendometrial low-signal intensity region and the area of the uterine myometrium are closely associated with the degree of pain (Kataoka et al., 2005). The uterus in eumenorrheic women has a thick inner layer, small myometrial area and increased endometrial distortion compared with eumenorrheic women (Kataoka et al., 2005). Such findings were considered to reflect the effects of sporadic and sustained uterine contractions, which squeeze out menstrual contents (Kataoka et al., 2005; Togashi et al., 1993a, b). On the other hand, in a study that measured intrauterine pressure, it was demonstrated that there was a close relationship among dysmenorrhea, contraction amplitude and high-resting tone (Ekstrom et al., 1989). Such findings with intrauterine pressure measurements were also thought to result from sustained uterine contractions. Nonetheless, there has still been no report that has directly evaluated the relationship between uterine contractions and the degree of uterine distortion on MRI. To investigate this relationship, it would be necessary to measure intrauterine pressure and acquire MRI at the same time during menstruation. Such a study should be performed in the future.

Table 3: Evaluation of MRI findings

<table>
<thead>
<tr>
<th></th>
<th>Controls</th>
<th>OC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thickness of subendometrial low-intensity area</td>
<td>Full</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>&gt;1/2</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>&lt;1/2</td>
<td>2</td>
</tr>
<tr>
<td>Endometrial distortion</td>
<td>Present</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>Absent</td>
<td>6</td>
</tr>
<tr>
<td>Myometrial area</td>
<td>Mean</td>
<td>17.2</td>
</tr>
<tr>
<td></td>
<td>SD</td>
<td>3.6</td>
</tr>
</tbody>
</table>

Figure 2: Sagittal T2-WI (Fast spin echo, TR = 5470 ms, TE = 122 ms) (A) A 24-year-old healthy volunteer not taking OC, acquired during the menstrual phase (cycle day 2). On this image, the zonal anatomy of the myometrium is ill defined and the inner layer of the subendometrial low-intensity area occupied more than half of the total myometrium. The endometrium is strongly distorted by a bulging of the myometrium. The low-intensity substance in the uterine cavity is fresh menstrual blood. (B) A 41-year-old healthy volunteer taking OC for three months, acquired during the menstrual phase (cycle day 2). On this image, the thickness of the subendometrial myometrium is thinner compared with the control uterus. Endometrial distortion is not observed.
The present study attempted to evaluate potential differences in contractility between subjects that use OC, a therapeutic agent for dysmenorrhea, and those who do not. With cine MRI of the uterus, the current study demonstrated that there was a significant difference between the OC and control groups during the menstrual phase. The subendometrial low-intensity area was significantly thinner in the OC group. Endometrial distortion was detected more frequently in the control group than in the OC group. In addition, the mid-sagittal uterine myometrial area was larger (although not significantly) in the OC group than in the control group. All such results indicated that OC users exhibit less uterine contractions during the menstrual phase.

The result of the present study, i.e. reduced uterine contractions in the OC group, are likely to have resulted from decreased PG secretion. OC have been known to decrease levels of metabolites, such as menstrual fluid PGs, serum PGs and serum arginine vasopression, as well as to decrease contractions in the OC group, are likely to have resulted from an overall reduction in uterine contractions. In OC users, the cause of pain relief by OC might be related to alleviation of uterine ischemia, which occurs due to uterine contractions.

Several limitations of the present study deserve mention. First, the subjects taking OC and the normal controls were different people, limiting comparison. In addition, the breakdown of the 25 OC users included 14 subjects referred from gynecologists and 11 subjects who volunteered for the study.

### Table 4: Evaluation of the degree of menstrual pain

<table>
<thead>
<tr>
<th>Degree of pain</th>
<th>Controls</th>
<th>OC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Severe</td>
<td>Moderate–mild</td>
</tr>
<tr>
<td>Severe</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>Moderate–mild</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>None</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Ekström et al. (1989) reported that intrauterine pressure results from reduced uterine contractions, as reported by Ekström. The present study agrees with their speculation and supports the use of OC for menstrual pain. Ekström et al. (1989) concluded their study by speculating that the mechanism underlying pain relief in OC users was resolution of uterine ischemia due to increased uterine activity.

The thickness of the JZ (subendometrial low-intensity area) was significantly thinner in the OC group compared with the control group on cine mode evaluation. The JZ is recognized as a low-signal intensity area on MRI, but such an observation has no macroscopic correlation. It has been thought to correspond to the inner myometrium (Haynor et al., 1986). On static T2-WI, its appearance changes according to the hormonal milieu, e.g. the JZ is thinner in OC users and is more distinctly observed during the luteal phase compared to the follicular phase (Demas et al., 1986; McCarthy et al., 1986). The cause of such a low-signal intensity on MRI has been suggested to result from morphologic differences, such as a relatively decreased water content and a relatively increased cellular density, among other explanations (McCarthy et al., 1989). Nonetheless, such explanations remain controversial. On the other hand, previous investigations have also suggested that the physiologic changes of the JZ may also cause such a low-signal intensity (Lee et al., 1985; Nakai et al., 2001, 2003). It has been reported that the JZ thickness changes over time with the direction of peristalsis. Given such observations, it has been hypothesized that peristaltic contractions might cause the subendometrial layer to exhibit a relatively low-signal intensity and that the appearance of the JZ on static MR images probably represents a summation of the zonal appearance visualized with ultrafast images (Nakai et al., 2001, 2003). We speculate therefore that the thin JZ observed in the OC group of the present study might result from a subsequent study. Second, the small sample size of 25 OC subjects and 23 controls limits the study. A study with more subjects and 23 controls limits the study. A study with more subjects may permit examination of the differences of uterine contractions in parous and nulliparous women. Third, the variety of OCs taken by the OC group was broad (six types). Although all of the drugs were combined OCs, the doses and type of estrogen and progestin were different for each OC. Although it has been suggested that different OC formulations exhibit consistency with respect to effects (Davis and Westhoff, 2001), it would be ideal to use a uniform type of drug to evaluate uterine conditions. Fourth, there was not a gold standard with which to compare the MR images, such as measurements of intrauterine pressure as suggested by Ekström et al. (1989). In this study, such measurements were not performed due to the invasiveness of such a procedure, despite the fact that such measurements are well tolerated and much cheaper than MRI. Collaborative studies between radiologists and gynecologists will enable better characterization of the relationship between MRI findings and intrauterine pressure measurements. Fifth, ideally serum hormonal levels, such as estrogen and progesterone, would be measured to
more fully examine the relationship between hormonal status and uterine peristalsis. Sixth, with respect to the scanning schedule, the fact that imaging was acquired on the first 2 days instead of on only the first day of menstrual onset limits evaluation, as the MRI appearance of contractility may differ on first and second day after menstrual onset. Finally, as the quantitative analysis was performed by only one person, this may lead to bias and it would have been ideal to have the evaluation performed by two or more people.

However to conclude, the present study demonstrates that MRI of the uterus during the menstrual phase differs for subjects taking OC compared with those not taking OC. It was found that the JZ (subendometrial low-intensity area) was thinner, the uterine corpus was smaller, and endometrial distortion was less in OC users compared with controls. In addition, dysmenorrheal tended to be experienced less by the OC group. Such differences likely represent the effects of reduced contractility, which was speculated to result from a reduction in prostaglandin levels in menstrual fluid of dysmenorrheal adolescents before, during and after treatment with oral contraceptives. Eur J Obstet Gynecol Reprod Biol 1990;36:292–298.


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