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Three-dimensional ultrasound detection of abnormally located intrauterine contraceptive devices which are a source of pelvic pain and abnormal bleeding

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ABSTRACT

Objective *To determine whether intrauterine contraceptive devices (IUDs) that are located abnormally within the myometrium or cervix cause a higher incidence of pelvic pain and abnormal bleeding compared with normally positioned devices.*

Methods *Over a period of 9 months, all patients with an IUD presenting at our unit for two-dimensional pelvic ultrasound underwent a three-dimensional (3D) volume reconstruction of the coronal view, to visualize the entire IUD within the cavity. The IUD was deemed malpositioned if any part extended past the cavity, into the myometrium or cervix. The indications for ultrasound were recorded at presentation for the exam. The presenting symptoms of patients with an abnormally located IUD were compared with those with normally positioned ones.*

Results *Among 167 consecutive patients with an IUD evaluated using the 3D reconstructed coronal view, 28 (16.8%) had an IUD with side arms abnormally located within the myometrium. The abnormal positioning of the IUD arms was only detected using the 3D coronal view. A higher proportion of patients with an abnormally located IUD presented with bleeding (35.7%) or pain (39.3%) compared with those with normally positioned IUDs (15.1% with bleeding and 19.4% with pain) (*$P = 0.02$ *and 0.03, respectively). Seventy-five percent of patients with an abnormally located IUD presented with bleeding or pain compared with 34.5% of those whose IUD was normally placed (*$P = 0.0001$*). Twenty of 21 patients with an abnormally located IUD presenting with pelvic pain or bleeding reported improvement in their symptoms after IUD removal.*

Conclusion *A 3D coronal view of the uterus is useful in the visualization of IUDs. The coronal view showing the entire device and its position within the uterus may help in identifying the cause of pelvic pain and bleeding in patients with an embedded IUD. Copyright © 2009 ISUOG. Published by John Wiley & Sons, Ltd.*

INTRODUCTION

The intrauterine contraceptive device (IUD) has been one of the most commonly used forms of contraception throughout the world over the last 50 years[1,2]. While its use has waxed and waned in the United States owing to associated complications and lawsuits, the IUD has become more popular lately, with the introduction of copper-containing and hormone-containing devices that have progesterone or synthetic progestogen[3].

IUDs are often seen incidentally during pelvic ultrasound examination, and it is important to be able to determine their position within the uterus accurately. Typically, a standard two-dimensional (2D) ultrasound examination demonstrates the shaft of the IUD with reasonable precision, but is often unable to show the location of the IUD side arms that are found on most IUDs currently in use[4].

Three-dimensional (3D) ultrasound can be used to acquire a volume containing the entire uterine anatomy, from which the coronal plane of the endometrial cavity can be reconstructed. The coronal view of the uterus is particularly well-suited to demonstrate the relationship of the entire IUD, including the shaft and both arms, to the endometrial cavity. Such a coronal reconstructed view can demonstrate the exact position of the IUD, and specifically whether the side arms of

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Figure 1 Coronal view of the uterine cavity showing a normally located T-shaped intrauterine contraceptive device.

the device are located abnormally, embedded within the myometrium[4–6] (Figure 1).

This retrospective study was undertaken to determine the incidence of malpositioned IUDs among patients presenting for ultrasound with an IUD in place and whether there is a difference in the symptomatology of the patient at presentation for ultrasound, depending upon whether the IUD is positioned correctly.

PATIENTS AND METHODS

Internal review board approval was obtained for this retrospective study which involved review of medical records.

In our lab, all patients undergoing gynecological sonography have a 3D volume acquisition of the uterus in addition to the standard 2D ultrasound evaluation, regardless of the indication for the scan. The coronal view of the uterus is then reconstructed to evaluate for endometrial polyps and the position of fibroids, and to determine the configuration of the uterus. From 1st September 2007 to 31st May 2008, all patients who had an IUD demonstrated on 2D ultrasound by visualization of the shaft of the IUD underwent a 3D volume sweep of the uterus, with reconstruction of the coronal view of the uterine cavity, to demonstrate the position of the entire IUD.

The method of coronal view reconstruction was based on the Z-plane technique of Abuhamad *et al.*[7]. This technique is a quick and easy way to manipulate 3D volumes so that a coronal view of the uterine cavity and its contents can be displayed in under a minute. Each 3D volume acquisition was performed transvaginally with a Voluson ultrasound system (GE Healthcare Technologies, Milwaukee, WI, USA), using a 5–9-MHz transvaginal transducer, and the sweep was undertaken in a longitudinal view of the uterus. With the A-plane (sagittal view) representing the acquisition plane and the B-plane (transverse view) being perpendicular to the acquisition plane, the C-plane represented the coronal plane, and by minor adjustments of this plane the IUD could be best visualized throughout its full extent. The IUD was also rendered by placing the 3D

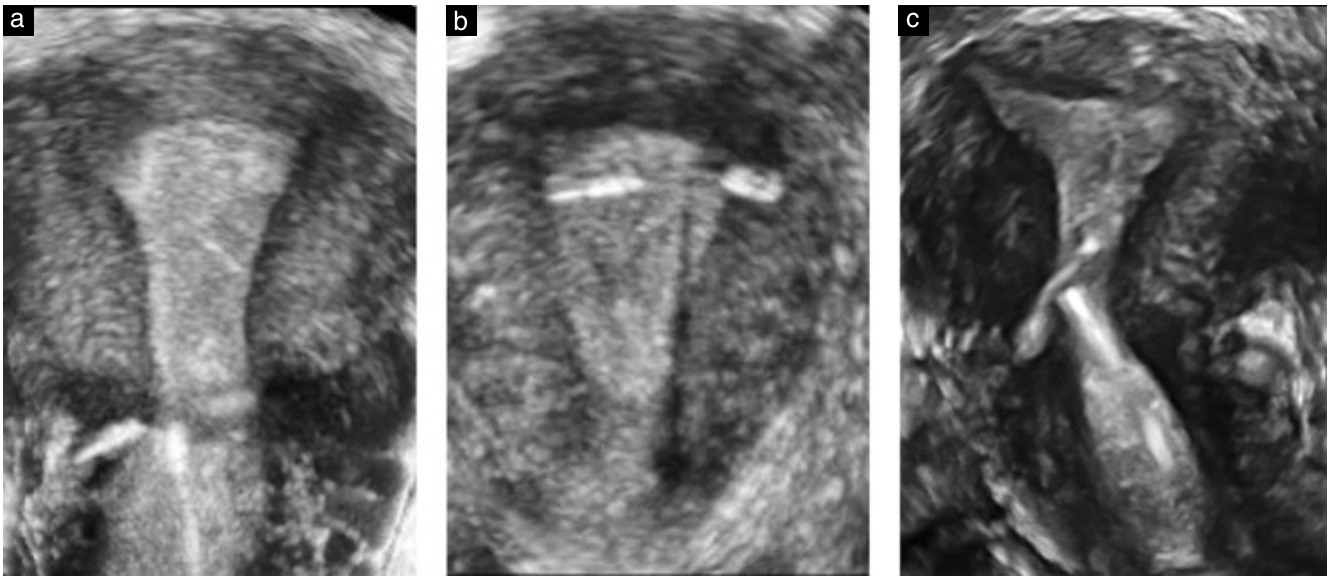

Figure 2 Coronal views of the uterine cavities of three different patients with intrauterine contraceptive devices abnormally located in different parts of the myometrium or cervix.

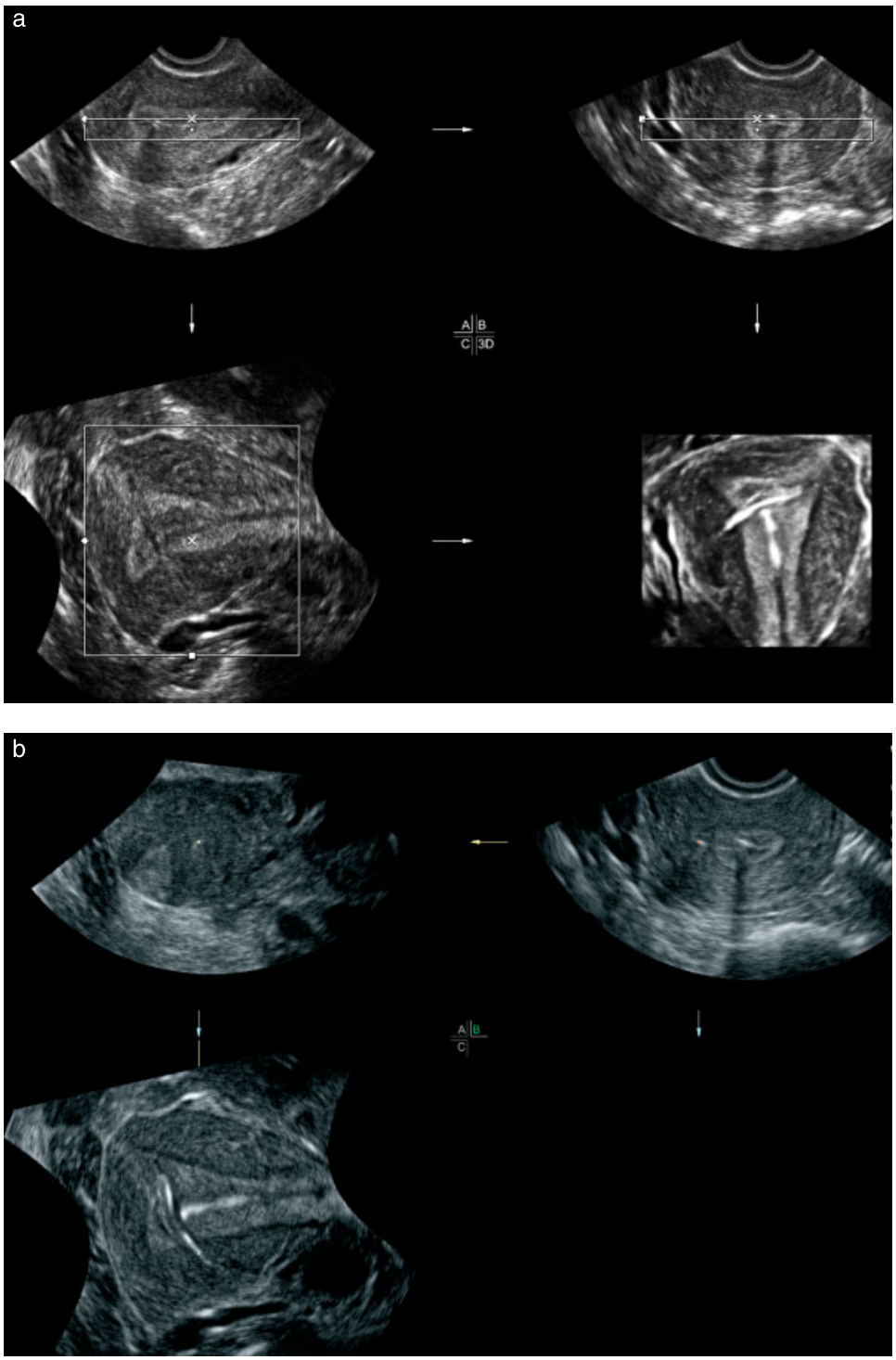

Figure 3 Imaging in a patient with abnormally positioned intrauterine contraceptive device (IUD). (a) The multiplanar reconstruction view and the rendered image; note that the right arm of the IUD protrudes past the confines of the endometrial echo. (b) The dot intersecting all three planes is located on the arm of the IUD protruding beyond the endometrium; note plane B, in which the dot representing the arm of the IUD is clearly beyond the confines of the endometrial echo.

rendering window in a linear fashion, along the shaft of the IUD, and then manipulating the *y*-axis of the volume such that the arms of the IUD appeared on either side. This volume manipulation was done directly on the ultrasound machine at the time of the scan, and the examining physician determined whether the IUD was in a normal location or located abnormally in the myometrium. The IUD was considered abnormally located if any part of it was seen to extend past the confines of the endometrial cavity, poking into the substance of the uterus or cervix. This was a subjective determination as no specific measurement of the abnormally located portion was made. If there was any question as to whether the IUD was slightly embedded or not, then the patient

was not included in the abnormally located group but included in the normal group. Only those IUDs that were embedded unequivocally on the 3D reconstructed views were considered malpositioned.

The indications for sonography were recorded at the time of presentation for the examination. For those patients with an abnormally located IUD, follow-up was undertaken by telephone conversation with the referring physician's office and included information on whether the IUD was removed and whether the patient's symptoms had improved.

Statistical comparison was carried out using Fisher's exact test, comparing the presenting symptoms of patients with abnormally located vs. normally located IUDs.

RESULTS

One hundred and sixty-seven consecutive patients who had an IUD noted within the uterus on standard 2D ultrasound examination were included in this study. Twenty eight (16.7%) of these patients had an IUD found to be located abnormally in the myometrium or in the cervix using the coronal reconstructed view of the uterine cavity (Figures 2 and 3). All of the IUDs whose shaft was seen to be low in the uterus or in the upper cervix on 2D ultrasound were found to be located abnormally within the myometrium or upper cervix on 3D reconstruction. The abnormal location of the side arms of the IUD in the 28 patients with an abnormally located device had not been detected with the initial 2D ultrasound examination, which included only standard views of the shaft of the IUDs, and was demonstrated accurately only with the 3D coronal reconstructed view.

The principal indications for sonography in the 139 patients with a normally located IUD are shown in Table 1. The two most common indications among these patients were localization of an IUD due to a lost string ($n = 34$) and to rule out ovarian cyst ($n = 30$). Table 2 shows the indications for sonography among the 28 patients whose IUD was found to be located abnormally on 3D ultrasound. The two most common indications for these examinations were pelvic pain ($n = 11$ patients) and bleeding ($n = 10$ patients).

Table 1 Principal indications for sonography in the 139 patients with a normally positioned intrauterine contraceptive device (IUD)

Indication for sonography	n
Localization of IUD	34
Suspected ovarian cyst	30
Pelvic pain	27
Abnormal bleeding	21
Suspected adnexal mass	11
Suspected fibroids	6
Family history of ovarian cancer	5
Suspected dermoid	2
Family history of endometrial cancer	2
Amenorrhea	1

Table 2 Principal indications for sonography in the 28 patients with an abnormally located intrauterine contraceptive device (IUD)

Indication for sonography	n
Pelvic pain	11
Bleeding	10
Localization of IUD	5
Suspected fibroid	1
Suspected ovarian cyst	1

Table 3 compares women with abnormally and those with normally located IUDs with respect to their indication for sonography. The proportions of patients whose principal indication for sonography was bleeding, pain, and either bleeding or pain were significantly greater in those with an abnormally located IUD compared with those whose IUD was not located abnormally ($P = 0.02$, 0.03 and 0.0001, respectively).

Table 4 shows the approximate length of time between the insertion of the IUD and the sonographic evaluation in the 28 patients who had an abnormally located IUD. Note that six (21.4%) of the 28 patients had the IUD inserted less than 5 months before the examination. Following the sonographic diagnosis of an abnormally located IUD, 21 of the 28 patients had the IUD removed, seven of whom then had it replaced. The other seven patients did not have their IUD removed. In 20 of the 28 patients with an abnormally located IUD, it was located at the fundus and embedded in the myometrium, in two it was embedded in the lower body of the uterus and in six it was embedded in the upper cervix. In six of the seven patients whose IUD was not removed, it was located at the fundus and in only one was the IUD partly in the cervix. This last patient chose to delay the removal of her IUD until her husband had his vasectomy. The decision on whether or not to remove and replace the IUD was made by each individual referring gynecologist and we do not have detailed information of long-term follow up.

Among the 21 patients with an abnormally located IUD who presented with pelvic pain or bleeding and whose IUD was removed, 20 reported improvement in their symptoms following its removal.

DISCUSSION

The coronal view of the uterus, obtained by reconstructing a 3D volume, is an important part of its evaluation[4,8,9]. In a recent study of 66 patients, we showed that the 3D coronal view of the uterus added value to the standard 2D scan in 24% of consecutive gynecological patients presenting for pelvic ultrasound[9]. Andreotti *et al.*[4] also obtained additional findings in the coronal view in 30.8% of their 91 gynecologic studies. Furthermore, when an abnormality was suspected on standard 2D ultrasound, in 53% of cases the 3D coronal view added

Table 3 Incidence of pain or bleeding as the principal indication for sonography in women with an abnormally or normally located intrauterine contraceptive device (IUD)

	Indication for sonography		
Location	*Bleeding*	*Pain*	*Either bleeding or pain*
Abnormal ($n = 28$)	10/28 (35.7%)	11/28 (39.3%)	21/28 (75.0%)
Normal ($n = 139$)	21/139 (15.1%)	27/139 (19.4%)	48/139 (34.5%)
P*	0.02	0.03	0.0001

*Fisher's exact test.

key diagnostic information, including diagnosis of uterine anomalies, better definition of the endometrium, and location of endometrial polyps, myomata and intrauterine contraceptive devices. In two patients with copper-T IUDs, the IUD could be seen in its entirety using the reconstructed coronal image; however, although the shaft of the IUD could be seen on the standard 2D imaging, the short arms were not demonstrable[4].

Bonilla-Musoles *et al.*[5] investigated the addition of 3D transvaginal sonography to accurately identify the location of IUDs. They showed that the location of the IUD in the cavity was misidentified in 12% of patients, and could not be seen at all in 9% of patients, with standard 2D ultrasound. In contrast, all IUDs were correctly identified with 3D volume ultrasound. Lee *et al.*[6] reported on 96 women who had a 3D sonographic evaluation following IUD insertion. Complete visualization of all of the parts of the IUD was achieved in 95% of cases on 3D reconstruction, as opposed to 64% without volume rendering. Peri *et al.*[3] described different sonographic configurations of IUD types, which are important to recognize, and demonstrated that 3D imaging can show the entire IUD rather than just a piece of it.

Valsky *et al.* reported that irregular bleeding and/or pain is a common symptom of the IUD and that 3D ultrasound has been shown to be particularly helpful in evaluating the position of the IUD within the uterus in cases in which the IUD cannot be located with standard 2D ultrasound[10]. These authors used the acoustic shadow of the IUD to facilitate its identification within the uterus on their 3D volumes. This technique may be helpful for IUDs that are difficult to visualize.

Table 4 Length of time between intrauterine contraceptive device (IUD) insertion and sonographic evaluation in 28 patients with an abnormally located device

Length of time	n
1 month	2
2 months	1
3 months	2
4 months	1
5 months	1
$\geq$ 6 months $<$ 1 year	7
$>$ 1 year	13
Unknown	1

Our study demonstrates that the correct detection of abnormally located IUDs is a clinically important issue, since many patients who present with pelvic pain and/or bleeding actually have a misplaced IUD, located abnormally in the myometrium or cervix. We found a significantly higher proportion of patients presenting with pain and/or bleeding who had an abnormally located IUD compared with those who had a normally positioned IUD, as judged by the 3D coronal view of the uterine cavity. After the abnormally located IUDs had been removed, there was an improvement in the symptomatology of the majority of affected patients. Malposition of an IUD is known to cause pain, especially during intercourse, as well as abnormal bleeding[10]. Had our unit not been performing a routine 3D coronal view of the uterus, the abnormal location of the arms of the IUDs in these patients might not have been detected. Perhaps the likely explanation for the pain and bleeding among these patients would have remained a mystery. When the IUDs became abnormally located was not addressed in this study and it remains unclear whether the side arms become abnormally located when the IUD is first inserted or whether it migrates later.

Several limitations of this study should be mentioned. Because it was retrospective, we do not have a full history of the patients' symptomatology, and can only report on the indications for scans. We also cannot prove that the malposition of the IUD was directly responsible for the patients' symptoms, other than to report an improvement after the IUD was removed. Additionally, the patients with normally positioned IUD were not followed up, as there was no plan to remove the IUD in these patients. We are also unable to comment on the specific types of IUD involved, although all were 'T-shaped' on ultrasound imaging. It is possible that, had the sonographers spent extended time and effort evaluating the side arms of the IUDs with 2D ultrasound rather than just routinely obtaining the standard images of the shaft, some of the abnormally located arms might have been detected; however, the ease with which the entire IUD was demonstrated by the 3D coronal view would not have been possible with 2D imaging. We also cannot provide pathological evidence that the malpositioned IUDs in fact penetrated the layers of the myometrium or that this was the cause of the pain and bleeding.

Despite these limitations, this preliminary study shows that a 3D coronal view of the uterus may be an important

part of the gynecological ultrasound examination in any patient with an IUD. Producing a coronal view of the IUD that shows the entire device and its position within the uterus may help to explain pelvic pain and bleeding in patients with malpositioned IUDs.

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