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COMMENTARY

Is Sounding the Uterus Prior to Intrauterine Device Placement Still Relevant?

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Background: Uterine sounds have been used in gynaecological practice for at least 200 years for various reasons. They were introduced to intrauterine device (IUD) insertion and management with the introduction of the thermoplastic devices.

Methods: A literature search was performed to see whether clinical practice or manufacturers instructions had changed regarding sounding the uterus before IUD placement.

Results: Despite changes in shape, size and structure, IUDs in current use still have recommendations for sounding before placement despite the lack of evidence that it provides any objective benefit. The potential benefits of all aspects of sounding appear to be outweighed by the disadvantages, especially where ultrasound imaging is available. Sounding produces measurements of dubious value and which are prone to produce errors possibly causing incorrect placement.

Conclusion: Sounding the uterus prior to IUD placement appears to have originated at a time when it was being used for other procedures. Times and IUDs have changed, but there is still no evidence for supporting this practice. The insertion of IUDs is usually a minimally invasive procedure, and it is time to abandon pre-placement sounding and make it more minimally invasive. Benefits of not sounding include simplification of the insertion procedure, reduction of pain and possibly decreased introduction of bacteria into the endometrial cavity.

Keywords: sound, metal, flexible, uterine length, intrauterine devices, uterine sounding, pelvic ultrasound

Historical Background

The Uterine Sound as a Gynecological Instrument

The uterine sound is an instrument that has been in common use since at least the 19th century. By the end of the century the nickel plated, Fitch and Galabin sounds were used for various procedures. Their main purpose was to determine the depth and direction of the uterus and dilatation of the cervix. It is unknown when sounds were first used, but primitive gynaecological instruments were in use centuries ago. A more modern understanding of uterine anatomy and dimensions is given as an appendix to the full text.

Sounding Prior to Intrauterine Device Placement

The purpose of this opinion piece is to examine how sounding the uterus came into common practice before intrauterine device (IUD) placement, and whether it was, and remains, based on sound anatomical and scientific principles.

The first formal, rather than anecdotal use of an intrauterine foreign body to prevent pregnancy was reported by Richter in 1909.[1] He used a silk device which was inserted using a urethral catheter. Grafenberg used a copper alloy ring which required cervical dilatation.[2] These IUDs were never available commercially and so there were no formal instructions as to how they should be inserted. It is not possible to go over all the instructions for insertion for all the different IUDs so a few examples of the major products have been chosen for examination in an attempt to understand the reasoning behind the sounding instructions as contained in the insertion instructions supplied by the manufacturers for the original and current devices.

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The Original Plastic IUDs

Lippes Loop

It was the development of thermoplastics after WWII that made practical the development of IUDs which could be made available on a commercial scale. A number of IUDs including the Saf-T-Coil (Julius Schmid corporation, Connecticut), Margulies Spiral, etc. were made from polyethylene or similar material. The most widely used was the Lippes Loop designed by Jack Lippes[3] which became available in 1962. There were initially 2 sizes, A and B and later 4, A-D. The sizes of these devices were based of the anatomical measurements of Dickinson.[4] We now know that these measurements, based on morbid anatomical specimens do not reflect the in vivo anatomical situation based on more recent ultrasound measurements. However, with some exception they still remain the measurements on which most currently used IUDs are constructed. The provided instructions (Lippes Loop, insertion instructions, Ortho Pharmaceutical corporation, Raritan, New Jersey, 1962) included advising sounding of the uterus to determine the depth and direction, anteverted or retroverted of the uterine cavity before placement. The choice of Loop was based largely on parity and gynaecological history except Loop B was to be used in multiparas sounding less than 6 cm. No explanation or basis for this recommendation was ever given or referenced and this became the standard for every IUD ever since.

The Loops were inserted with an injection technique after pushing the inserter tube up to a flange at 4 cm. Knowing the direction of the uterus was anteverted or retroverted had no bearing whatever on the insertion procedure. The B Loop would be suitable for multiparas with a uterine length of 6 cm or less. No evidence for this choice was given. We now know the endometrial cavity lengthens with parity and to a lesser extent total uterine axial length,[5] so there is no reason why a narrower B loop would be more suitable than a C or D loop which is of the same length but slightly wider. The Loops varied between 22.2 mm to 30 mm in width and were 25mm long. There was no published data which demonstrated the validity of these insertion instructions. These sounding instructions, like all others that were to follow, were not evidence based.

Dalkon Shield

The Dalkon shield was introduced in 1970 and became notorious as a cause of infections. While the multi-filamentous tail was responsible for the infection problem the device was technically different from everything proceeding it and a challenge for the inexperienced to insert. The device was held at the end of a firm graduated curved plastic holder. The thread had a knot at the 7 cm position in order to tell the depth to which the device had been inserted.

The insertion instructions (Dalkon Shield, insertion instructions, A.H. Robbins company, Richmond, Virginia, 1970) included advising sounding to determine the length and direction of the uterine cavity. The measurement was to be made from the external os to the fundus, which is an unambiguous measurement. If the sounding was less than 5 cm this was a contraindication to insertion. The multiparous Dalkon shield was 2.5 cm and the nulliparous one 2.1 cm long, much shorter than the devices in common usage today. There was no scientific rationale for this limitation (a 5 cm uterus), albeit a fairly rare occurrence. It was however crucial to know the uterine direction for the relatively stiff curved plastic inserter. This would have been more important than knowing the actual length.

The Original Copper IUDs

The introduction of IUDs containing copper as the anti-fertility agent began in the early 1970's. Plastic IUDs have to have a surface area of 600 mm^2 to be effective.[3] Copper IUDs do not have this constraint and copper wire has a large surface area to volume ratio. Not only was there now a vast difference in IUD size but the inserter tubes including those with an internal rod like the Copper-7 (Gravigard) and Copper T-200 and Nova-T-200 and those without, like the Multiload, were made of much more flexible polyethylene or polypropylene. The physical implications of this were not, and still are not, fully appreciated. Attempting to determine uterine cavity direction with an inflexible metal sound was pointless and counterproductive before using a soft flexible inserter tube which would have less difficulty negotiating and following the cervical canal and endometrial cavity direction than the inflexible sound. The operator could also not influence the direction in which the inserter tube moves (it would simply follow the path of least resistance), rendering the sounding direction information valueless.

The Coper-7 (Gravigard)

The insertion instructions (Copper-7, insertion instructions, GD Searle and Co., Skokie, Illinois, 1973) claimed the hazard of perforation can be reduced by sounding.

The TCu-200

Insertion instructions include measuring the length of the uterine cavity (Insertion instructions, Ortho Pharmaceuticals, Raritan, New Jersey, USA, 1972).

MLCu 375/250/250 Short

The instructions recommend measuring both the depth and direction of the uterine cavity. The standard devices were to be used if the sounding depth was 6 cm or more and the short if the sounding was between 5 and 6 cm (Multiload Cu 375/250/short, insertion instructions, Multilan SA, Fribourg, Switzerland, 1975). The Multiload does not have an inserter rod making it totally flexible virtually ensuring its ability to snake antero-posteriorly and laterally even in the presence of a small intrauterine obstacle.

The Original Hormone Releasing IUD

The original hormone releasing IUD was the Progestasert (Alza Corporation, Palo Alto, California, USA). It contained 38 mg of progesterone released at a rate of 65 µg pr day. The device was loaded into a hollow, relatively inflexible inserter tube held in place by a "lunar lander" plastic holder. The physician instructions recommended sounding the uterus to determine the direction of the uterus and not to insert the device if the uterus was greater than 10 cm or less than 6 cm, although no evidence for this recommendation was provided, and like the Dalkon shield, the Progestasert was not for the inexperienced inserter.

Sounding the uterus before IUD insertion appears to have been based on concerns regarding the physical nature of these early IUDs. These concerns appear to have been carried over to devices in current usage beside their different structure and the input from "complex sounds" and ultrasound.

IUDs in Present Usage

There are currently a large number of different types of IUDs in common usage around the world. The insertion instructions that are provided with these products are largely unchanged from 60 years ago. Many of the inaccurate terms used then are still used today.

A summary of these instructions for the more commonly used devices is given in Table 1. They include the familiar exhortations to determine uterine cavity depth and direction and based on that to select to use or not use any given device if it is the only one in the group or if there are multiple to use this measurement to make a choice.

What is apparent is that the definition of "uterine cavity" for the purpose of sounding is taken to be the total axial length by most manufactures. The uterus consists of a corpus and cervix which are of different embryological derivation, have distinctive anatomical features and are physiologically very differently. The problem of this terminology has been described at length.[6] The uterine cavity or, more correctly, the endometrial cavity (the part of the uterus lined by endometrium) can be measured historically by using a "complex" sound and currently more simply by using ultrasound. The instructions for the newer IUDs do not appear to place as much emphasis on "direction" as the older ones did.

These instructions and procedures are not evidence based and in fact some actual evidence is contrary to the recommendations. Particularly interesting is the recommendation to use certain types of IUD (usually the shorter ones) based on uterine length sounding. There is no relationship between total uterine length, endometrial cavity length and IUD expulsion and performance[7,8] Mean endometrial cavity length has subsequently found to be about 3.6 cm in nulligravida and 4.25 cm in multipara,[6] using mechanical and ultrasound measuring methods. Conventional uterine sounding appears to provide information of no clinical relevance and in particular provides no information on maximal endometrial cavity width.

Table 1 Summary of Insertion Instructions for IUDs in Current Use

Device and Manufacturer	Sounding Instructions	Actions Based on Sounding
Paragard[a], Cooper Surgical, Connecticut, USA	Measure depth of uterine cavity	Uterus should sound 6–9 cm to use device
Nova-T 380, Bayer Wuppertal, Germany	Position of the uterus and size of uterine cavity should be determined	
GyneFix-200, GyneFix 330 Contrel, Ghent, Belgium	Sound the uterus for depth and direction of uterine cavity.	Use GyneFix 330 if over 8 cm
IUB Ballerine, Ocon, Modiin, Israel	Measure depth and direction of uterine cavity	Cavity should be 6–9cm. Even more irrelevant for a three- dimensional device
Flexi-T, Prosan, Arnhem, Netherlands	Measure uterine length and flexion	
Generic TCu 380A, Nova-T 380 (mini), Multiload 375/250/short. Mona Lisa, Nv, Herk de Stad, Belgium	Determine depth of uterine cavity for CuT380 and for other generic copies	Nova-T copy is for uterine size 6.5–9cm and Nova-T mini for < 7 cm.
Mirena[b,c], Bayer AG, Leverkusen, Germany	Measure depth and direction of uterine cavity[c]	For uterine length 6–10 cm. Expulsion ↑ if < 6 cm
Lilletta, Abbvie, Chicago, Illinois, USA	Sound the uterus	Uterus less than 5.5 cm may ↑expulsion, bleeding, pain and perforation
Kylena[c], Bayer AG, Leverkusen, Germany	Measure depth and direction and detect anomaly of the uterine cavity[c]	

Notes: [a]Paragard (TCu 380A) is available in many generic forms and is widely used worldwide. [b]Mirena (LNG-IUS 52mg) is available in a number of generic forms, including Lilletta. [c]Mirena and Kyleena are supplied with a curved inserter rod. It is highly flexible and will follow uterine curvature even "against" the curve. This was not true for the Dalkon shield. ↑- increased.

The Development of "Complex" Sounds and Ultrasound Metrology

A "complex" sound for the want of a better word is a sound that can do more than simply measure total uterine axial length and is capable of providing information about other anatomical parameters of the uterus of possible practical use. For a number of years after the introduction of thermoplastic IUDs, only metal sounds were available. This may have been an oversight or an attempt to keep costs down. In the mid-1970's plastic sounds began to appear. One of the first was the Mark-7© sound (Figure 1) which was made to be used with the Copper −7 IUD. In addition to being made of plastic, it had a collar slide up to the external cervical os which could be fixed in place to get more accurate readings.

Wing Sound

The first truly complex sound was the Hasson Wing sound[5] (Figure 2). As the name implies after measuring total uterine length, a small wing could be activated and the sound withdrawn until it reached the internal cervical os or reasonably

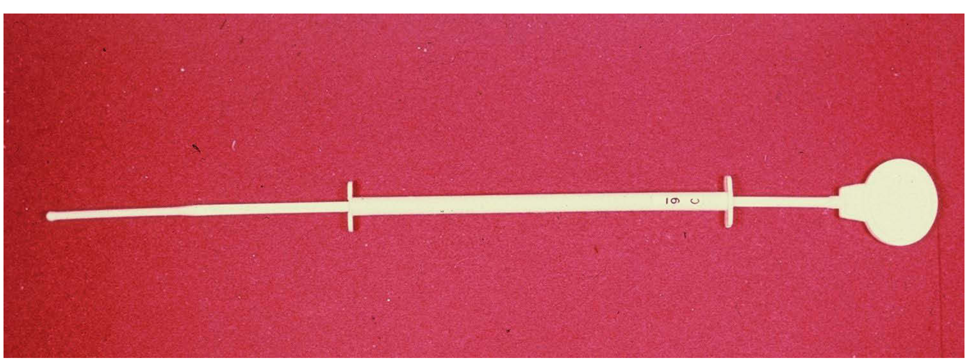

Figure 1 The Mark-7 sound with collar.

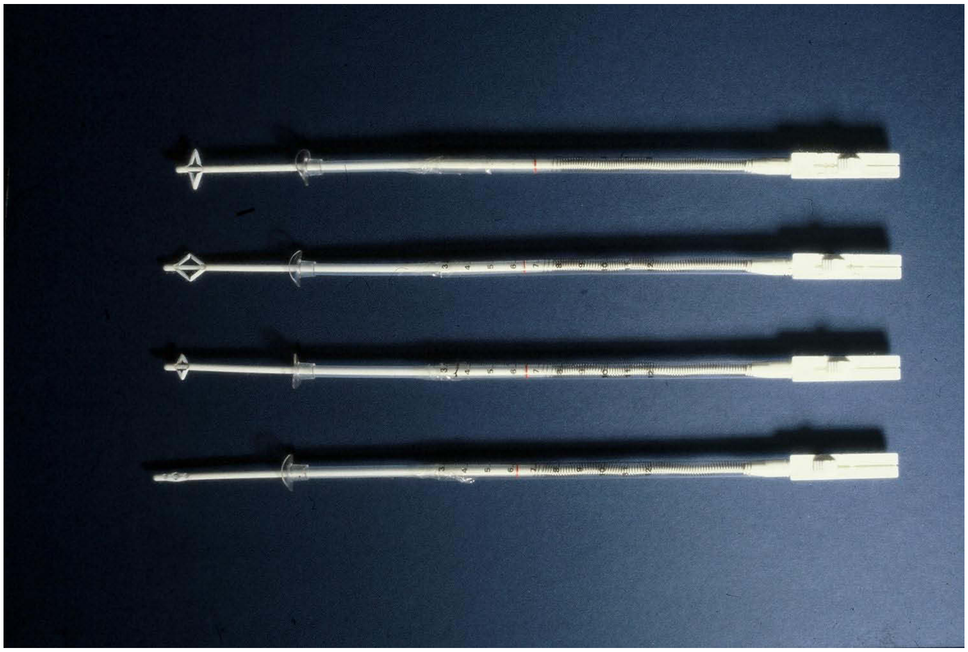

Figure 2 The Hasson Wing sound with open and closed wings (courtesy the late Dr Hasson).

close to it, so that cervical length, and by subtraction the endometrial cavity length could be measured. This sound was developed to attempt to show that there may be a relationship between IUD length, endometrial cavity length and IUD performance (Figure 1). It showed that there is no relationship between total axial length and endometrial cavity length (Figure 3). This sound, like the Mark-7 sound was never made commercially available. The Wing sound principle is, however, available in a modern form. The SureSound© made by Hologic is available for measuring endometrial cavity length prior to Novasure© endometrial ablation. Its cost and relatively wide diameter make it unsuitable for use prior to IUD placement.

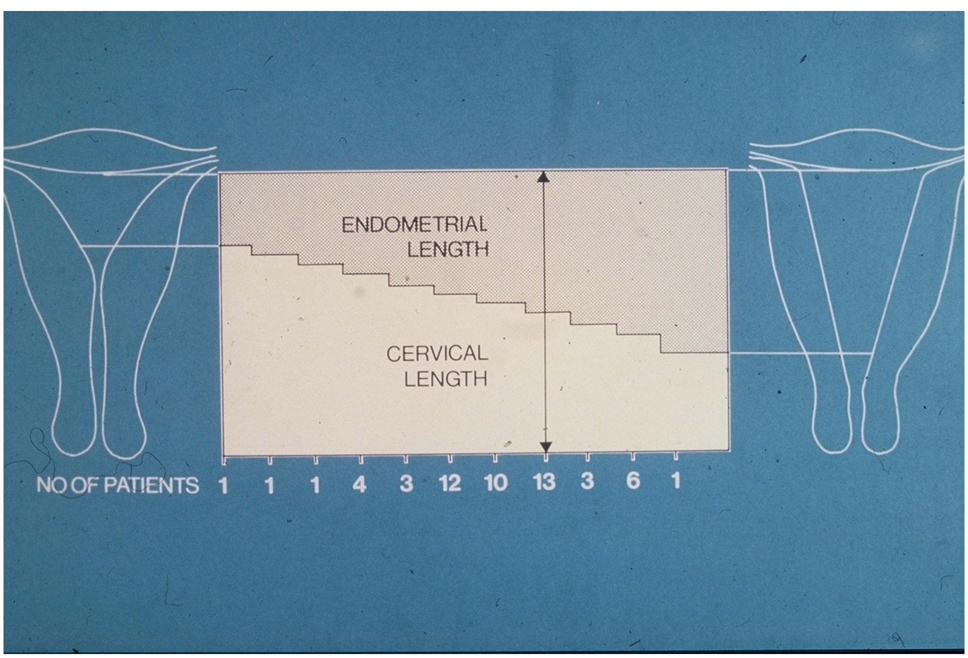

Figure 3 Varying endometrial cavity lengths in the same total length uterus (courtesy of the late Dr H Hasson).

Kurz Cavimeter

The cavimeter (Figure 4) was an instrument developed by Kurz in the late 1970's. It could measure the outline of the endometrial cavity including the maximum transfundal width and the endometrial cavity length.[9] The average transfundal width was around 2.4 cm which became slightly larger with advancing age and parity. The average endometrial cavity length was reported as 3.2 cm, advancing with age and parity. These estimations are smaller than the later ultrasound estimations because of the limits of mechanical measurement.[7]

Batelle Caliper Device

The Batelle caliper device was developed by the Batelle corporation of Columbus, Ohio. It was similar to the cavimeter and could make measurements which could be used to map out the shape of the endometrial cavity. It was tested in the United Kingdom (John R Newton, unpublished data) and Mexico. Only the Mexican results were ever published.[10] These investigators found that endometrial cavity length was a mean of 3.5 cm to 3.9 cm with increased parity with no relation to total axial length. The mean transfundal endometrial cavity width was 2.4 cm to 2.6 cm and showed only a small increase with parity.

Ultrasound

High-resolution 2D and 3D ultrasound has limited the usefulness of mechanical sounding in studying uterine metrology. Uterine length and width measurements are similar to those found with the complex sounds.[7,11] Ultrasound measurements of endometrial cavity length[7] measure a maximum mean 3.6 cm in multiparas and maximum mean width of 2.25 cm in nulliparas.[11]

While there is no relationship between total uterine length and endometrial cavity length and IUD performance, there is, however, a relationship between IUD transversal width and performance, and IUDs which are within these limits appear to perform better than those outside these limits.[12,13] Only the GyneFix IUD, the only one- dimensional IUD will always fit the endometrial cavity, whatever the dimension[14] (Figure 5).

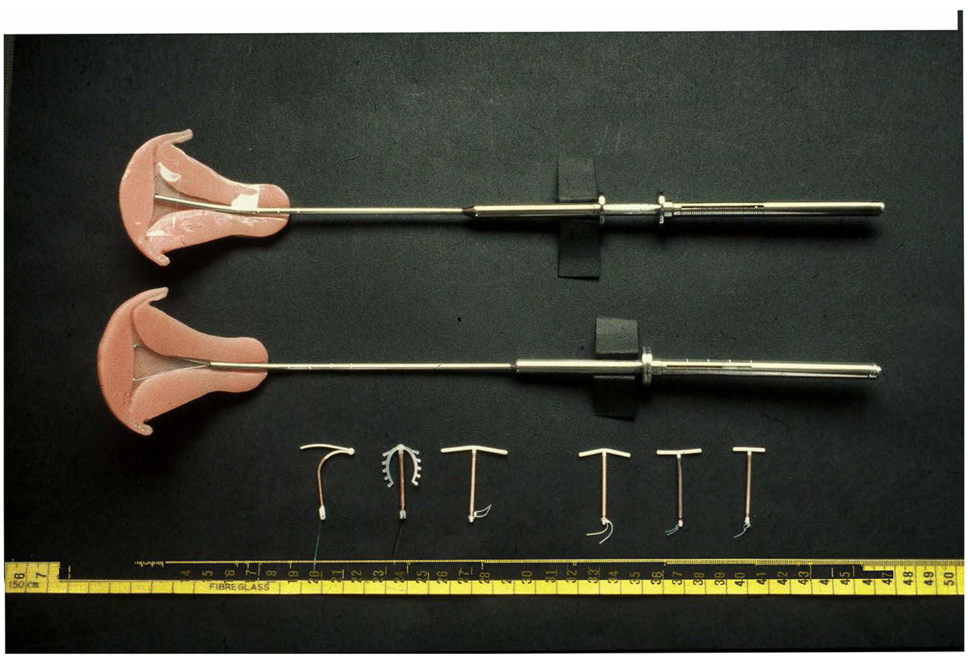

Figure 4 The Kurz cavimeter, showing how IUDs can be modified to fit uterine cavity transfundal width (courtesy Dr K Kurz).

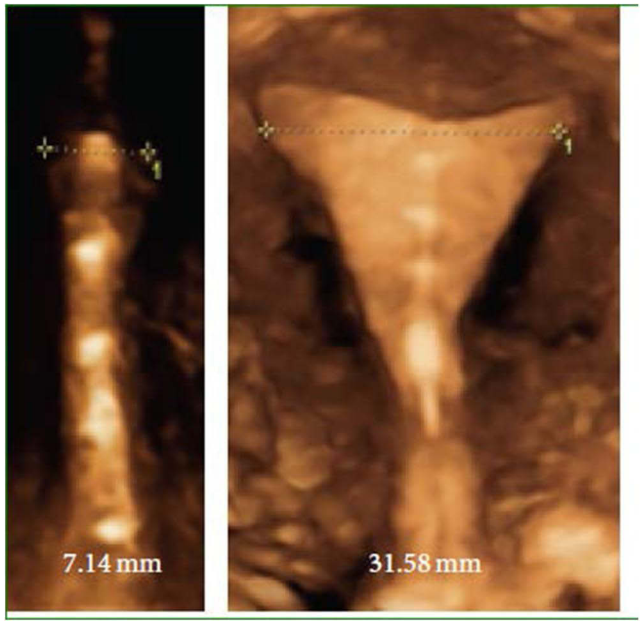

Figure 5 GyneFix inserted into endometrial cavities of dissimilar widths (courtesy of the late Dr D Wildemeersch).

Evidence for the Inaccuracy of Standard Sounding

Not only is conventional uterine sounding of dubious clinical relevance, but it may not be very accurate. A study comparing the Mark-7 plastic sound found that the inflexible metal sound consistently underestimated uterine length by about a 0.5 cm.[15] However, the current plastic sounds in common usage may also underestimate uterine length by up to a centimetre when compared to measurement at hysteroscopy.[16]

This error may lead to placing the stop collar on the IUD at an incorrect level, especially if the bottom end of the stop, rather than the top end is placed at the reading level. This will lead to the device being placed below the fundus. When uterine action draws the device up to the fundus the threads may go up with it, leading to problems when attempting to remove the device.[17] Uterine sounding may play a role in the problem of "missing strings".

Evaluation of the Non-Sounding Method

Search Methods

A literature search was performed to help ensure that all non-sounding studies were found. A search for IUD studies where it was explicitly stated that a no sounding technique was employed was conducted from 1960 to the present. Exclusion criteria were studies with fewer than 20 subjects. The medical subject headings were: uterus; uterine; intrauterine contraceptive device; IUD: non sounding; no sound. The databases searched included Index Medicus, PubMed and Google Scholar. The results of the search are given in Figure 6.

The concept of not sounding the uterus before inserting an IUD is not new. Physicians had been doing this since the 1970's informally. The first studies which stated categorically that sounding had not been performed appeared in the 1980's. The first was a study to estimate the pain response related to the IUD insertion specifically and not to the global response of the whole procedure.[18] The second was a study to evaluate the forces required to insert various types of devices.[19]

More recently, the availability of ultrasound has emboldened investigators to use a non-sounding method. A study in California concluded that it was possible to insert an IUD without pelvic examination or sounding. They performed an ultrasound afterwards to confirm placement.[20] They had to dilate the cervix on occasion. The aim of this study was to simplify the technique. The second study tested the hypothesis that ultrasound could determine the direction and the depth of the uterus so that sounding was unnecessary[21] and that ultrasound could, "replace the painful step" of sounding the uterus. They concluded that ultrasound could serve this purpose. The third and most recent study tested not sounding before inserting a levonorgestrel containing IUD.[22] They attempted to shorten the procedure and eliminate pain as far as

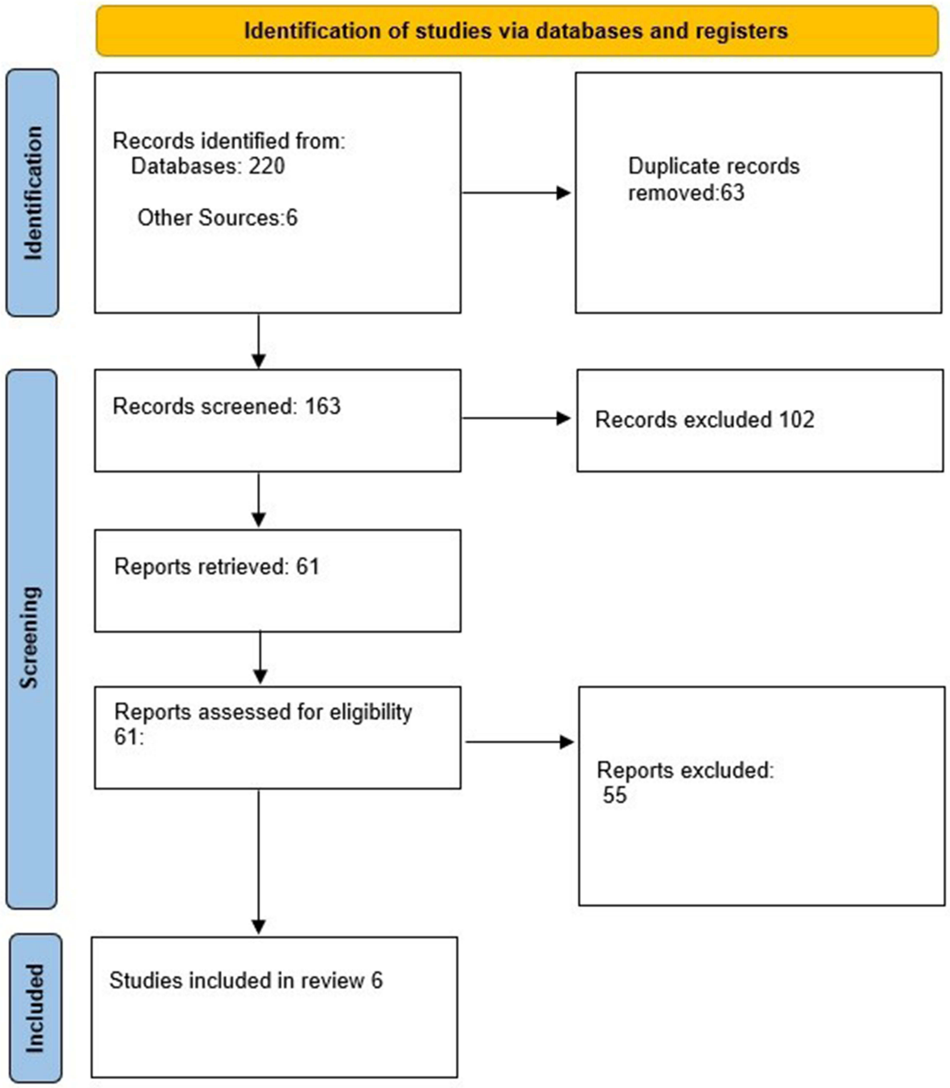

Figure 6 Results of search for non-sounding studies.

possible. The basis was that ultrasound made this feasible. Their results did not appear to decrease pain of insertion in their subjects. The principle behind these studies is that sounding adds information of value and this information can be obtained by ultrasound. Only the first study did not appear to have these preconceptions.

The Role of Ultrasound in Uterine Metrology

The non-sounding studies appear to give the impression that the technique is allowable because ultrasound is a viable alternative to mechanical sounding in terms of the measurements it can provide and its added diagnostic benefits. The suggestion that ultrasound is becoming an integral part of IUD placement has also been considered and dismissed.[23] The reason to dismiss the notion that IUD insertion must be preceded by ultrasound scanning is that this would severely limit the provision of this long- acting reversible contraceptive (LARC) method in low resource settings and act as a barrier[24] to IUD provision. The unavailability of ultrasound should not be an impediment to abandoning sounding before IUD placement. In fact, the non-sounding technique can help simplify and reduce the cost of providing IUDs in low resource settings.[25]

Advantages and Disadvantages of Sounding or Not Sounding

This section evaluates the advantages and disadvantages of sounding from a procedural and physical standpoint irrespective of whether the metrological data has any validity or utility or not.

Advantages of Sounding

The purported advantages of sounding (other than the supposed metrology benefits) are that it dilates the cervical canal when necessary and detects obstructions. Dilatation of the cervical canal prior to IUD placement may be necessary but this is not necessarily related to sounding and can be achieved with dilators. The detection of an obstruction as an impediment to placement of a device is rare, and on these occasions an opened device may be forfeited when the non-sounding technique is used without ultrasound. The insertion technique for most IUDs is not altered if sounding is not performed. The only exception is for IUDs whose arms open upwards like Mirena, Kylena, Jaydess and Nova-T.

Disadvantages of Sounding Before IUD Placement

Pain

There is a fear of pain from IUD insertion. It is not uncommon in some situations for IUD insertion to be performed as a minor surgical procedure with intravenous sedation. It is impossible to conduct a controlled evaluation of pain with and without sounding. A study attempting to evaluate pain without sounding is described later. Anyone who has inserted enough IUDs will have been asked by the acceptor if the procedure was over following sounding, only to be told that the device is still to be placed, and observed the disappointed look. The no- sounding technique provides a "one and done" experience.

Infection

The endometrial cavity becomes totally sterile about 6 weeks after the introduction of bacteria[26] following instrumentation. Cleansing the cervix prior to IUD insertion does not remove bacteria already present in the cervical canal.[26] This leads to bacteria entering the endometrial cavity on the passage of instruments into the uterus. Bacterial contamination is produced by sounding and then more of the dislodged bacteria enter the uterus on passage of the IUD itself. While this has not been demonstrated clinically, it is logical that a dual passage of instruments via the cervical canal can only increase the number of bacteria introduced into the endometrial cavity. The greater the number of bacteria introduced, the greater the possibility of an established infection taking place, especially if there is a reduced immune response. This is probably more important in areas of known high rates of infection, especially poor countries. Since the majority of sounds being used at present are mde of plastic, non-sounding reduces expense and hydrocarbon waste.

A summary of the advantages and disadvantages of sounding is given in Table 2.

Table 2 Intrauterine Device Placement with Prior Sounding

Advantages	Disadvantages
Dilatation of cervical canal if needed	Increased pain on cervical canal stretching prior to placement of IUD
Detection of obstruction or congenital abnormality	Possible transfer of bacteria into endometrial cavity and facilitation of further transfer on IUD placement
	Increase time to perform procedure
	Inaccuracies may increase incidence of lost threads
	Increases hydrocarbon waste
	Complicates the procedure reducing its utility for use in low-resource settings

Discussion

This review shows that the concept of sounding the uterus before placing an IUD began on unfirm territory and the reason for doing so, objectively, has become progressively weaker. The instructions for IUD placement for the earlier devices often included reference to a bimanual examination, but seldom appears with later IUDs, probably because the role of bimanual exams has become de-emphasized in modern practice.[27] The instructions for the Copper 7 IUD also intimated that sounding prior to insertion can somehow reduce the incidence of uterine perforation. Not only is there no evidence for this but in vitro studies only the Dalkon shield was shown to be able to perforate the myometrium.[19,28] The force required to do this is around 20 Newtons[19,29] for interval insertions. The post-partum, post-abortum, lactational and high progestin exposed myometrium are exceptional situations for both soundings and insertions.

The term "uterine cavity" should be reserved for the part of the uterus lined by endometrial tissue, and the term "total uterine axial length" should be used when referring to, or measuring the distance from the external os to the fundus.

For Mirena,Kylena, Jaydess/Sylar and Nova-T and generically similar, a different technique is used, after moving the marker collar out of the way, the inserter tube is advanced to the fundus. It is then withdrawn about a centimetre and the arms opened in the usual way before being re-advanced to the fundus and being released in the usual manner. Most practitioners familiar with these devices can learn this method in five minutes and it is much simpler than the alternative "direct" method sometimes advocated.[30]

The problem with sounding the uterus to obtain metrological information of use before IUD placement is essentially that it is not congruent with the science of topology, the mathematics relating to spatial configuration. The notion that a one- dimensional measurement (sounding) can provide information of use regarding a three- dimensional space (the endometrial cavity) prior to inserting a two-dimensional object (the IUD) defies the laws of topology and makes anyone who has even the most basic understanding of this subject hesitant. (The IUD-Ballerine is three-dimensional and the GyneFix is one-dimensional but the principle holds). Sounding the uterus adds time, discomfort and complicates the procedure for very little benefit. In modern day practice it is perpetuating a ritual from the 1960's and should be abandoned.

Conclusion

There is no scientific basis for sounding the uterus to determine total uterine axial length before placing an IUD or for making a judgment on what type of IUD to choose based on that measurement. This is especially true for modern IUDs Routine sounding of the uterus prior to IUD placement is a dubious, painful ritual, seemingly without established merit. Omitting uterine sounding before IUD placement reduces the invasiveness of what is a minimally invasive procedure even further. Directions for placement of IUDs and teaching the placement of IUDs should at least consider non sounding as an option. Future research should include taking three- dimensional uterine cavity ultrasound pictures and relating the fit of the IUD to performance. 3-D ultrasound machines are becoming more affordable and more portable so that this is a realistic goal. The design of future IUDs can then be based on these findings.

Data Sharing Statement

All data is contained in the references.

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Disclosure

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