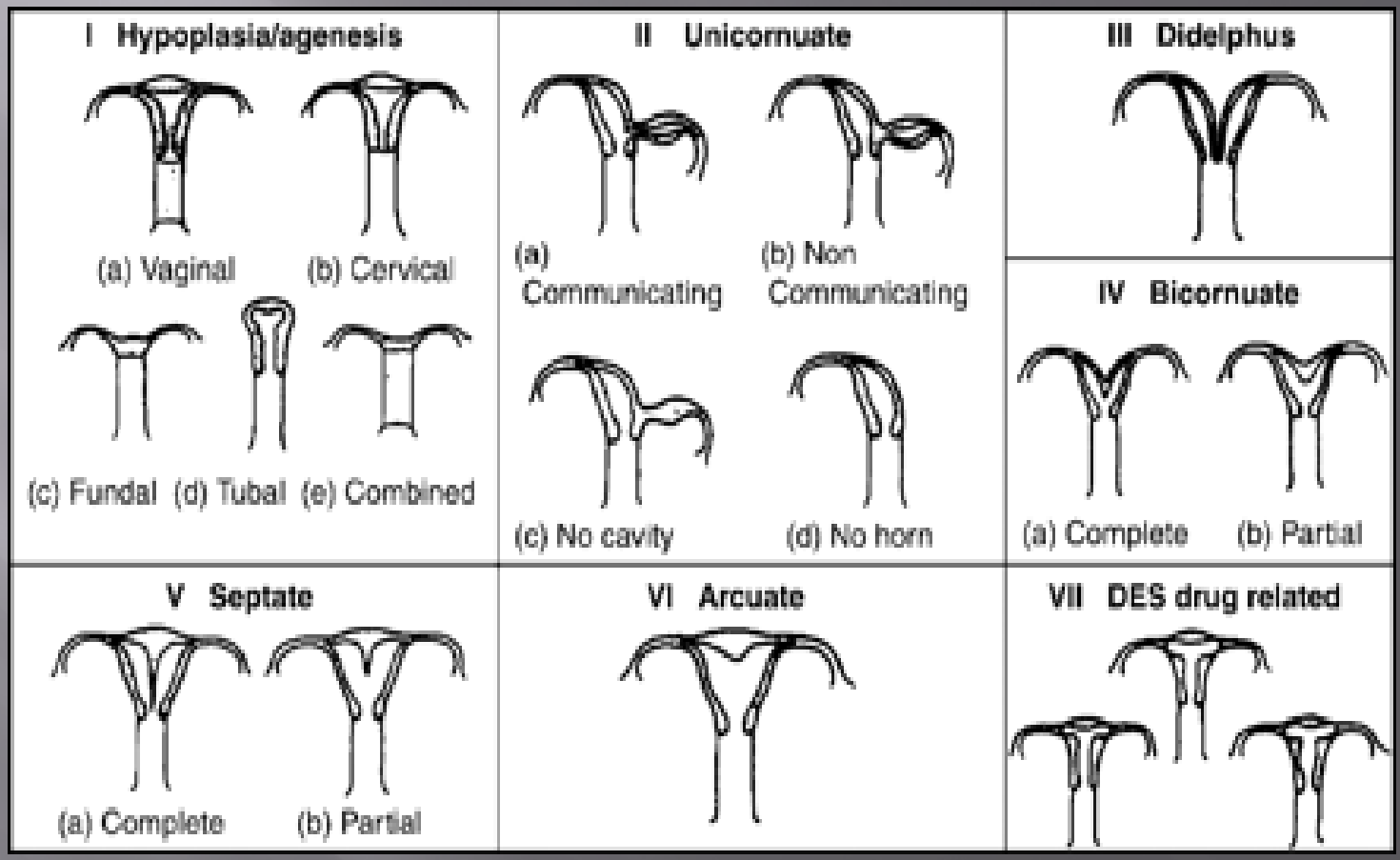
3D ULTRASOUND FOR THE DIAGNOSIS OF UTERINE ANOMALIES

Kamal Ojha

Consultant Gynaecologist

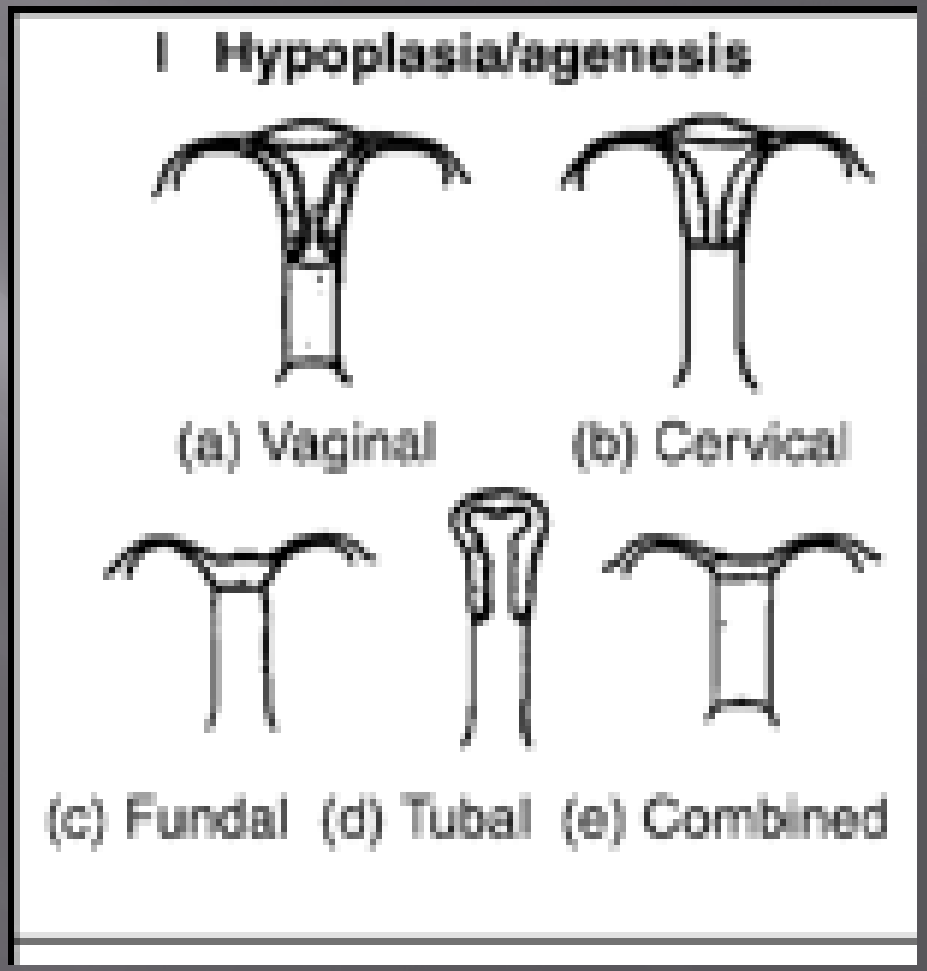
St George's Hospital

Classification of Cong Ut Anomalies AFS (1988).



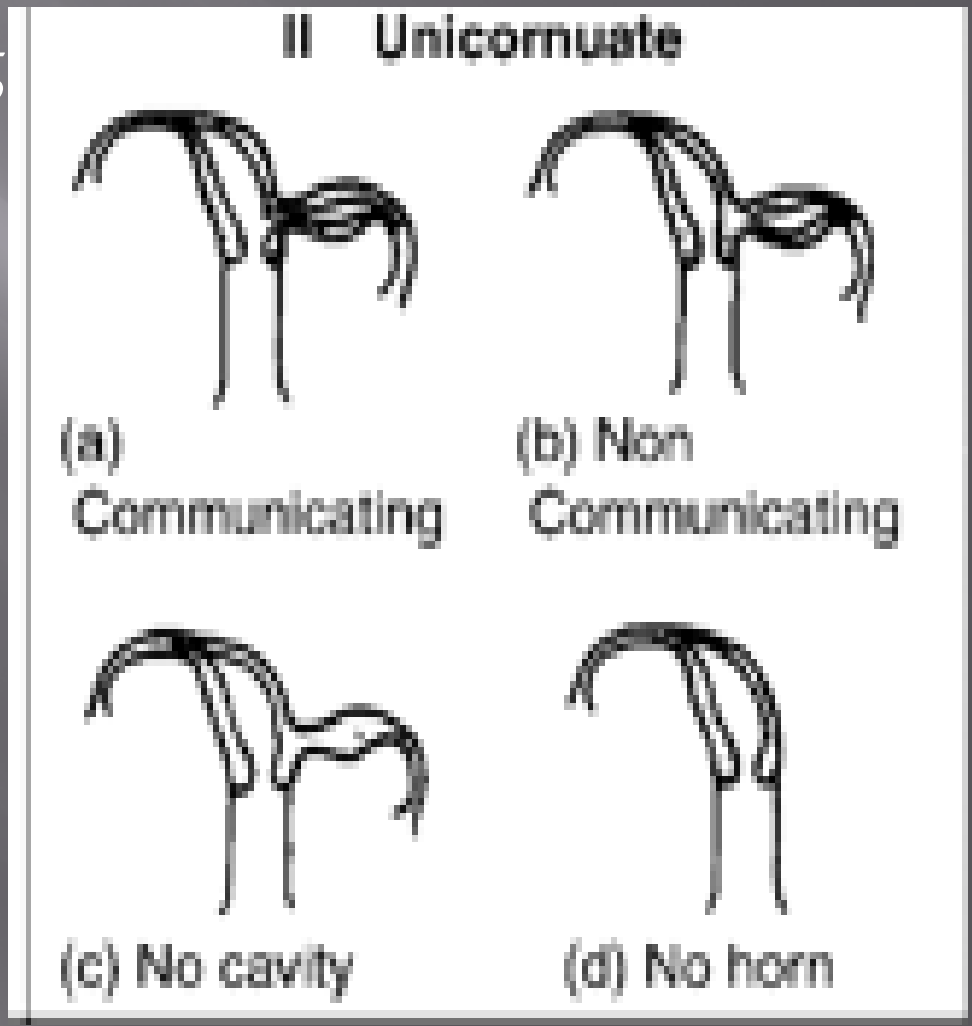
Müllerian Agenesis or Hypoplasia

a. Vaginal
b. Cervical
c. Fundal
d. Tubal
e. Combined



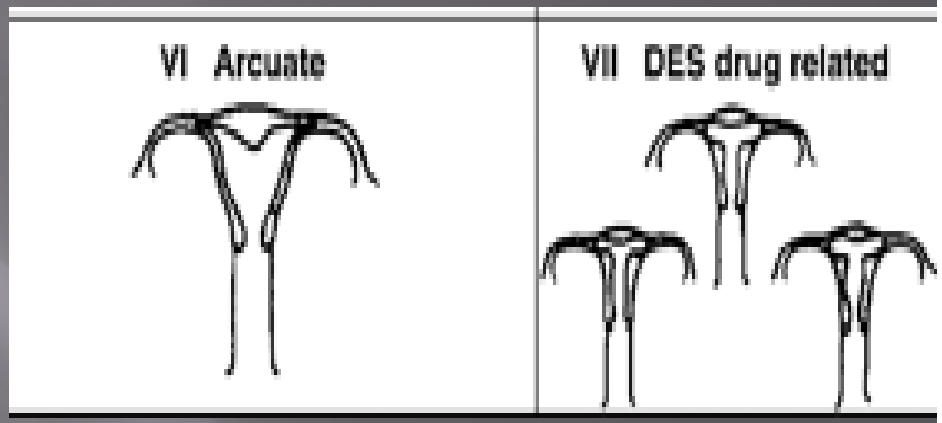
Unicornuate uterus (hypoplasia of one of the two Müllerian ducts)

a. With a communicating rudimentary horn
b. With a non-communicating rudimentary horn
c. With a rudimentary horn with no cavity
d. With an absent rudimentary horn



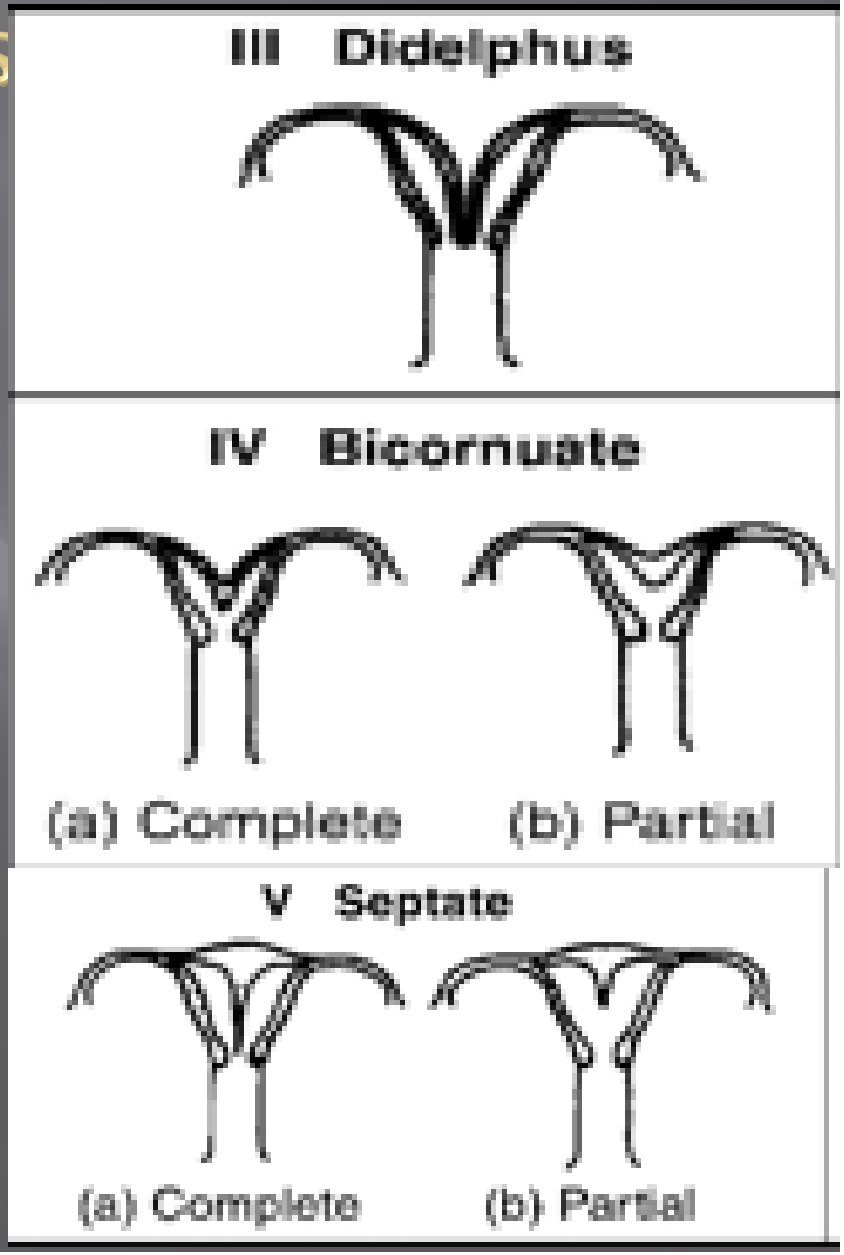
Arcuate Uterus

- Arcuate uterus (a mild indentation at the level of the fundus from a near-complete resorption of the uterovaginal septum)
- Diethylstilbestrol (DES) exposed uterus (T-shaped uterus resulting from DES exposure of the patient *in utero*)



Failure of Fusion of Mullerian Ducts

1. Didelphys uterus (failure of lateral fusion of the vagina and uterus Müllerian ducts)
2. Bicornuate Uterus (incomplete fusion of the uterine horns at the level of the fundus)
3. Septate Uterus
   a. Complete
   b. Partial



Limitation of the classification

- Does not specify the diagnostic methods or criteria
- Solely based on the subjective impression of the clinician performing the test (Woelfer *et al*., 2001).
- Not Comprehensive.

VCUAM classification - Oppelt *et al.* (2005):

- Vagina (V)
- Cervix (C)
- Uterus (U)
- Adnexa (A)
- Associated Malformations (M).

An anomaly is therefore graded individually for each anatomical structure

2D scan

- An experienced person will be able to provide almost all information
- 2D Image only to review later
- Coronal view generally not seen
- Most commonly used.
- Will remain the standard method
- Especially for junior trainees.

3D Scan

- Volume rather than slide
- Review at any point later
- Useful for Audit purposes
- Short time for scan
- More time required afterwards for analysis
- 3D volume stored on 4D view software
- Coronal plane, TUI, Inversion mode

Technique 2D

- TVS is ideal TAS poor views esp in difficult cases
- Longitudinal is better for diagnosis
- Scan from one end of uterus to the other
- Cervix – try to include in view
- May need to widen the angle.
- Bicornuate is more likely to miss than uterine septum
- Use as a screening tool – 3D needed

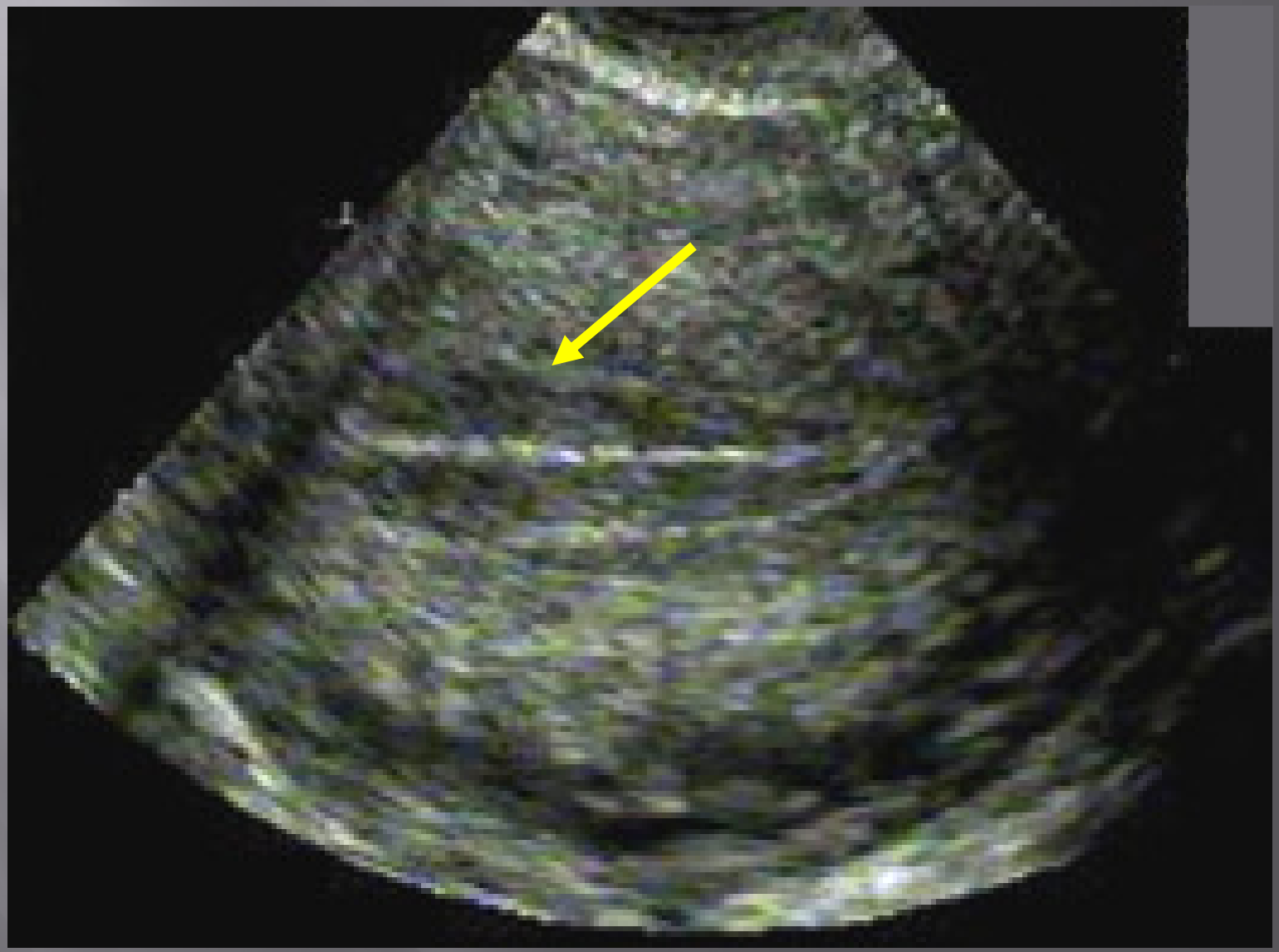
Technique 3D

- Increase the angle as wide as possible
- Keep probe in the middle of the volume to be captured
- Move the probe in 2D to assess
- Take the volume again if required
- Review the volume and take 3D pictures to demonstrate the defect
- Luteal phase endometrium acts as a contrast medium

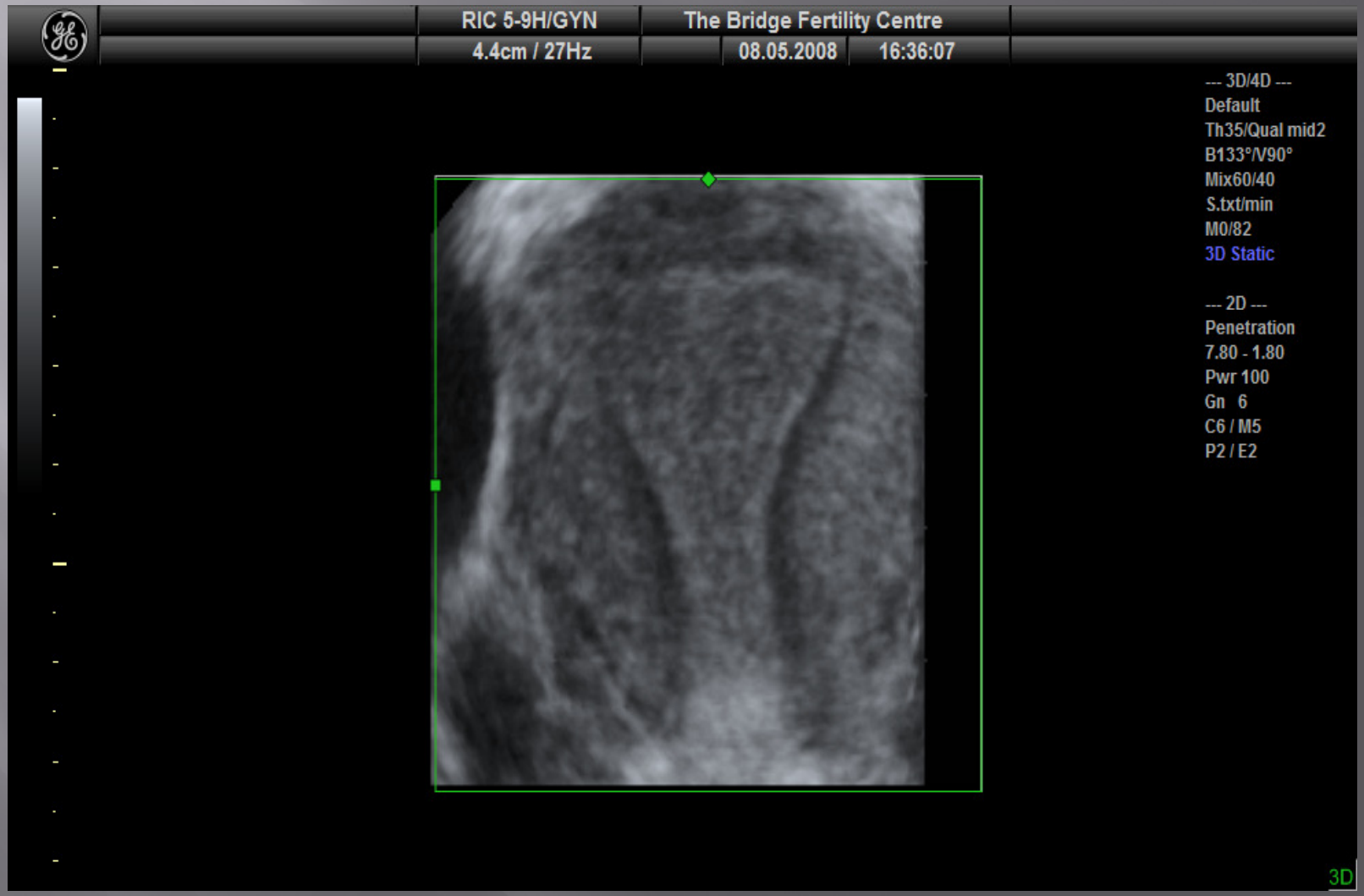
Role of 3D

- SIS or HYCOSY can help differentiate types of defects rudimentary or well developed cavity
- Bicornuate uterus can be a challenge to get the whole uterus in one volume
- Reports comparing SIS with hysteroscopy have suggested that SIS is highly accurate in both diagnosing and categorizing congenital uterine anomalies
- The weighted mean sensitivity and specificity was 93 and 99%, respectively

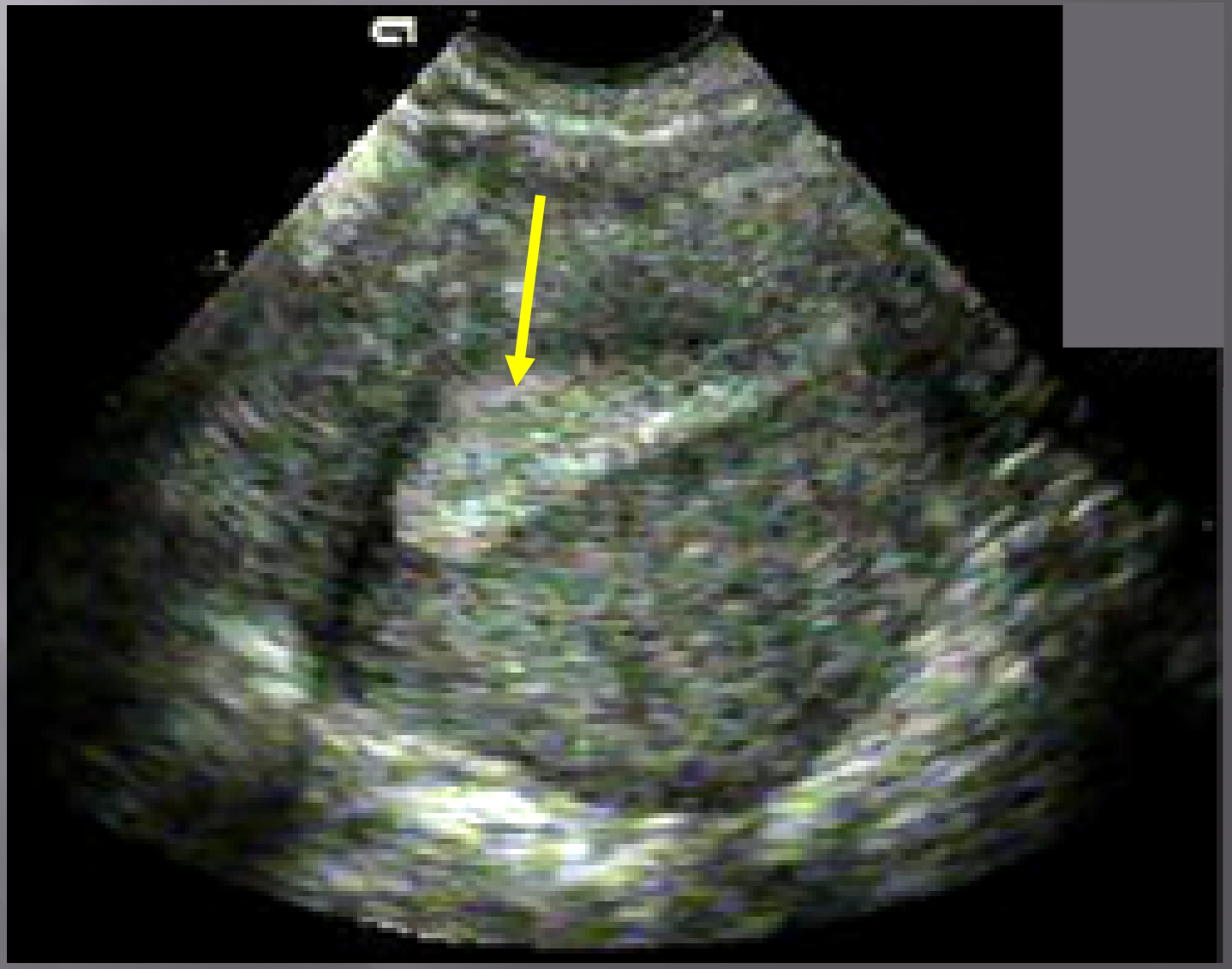
Proliferative endometrium



3D view Follicular Phase

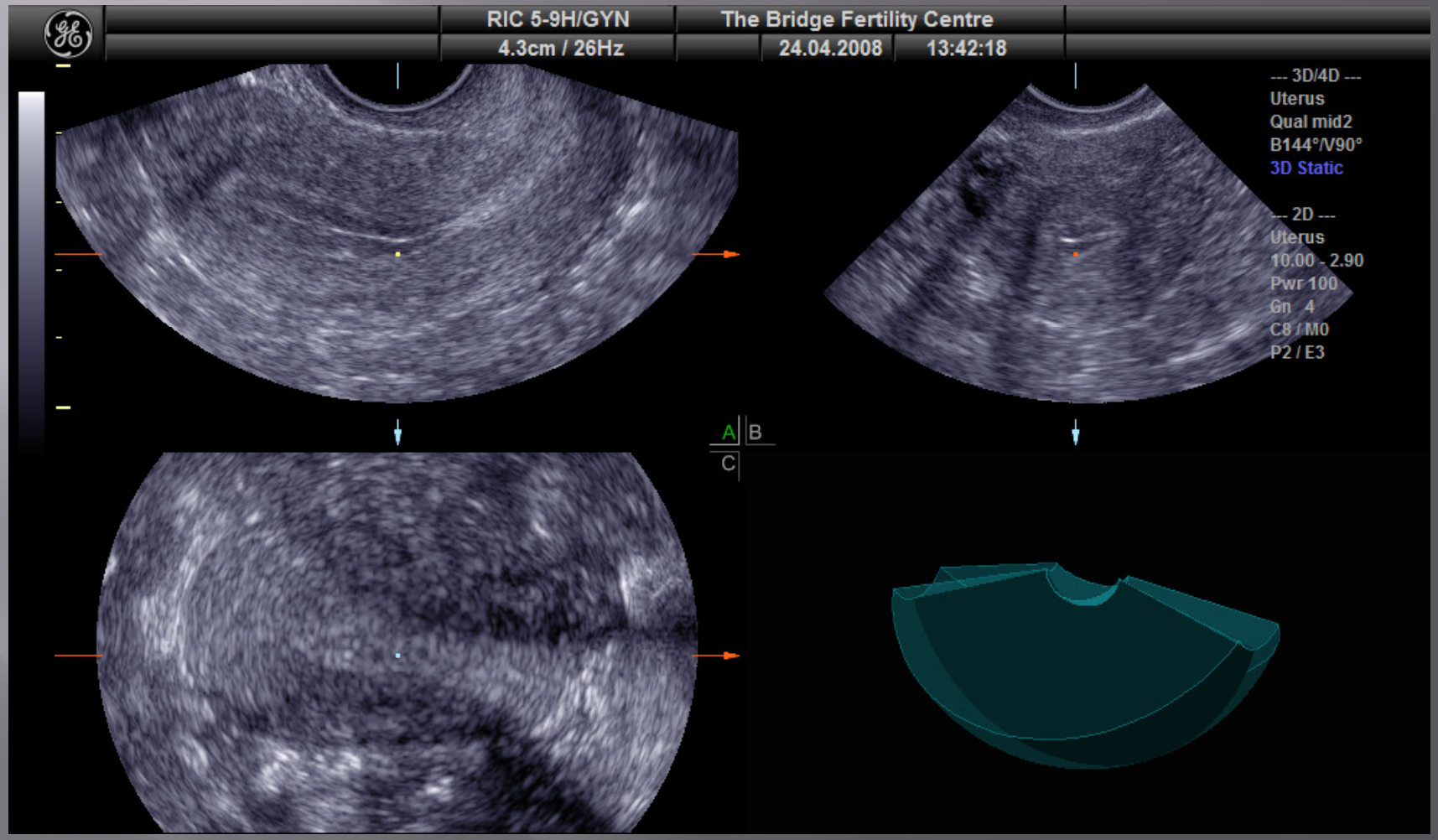


Secretory endometrium

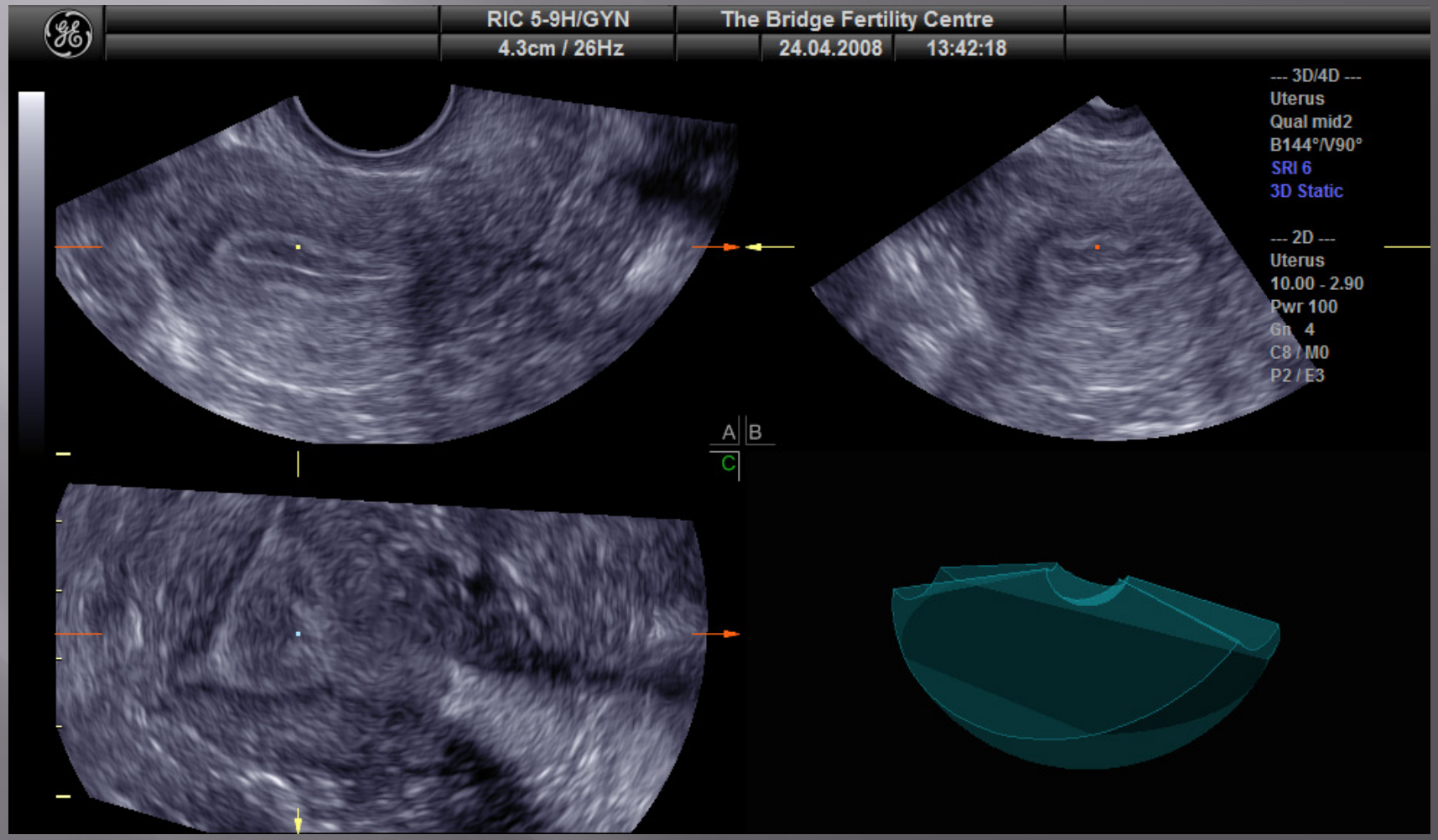


3D view Secretory Phase

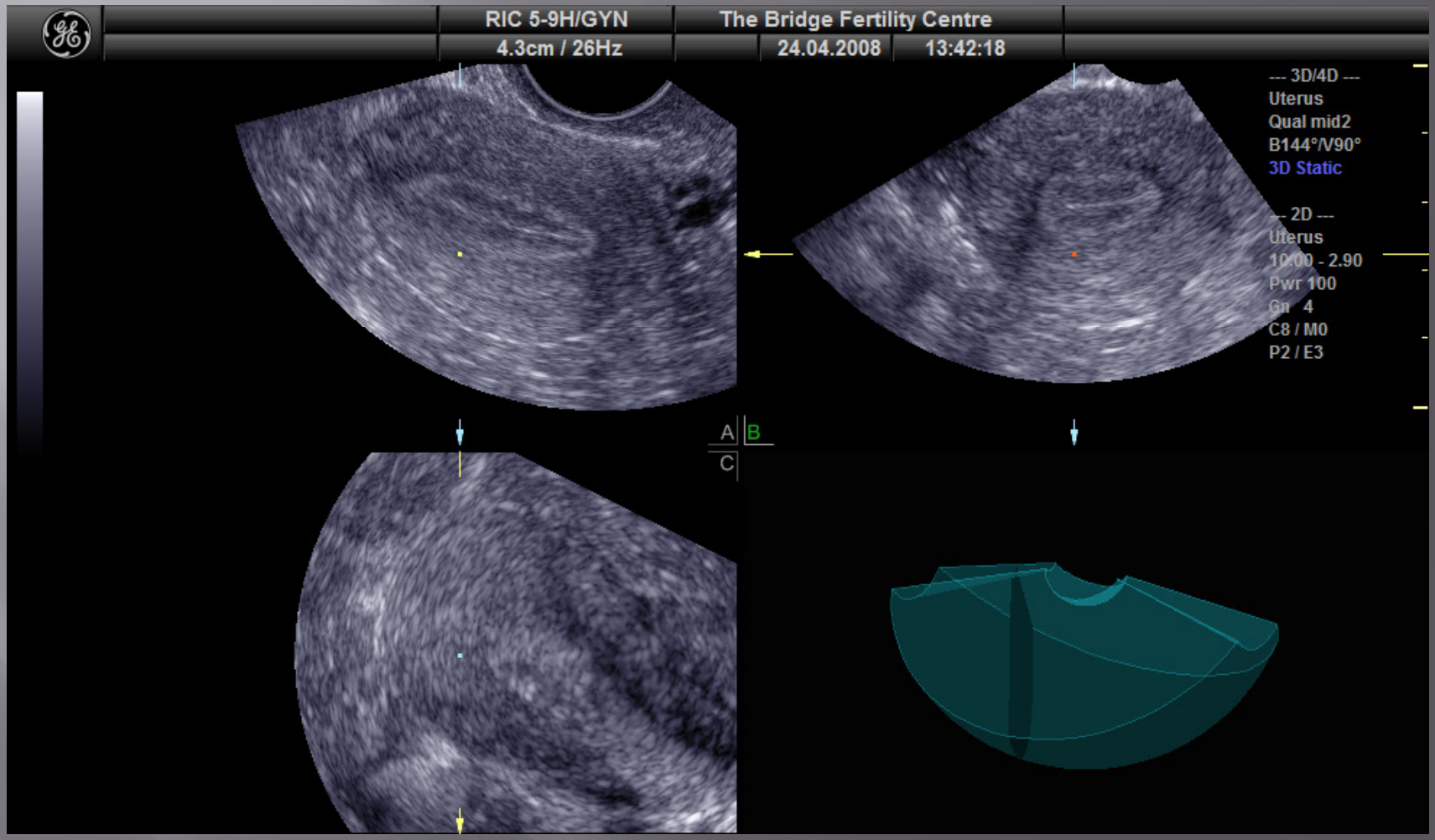
3D longitudinal view



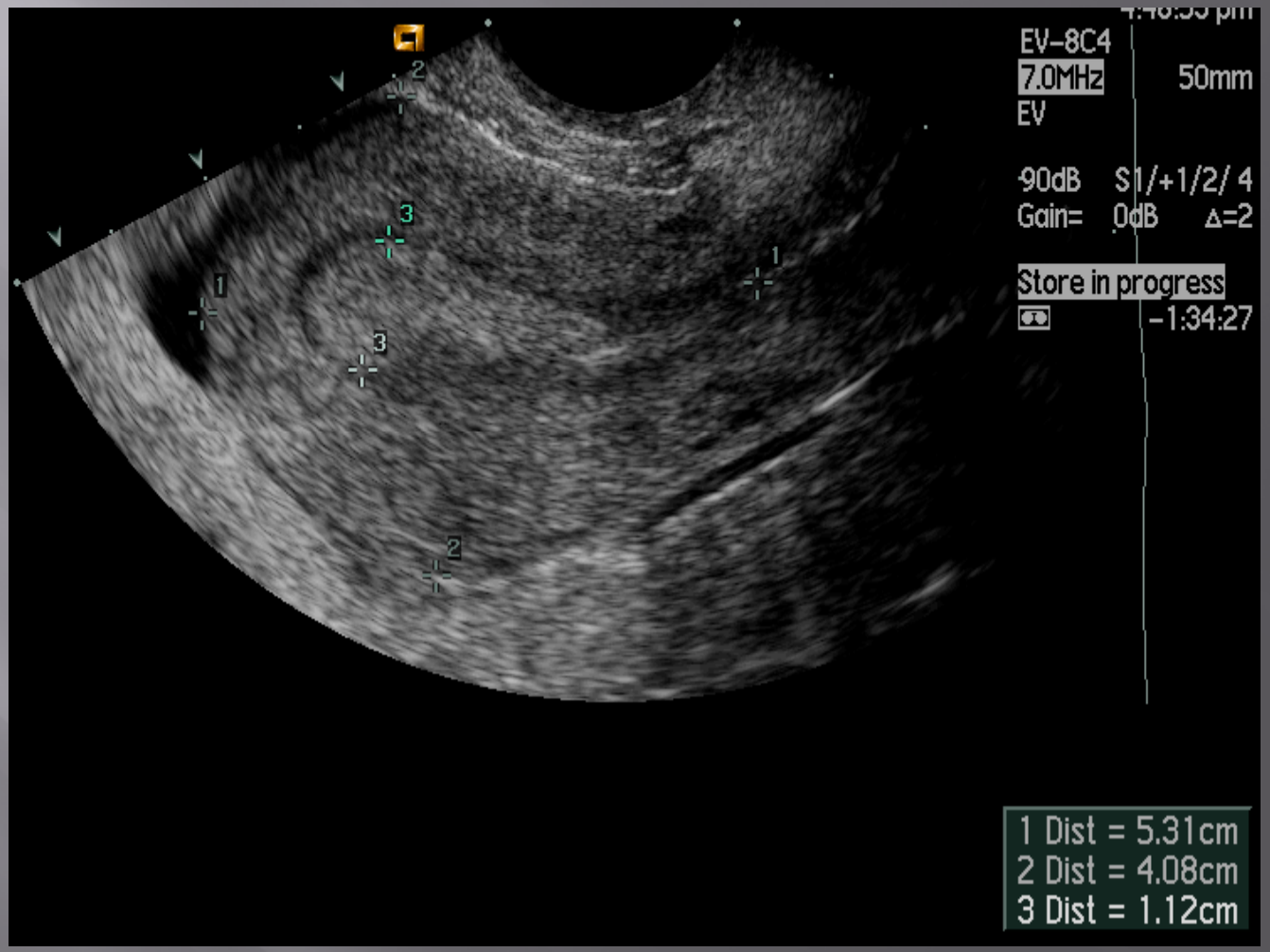
3D coronal view



3D transverse view

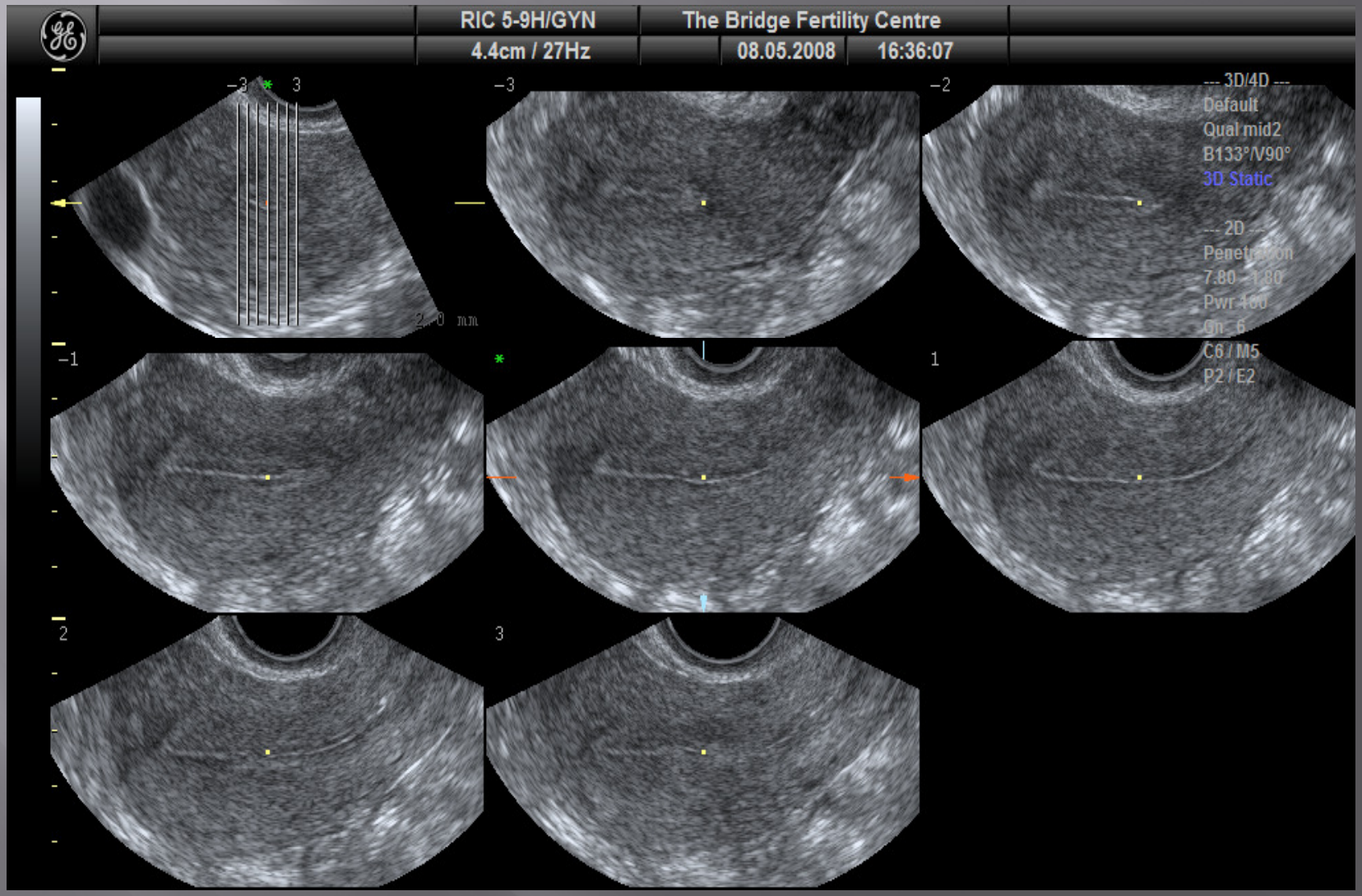


Longitudinal scan of uterus

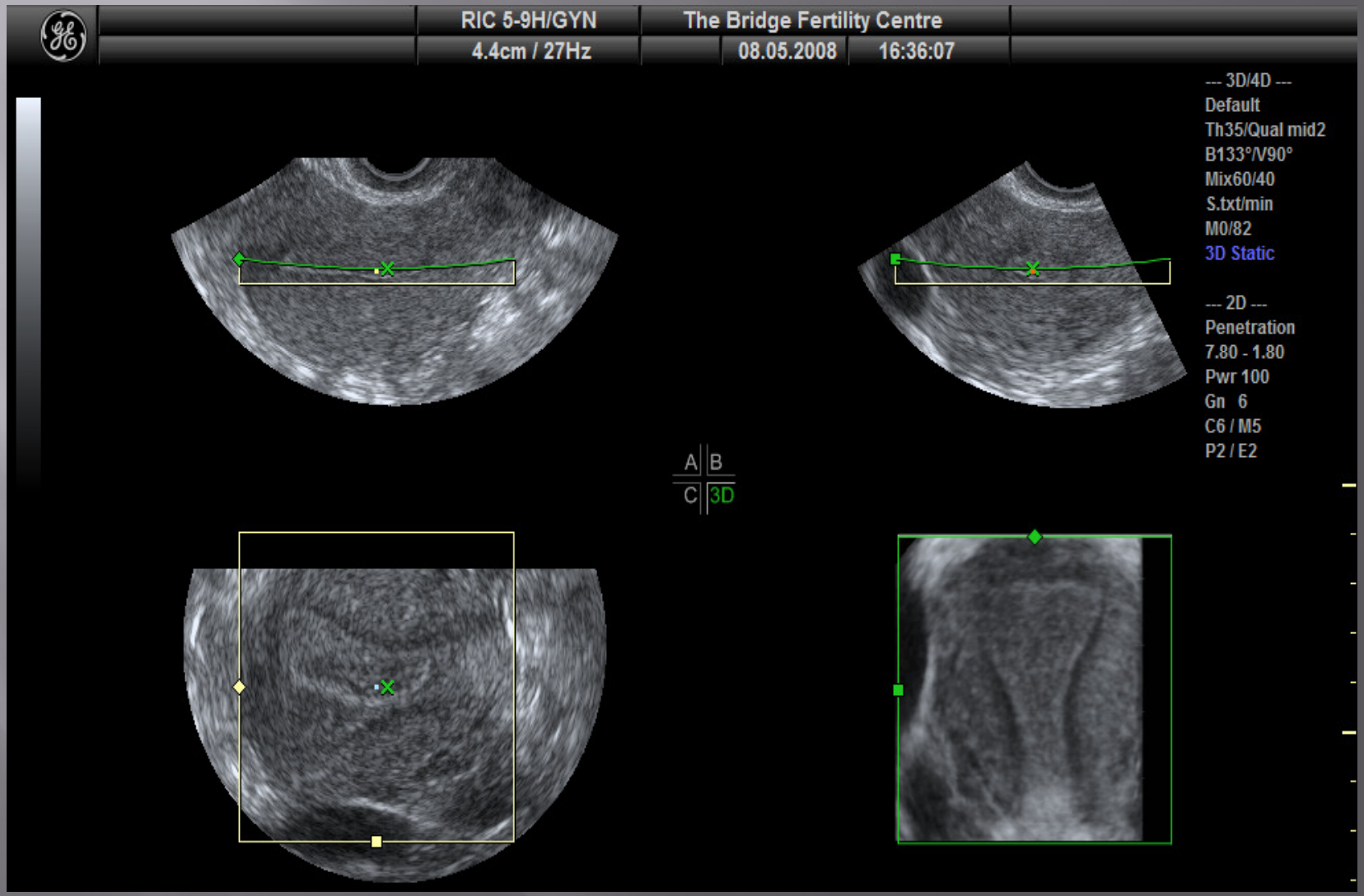


Endometrium

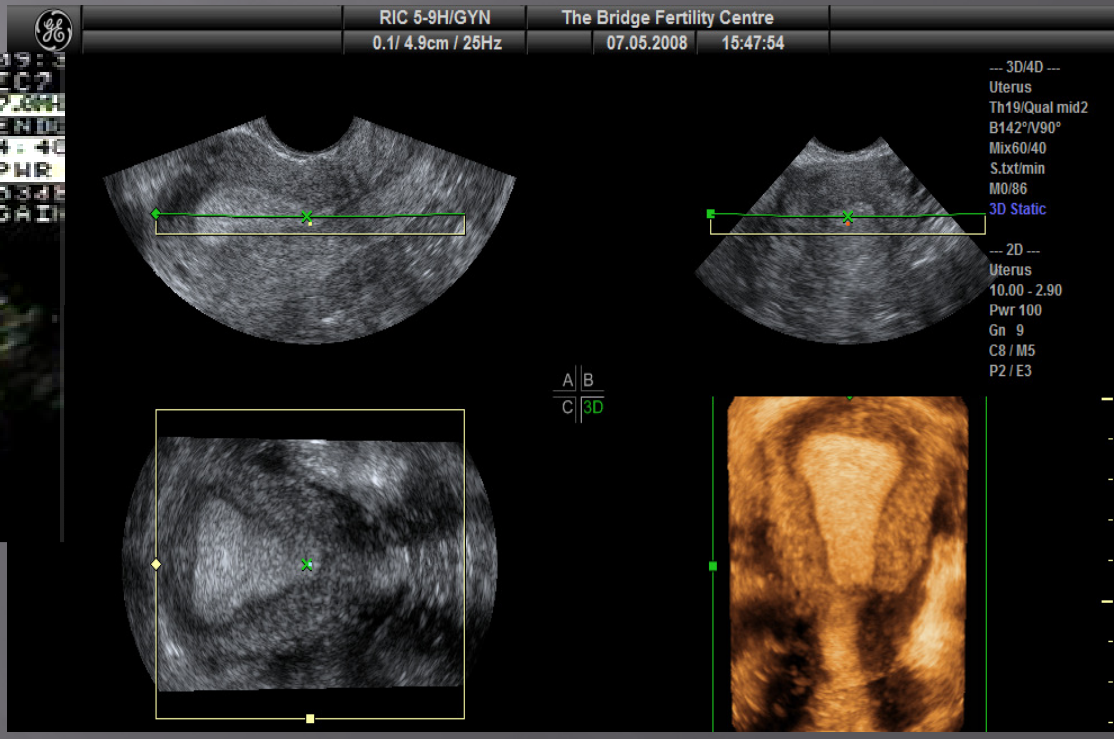
TUI view Follicular Phase

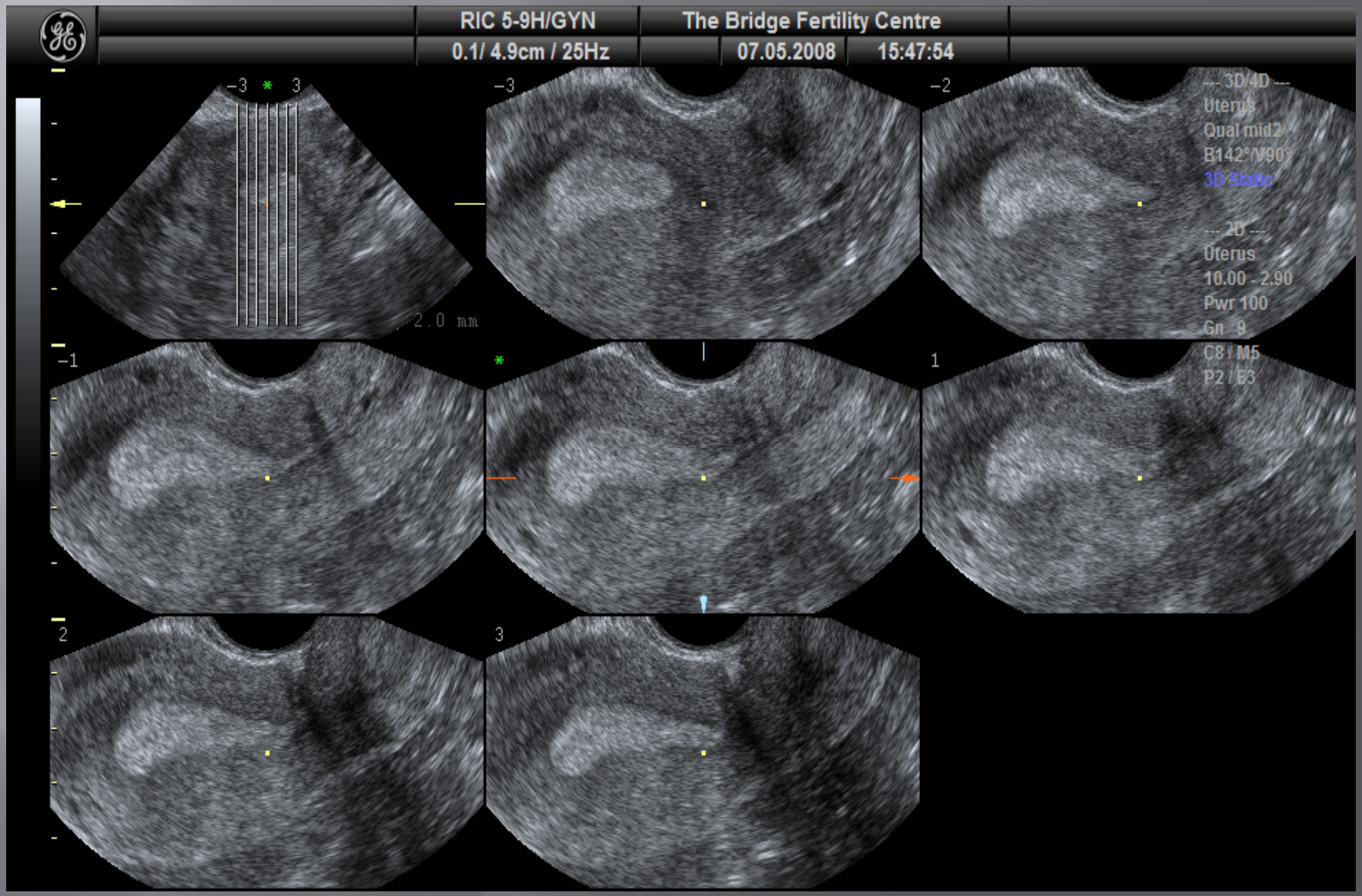


3D View Follicular Phase

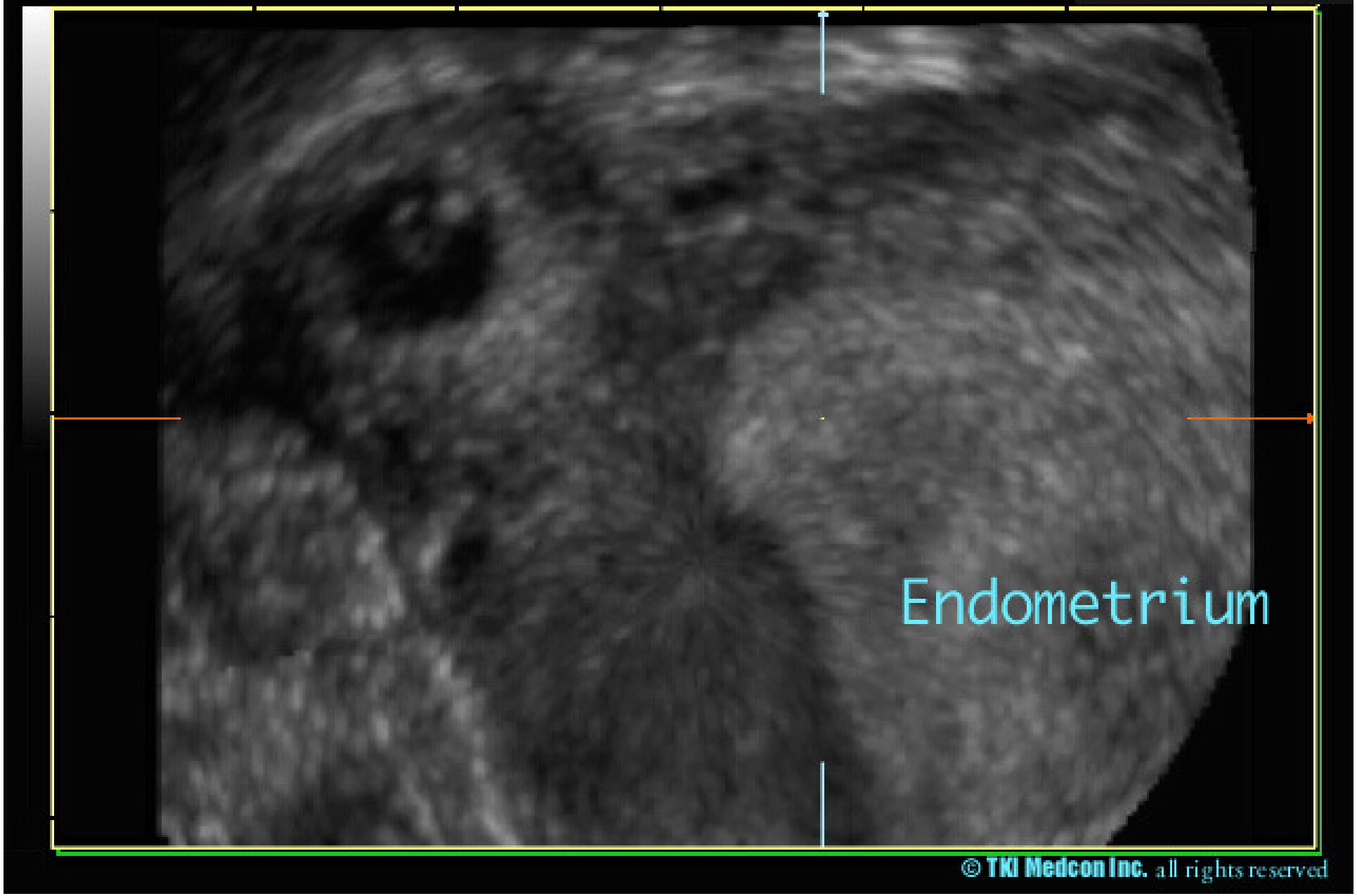


3D view Secretory Phase

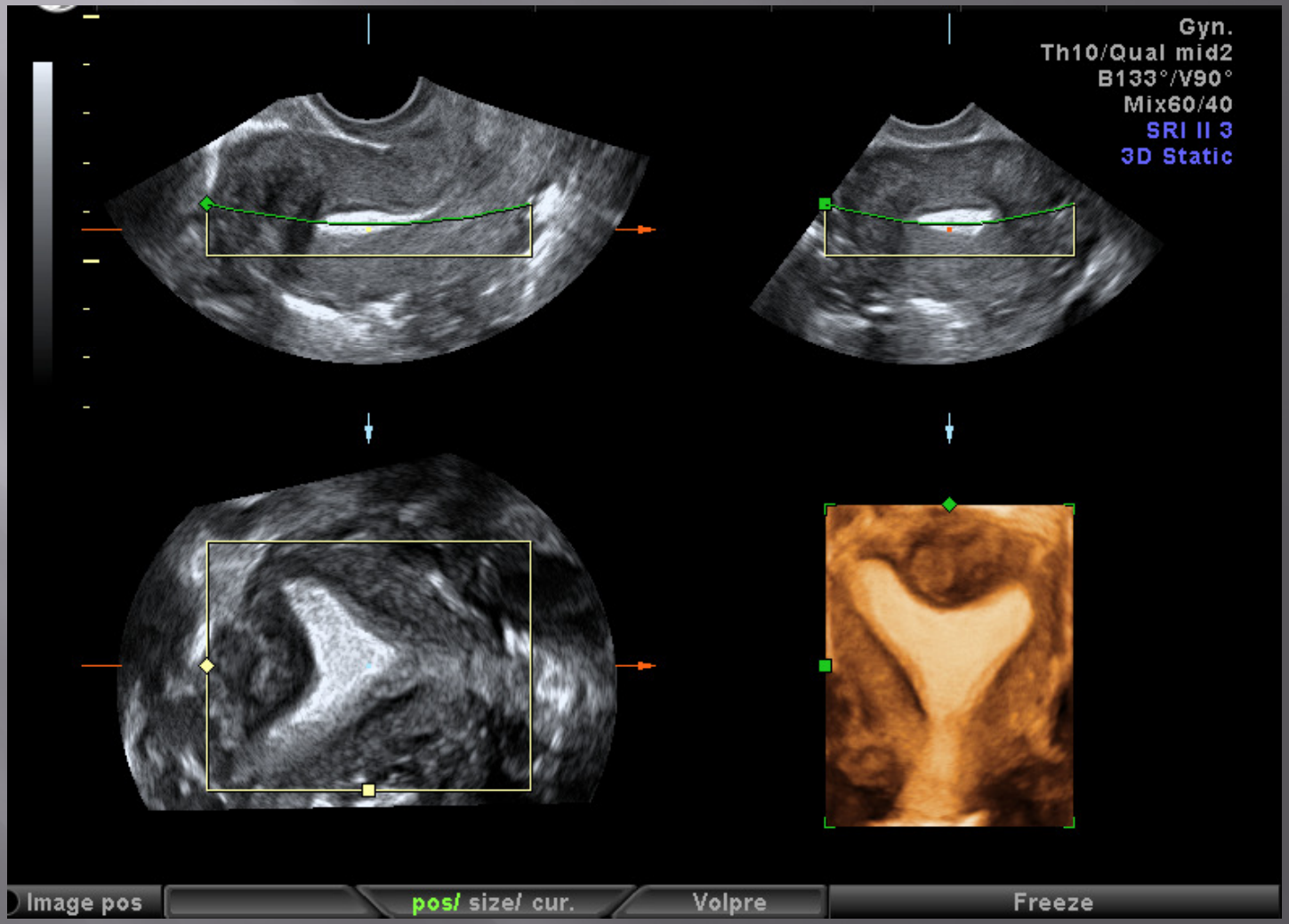


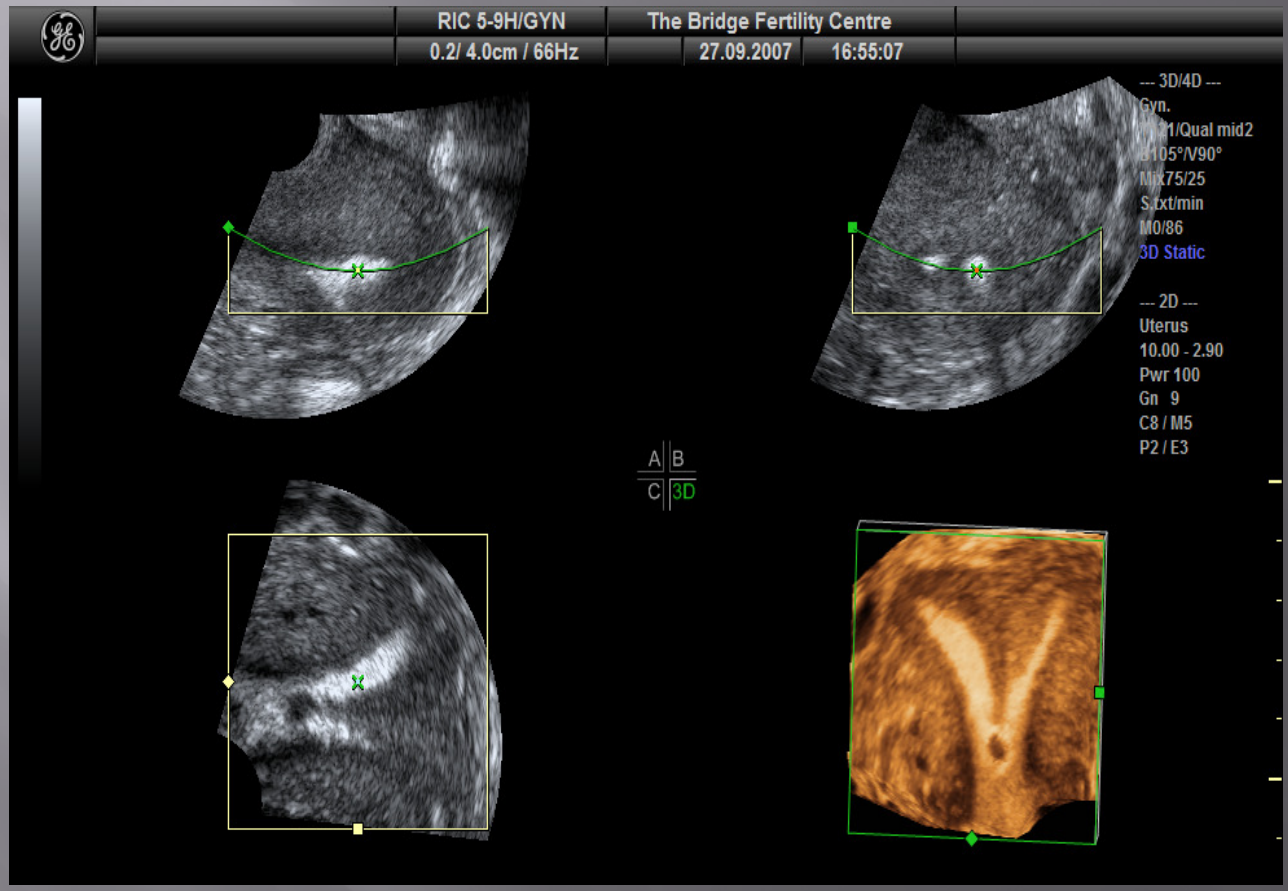

RIC 5-9H/GYN
The Bridge Fertility Centre
0.1/ 4.9cm / 25Hz
07.05.2008
15:47:54
--- 3D/4D ---
Uterus
Qual mid2
B142°/V90°
3D Static
--- 2D ---
Uterus
10.00 - 2.90
Pwr 100
Gn 9
C8 / M5
P2 / B3
2.0 mm

Cornual ectopic

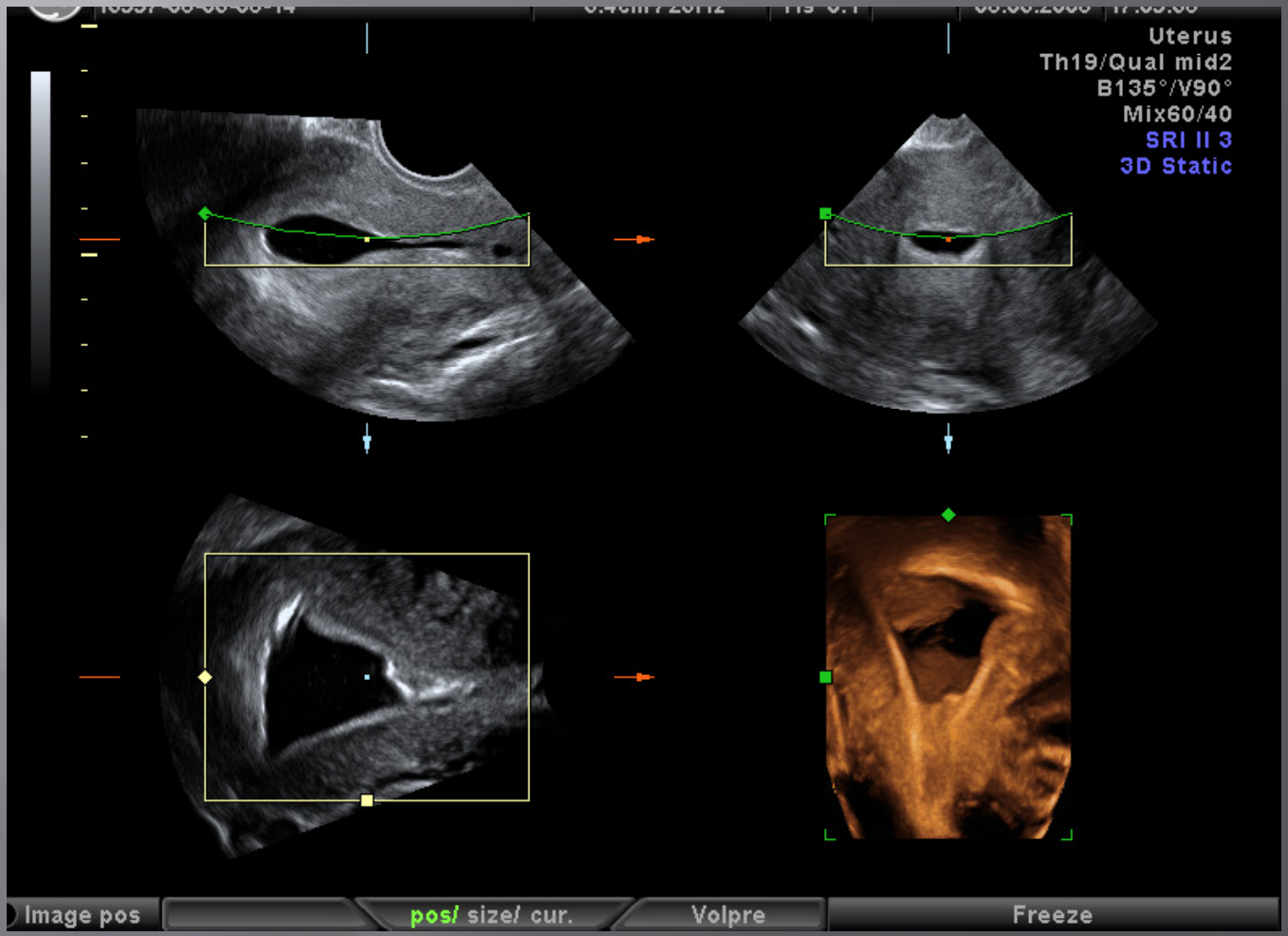


3D view with echovist

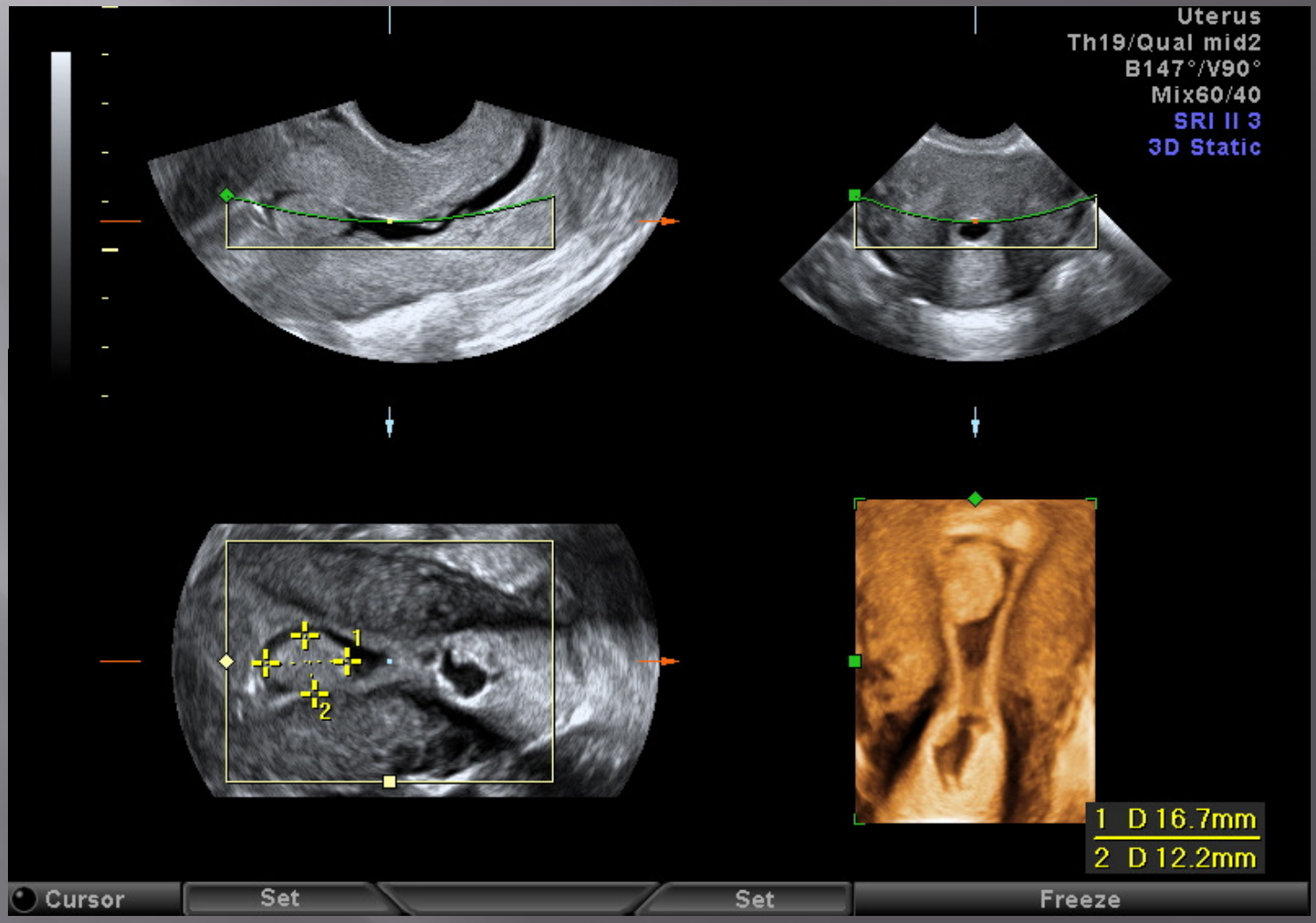



RIC 5-9H/GYN
The Bridge Fertility Centre
0.2/ 4.0cm / 66Hz
27.09.2007
16:55:07
--- 3D/4D ---
Gyn.
/Qual mid2
105°/V90°
Mix75/25
S.txt/min
M0/86
3D Static
--- 2D ---
Uterus
10.00 - 2.90
Pwr 100
Gn 9
C8 / M5
P2 / E3
A
B
C
3D

SIS 3D view

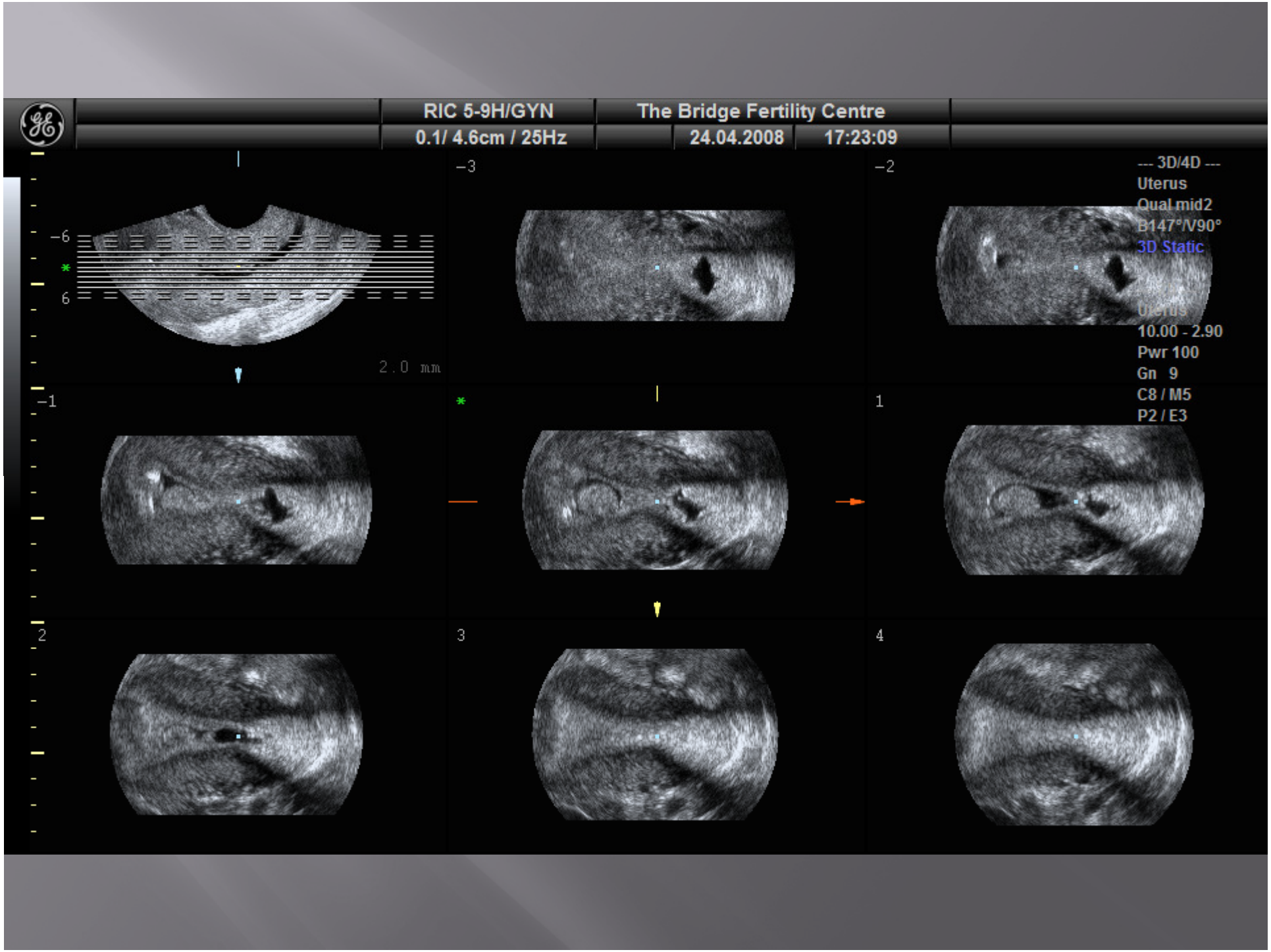

Uterus
Th19/Qual mid2
B135°/V90°
Mix60/40
SRI II 3
3D Static
Image pos
pos/ size/ cur.
Volpre
Freeze

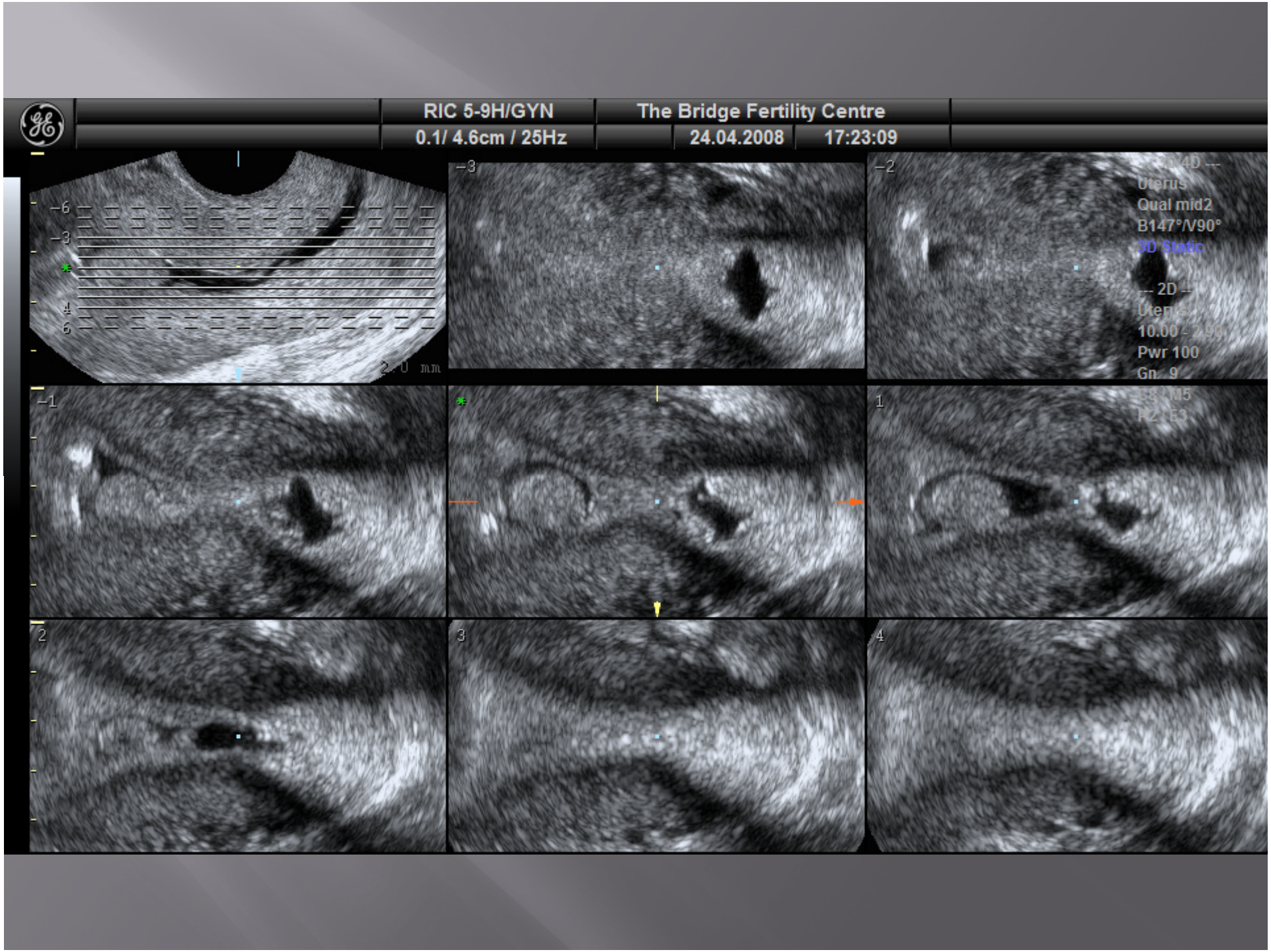
Fibroid polyp 3D view



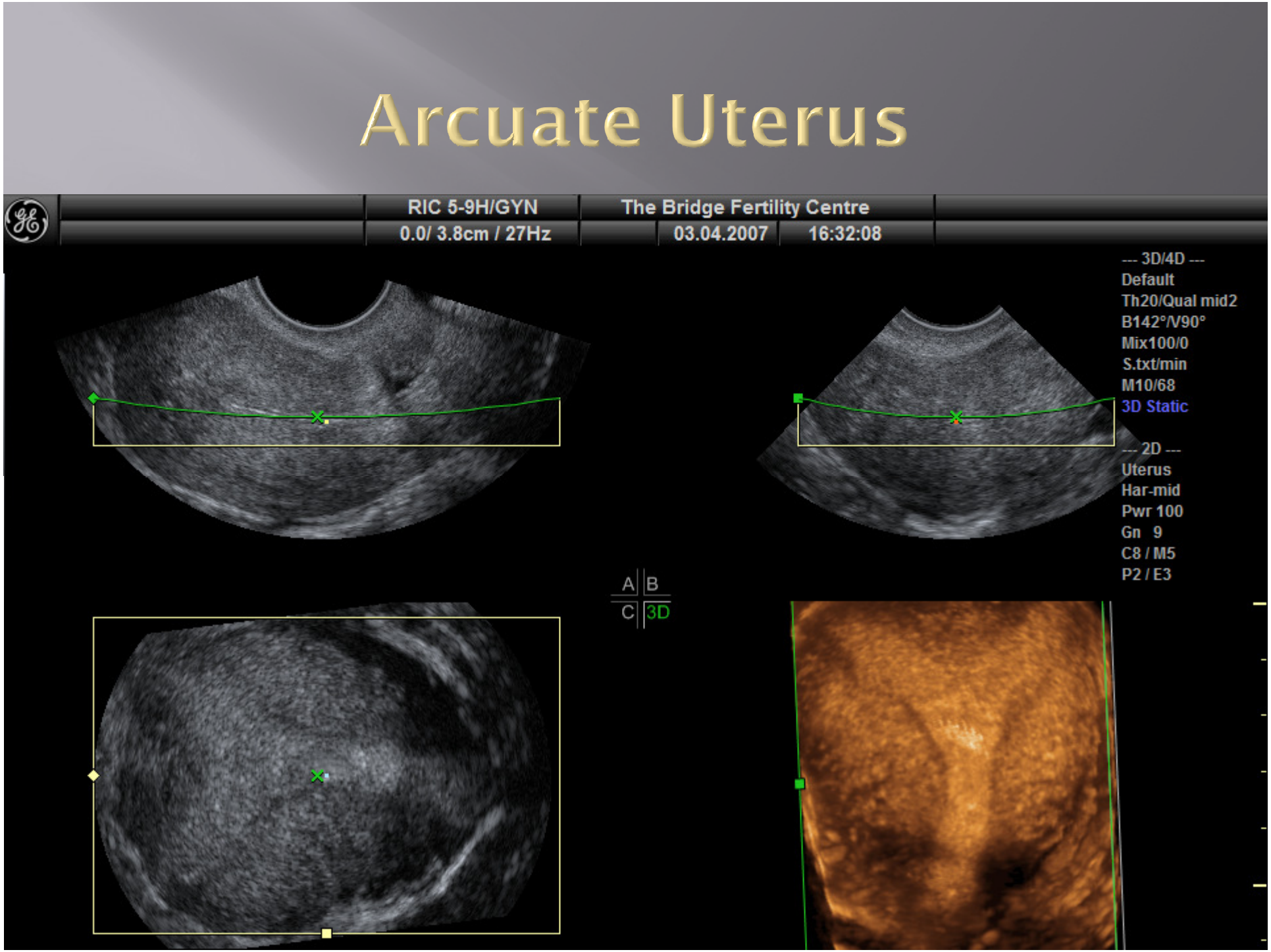
Uterine Septum with Echovist Dye


RIC 5-9H/GYN
The Bridge Fertility Centre
0.1/ 4.6cm / 25Hz
24.04.2008
17:23:09
--- 3D/4D ---
Uterus
Qual mid2
B147°/V90°
3D Static
--- 2D ---
Uterus

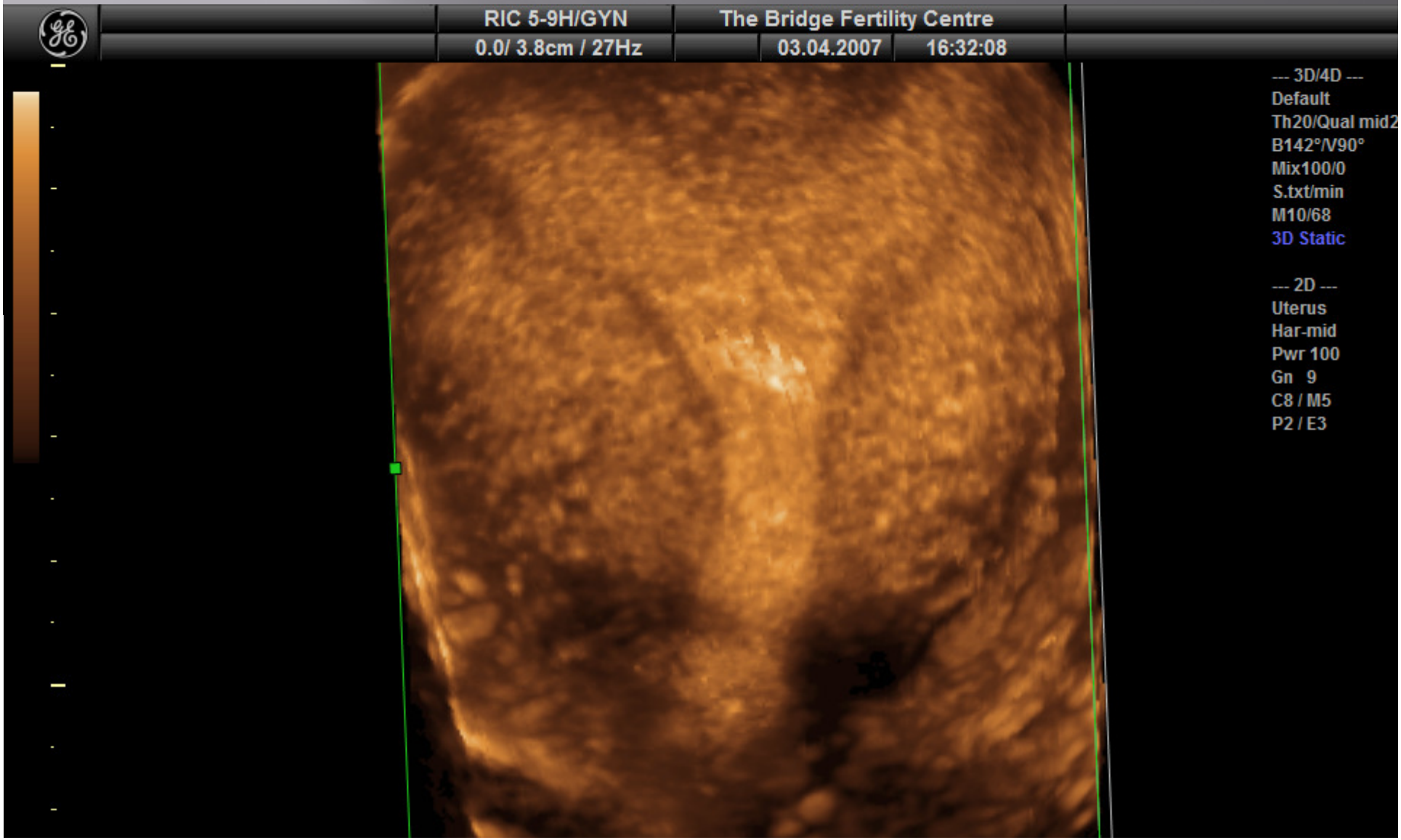

RIC 5-9H/GYN
The Bridge Fertility Centre
0.1/ 4.6cm / 25Hz
24.04.2008
17:23:09
--- 3D/4D ---
Uterus
Qual mid2
B147°/V90°
3D Static
Uterus
10.00 - 2.90
Pwr 100
Gn 9
C8 / M5
P2 / E3
2.0 mm
-3
-2
-1
1
2
3
4

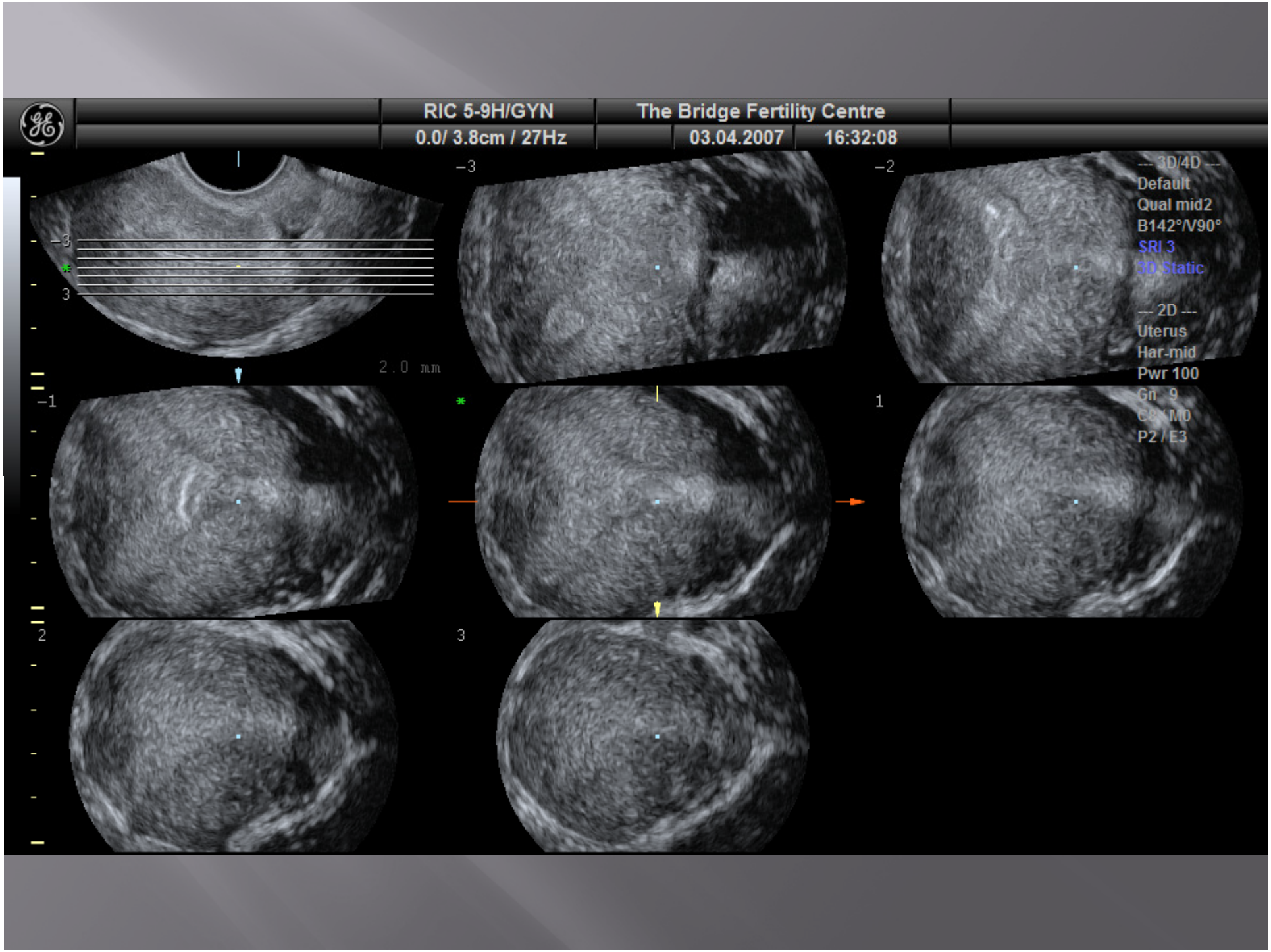

RIC 5-9H/GYN
The Bridge Fertility Centre
0.1/ 4.6cm / 25Hz
24.04.2008
17:23:09
Uterus
Qual mid2
B147°/V90°
3D Static
-- 2D --
Pwr 100
Gn 9

Arcuate Uterus



3D Arcuate Uterus




RIC 5-9H/GYN
The Bridge Fertility Centre
0.0/ 3.8cm / 27Hz
03.04.2007
16:32:08
--- 3D/4D ---
Default
Qual mid2
B142°/V90°
SRI 3
3D Static
--- 2D ---
Uterus
Har-mid
Pwr 100
Gn 9
P2 / E3
2.0 mm

Arcuate with Fundal fibroid

Incidence

- A critical analysis of studies suggests that the prevalence of congenital uterine anomalies is 6.7% in the general population
- 7.3% in the infertile population and
- 16.7% in the RM population.

Incidence

- The Arcuate uterus is the commonest anomaly in the general and RM population.
- In contrast, the Septate uterus is the commonest anomaly in the infertile population, suggesting a possible association

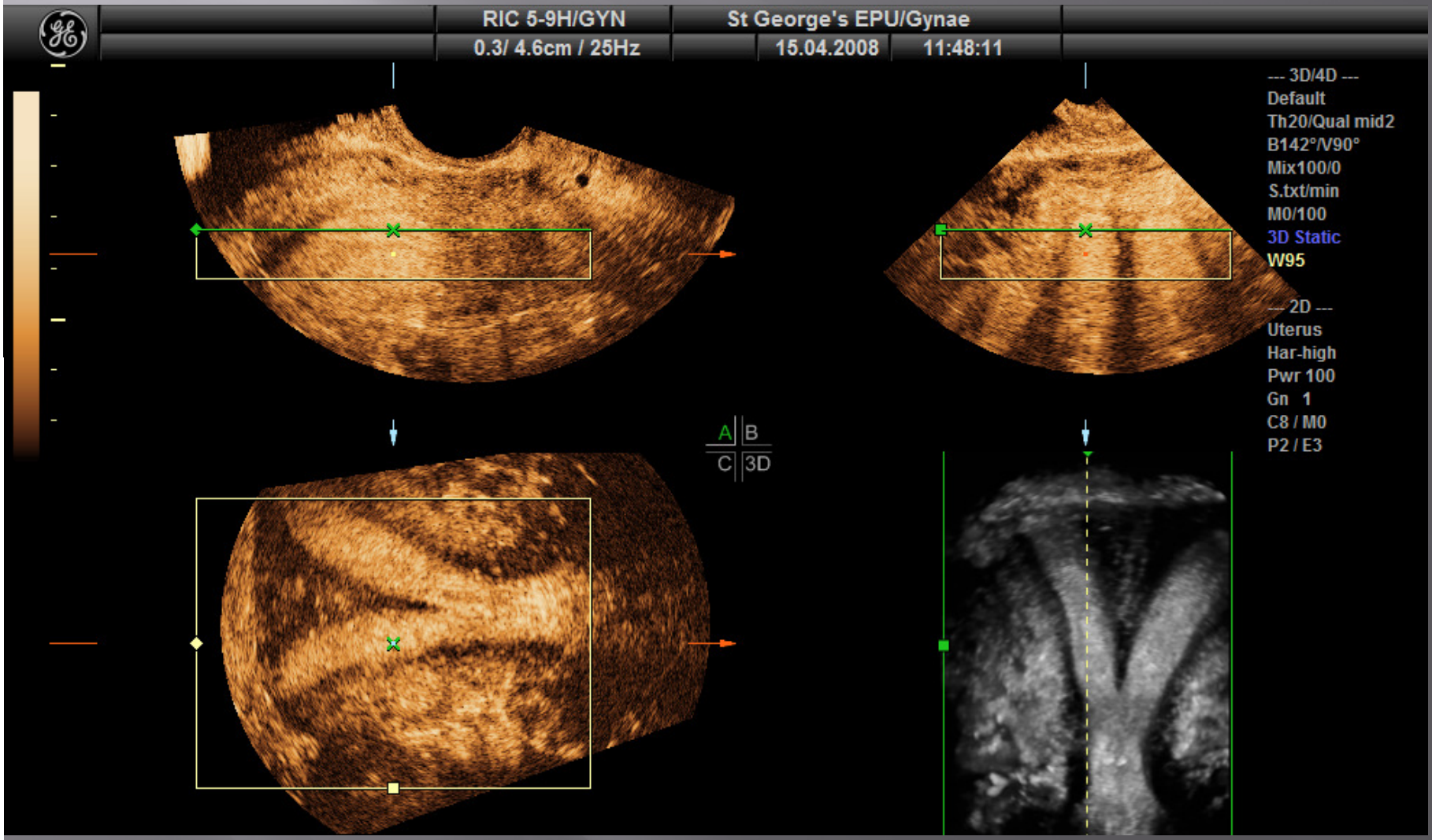
Rec Miscarriage

- Women with RM have a high prevalence of congenital uterine anomalies and should be thoroughly investigated
- HSG and/or 2D US can be used as an initial screening tool
- Combined hysteroscopy and laparoscopy, SHG and 3D US can be used for a definitive diagnosis
- The accuracy and practicality of MRI remains unclear.

Uterine Septum

- Fundus is well formed
- Septum could be partial or full
- Septum could be thin and fibrous or thick and muscular or both
- This may indicate the possibility of bleeding during surgery.

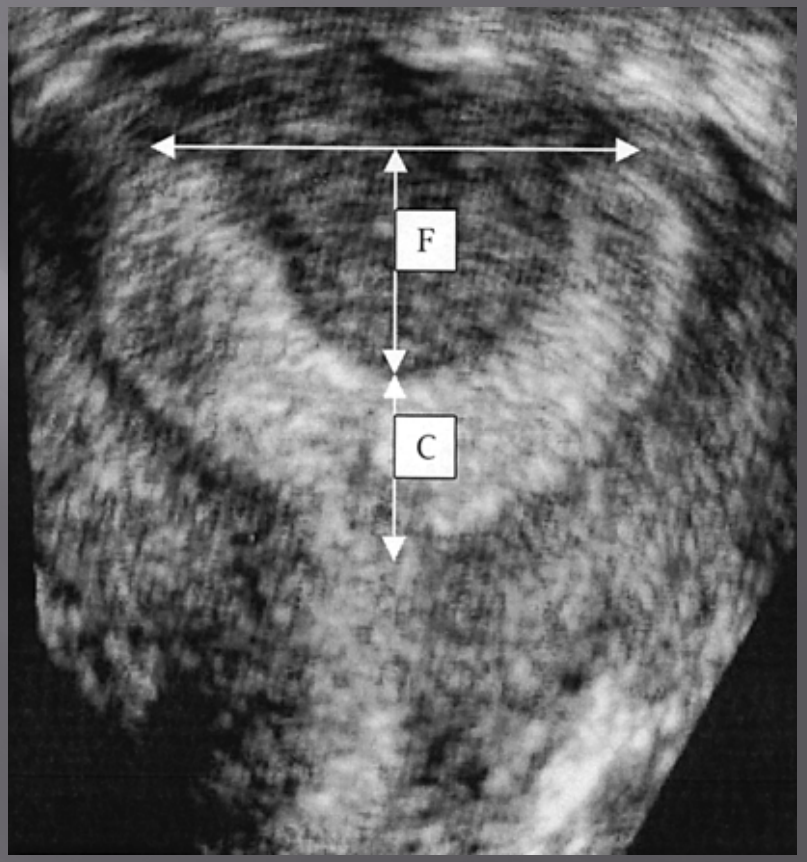
Uterine Septum

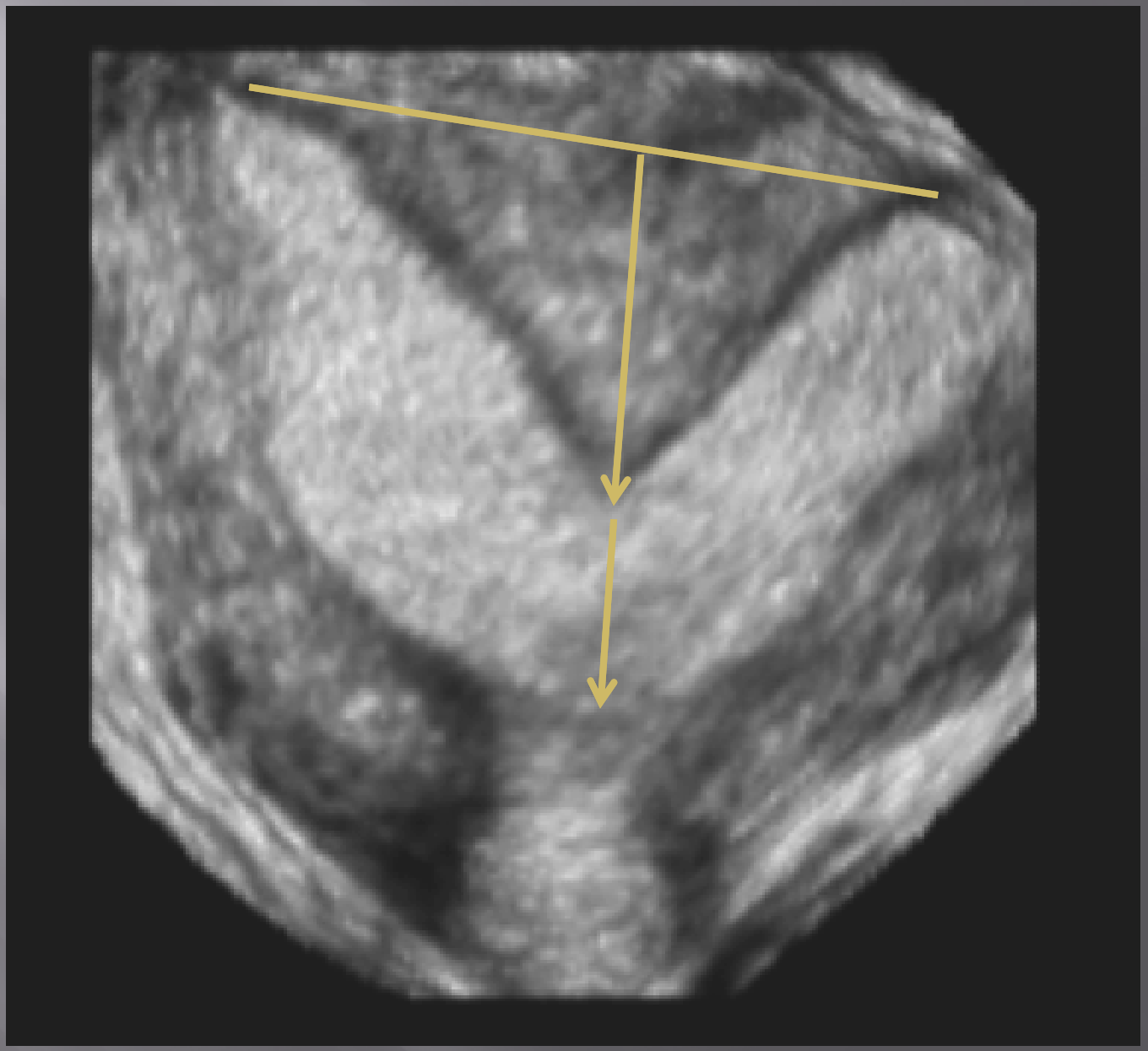


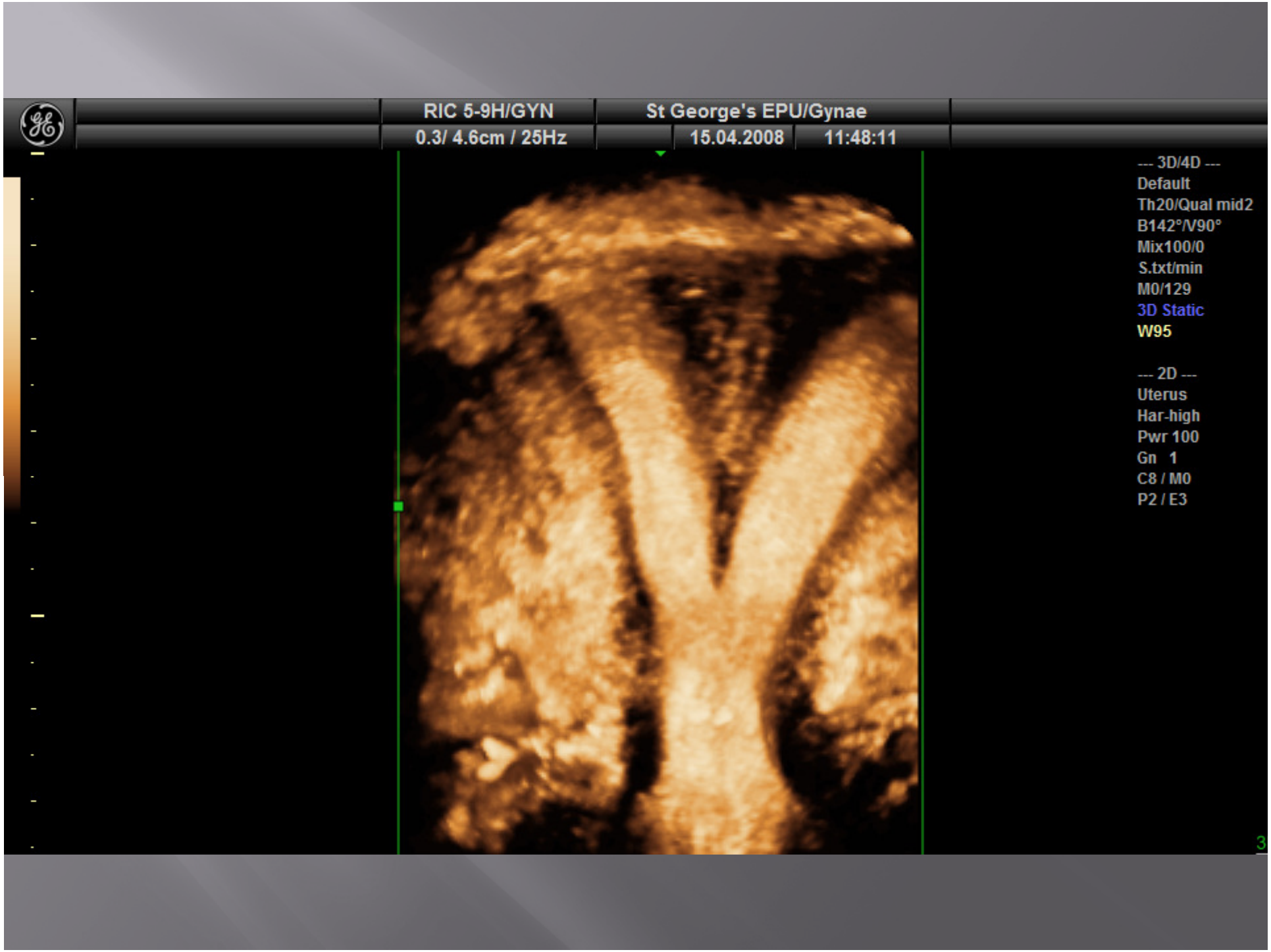
Coronal View - measurements

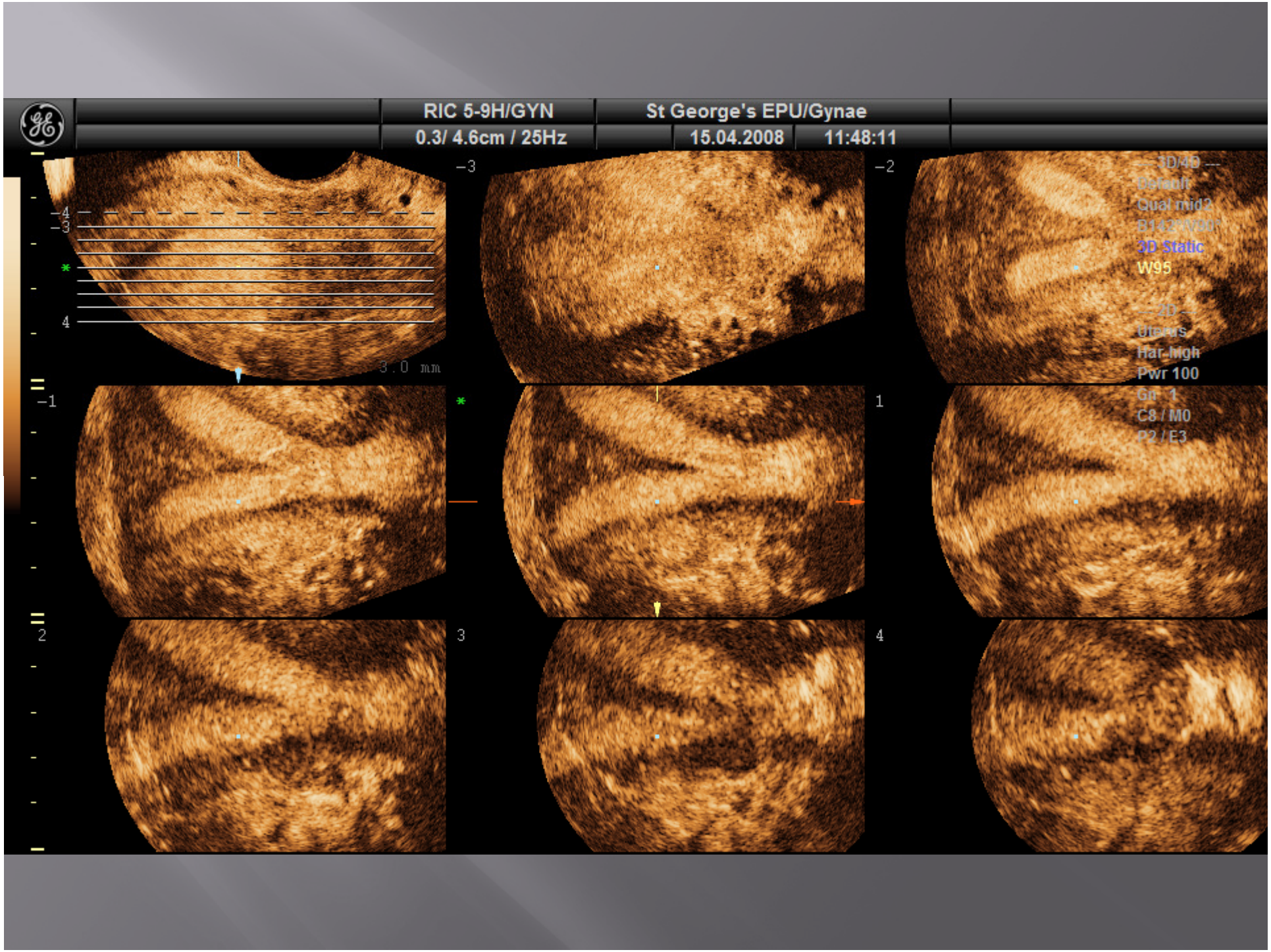
The length of the septum (*F*) is measured between its distal tip and the midpoint of the line adjoining tubal ostia.

The length of the residual uterine cavity (*C*) measured between the distal tip of the septum and the internal os.






RIC 5-9H/GYN
St George's EPU/Gynae
0.3/ 4.6cm / 25Hz
15.04.2008
11:48:11
--- 3D/4D ---
Default
Th20/Qual mid2
B142°/V90°
Mix100/0
S.txt/min
M0/129
3D Static
W95
--- 2D ---
Uterus
Har-high
Pwr 100
Gn 1
C8 / M0
P2 / E3


RIC 5-9H/GYN
St George's EPU/Gynae
0.3/ 4.6cm / 25Hz
15.04.2008
11:48:11
3.0 mm
3D Static
W95
Pwr 100
C8 / M0
P2 / E3

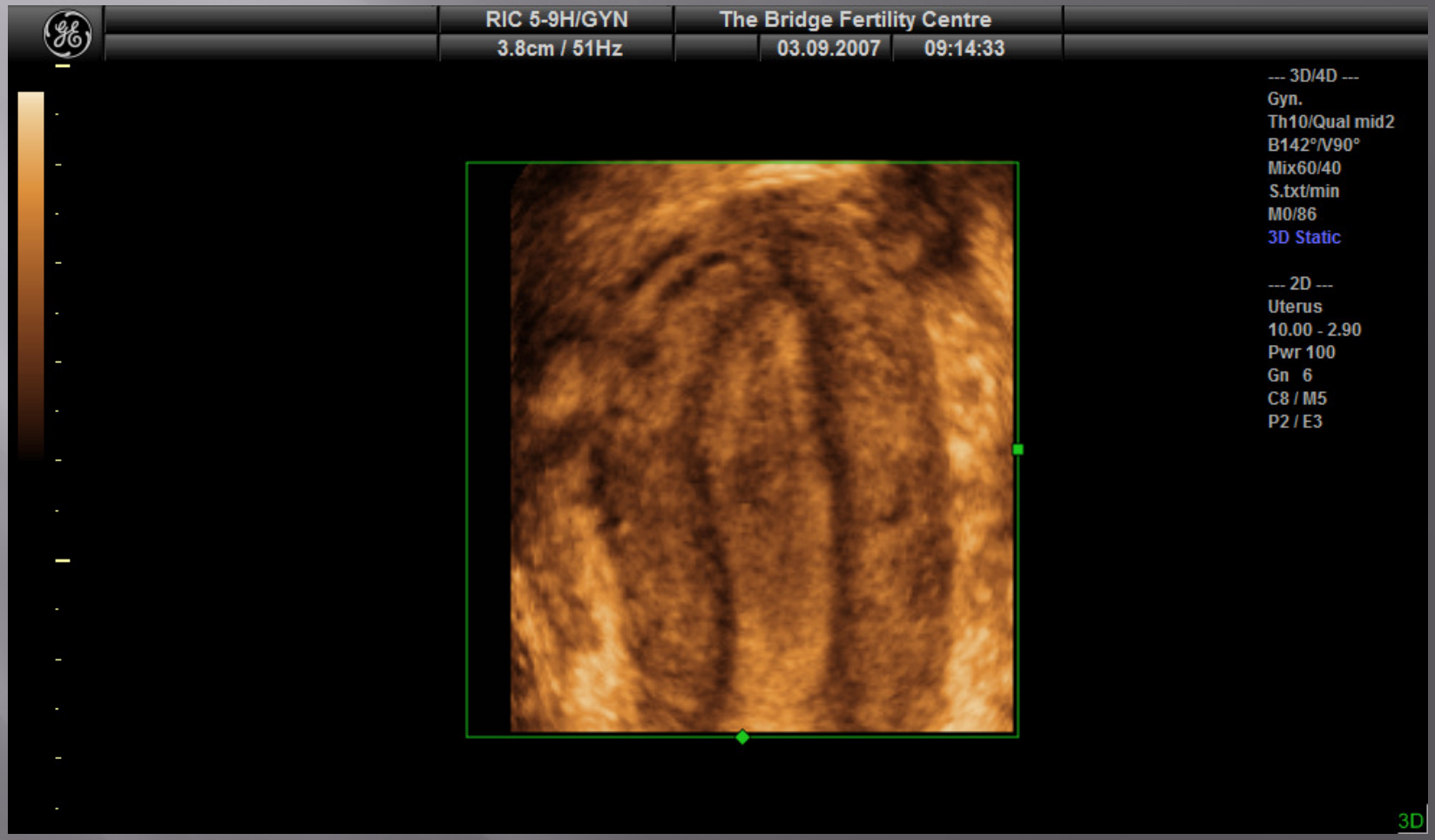
Unicornuate Uterus

Unicornuate uterus second cervical opening must be considered

Further injection of contrast into the cervix may lead to the diagnosis of a uterine didelphys or a complete septate uterus (Letterie, 1998).

In assessing a unicornuate uterus with HSG, blocked or non-communicating rudimentary horns will not appear on film (Propst and Hill, 2000)

Unicornuate uterus



Associated Renal Abnormality

- This is reflected in the fact that up to 60% of women with unilateral renal agenesis have been shown to have genital anomalies (Barakat, 2002), most commonly a unicornuate uterus (Troiano and McCarthy, 2004)
- 40% of all patients with a unicornuate uterus suffer from renal abnormalities (Fedele *et al*., 1996),

Uterus Didelphys

- Two cervix seen well in luteal phase
- Direct the probe to include the cervix
- Generally in close proximity
- Difficult when one of the cervix is rudimentary
- Especially if both cavity are well formed

Ultrasound criteria

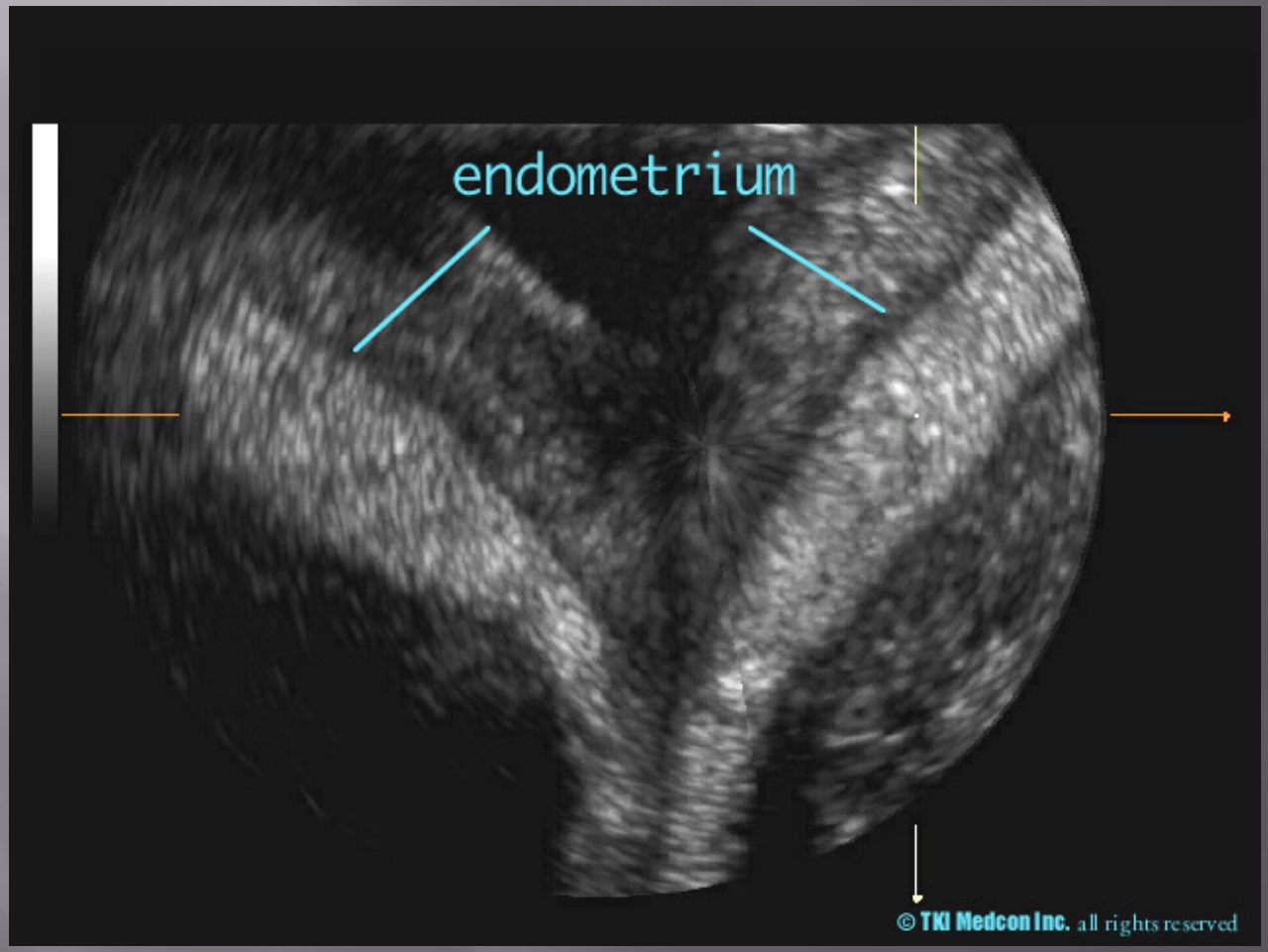
- Uterus to be septate rather than double (i.e. bicornuate or didelphys) when there is a fundal distal border indentation of 5 mm above the line joining the two ostia (interostial line

Fedele *et al*. (1989) and Troiano and McCarthy (2004)

- Uterus to be septate when the fundal indentation is <10 mm below the interostial line

  Wu *et al*. (1997), Letterie (1998) and Woelfer *et al*. (2001)

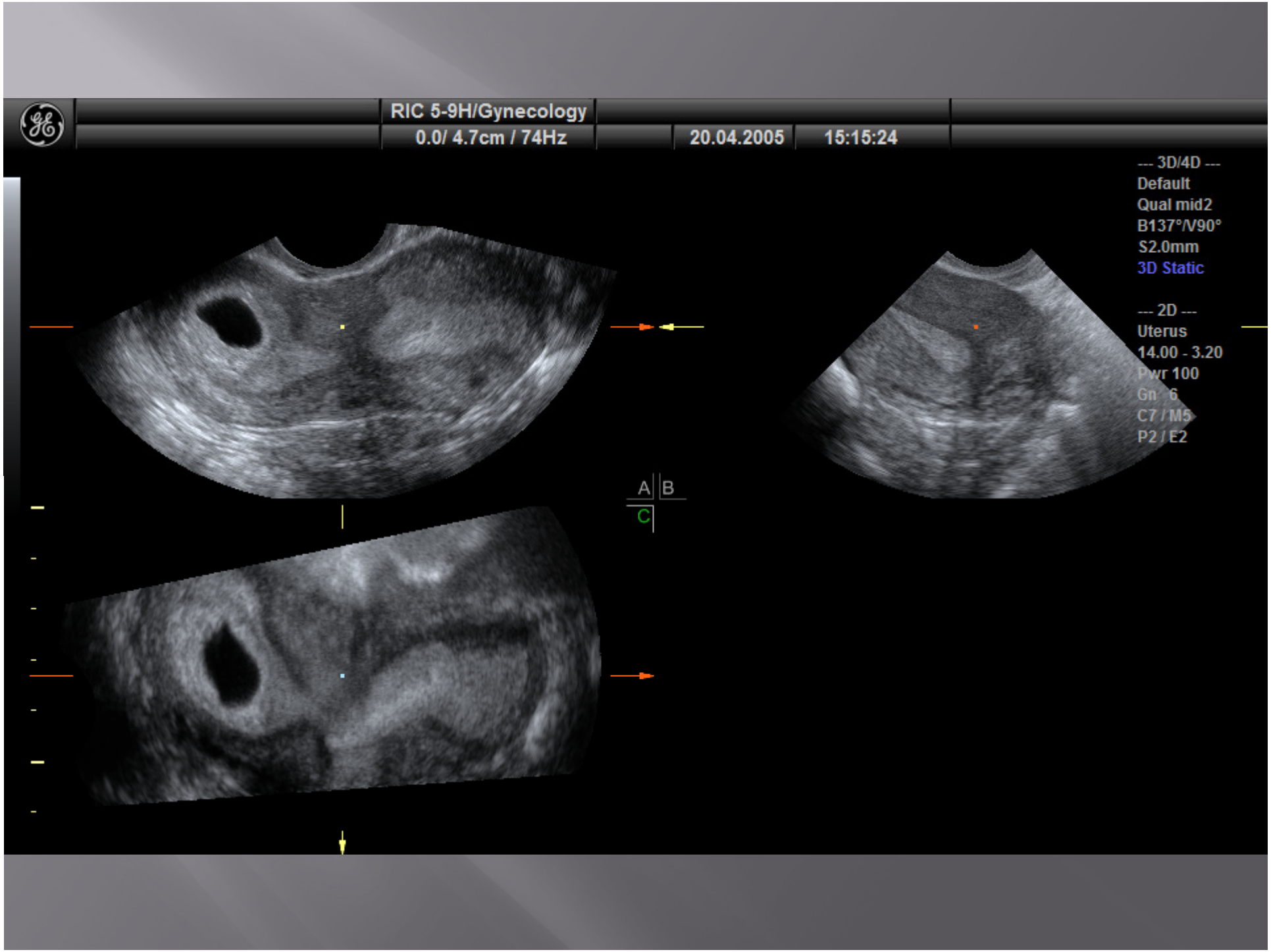
Uterus Didelphus



Bicornuate

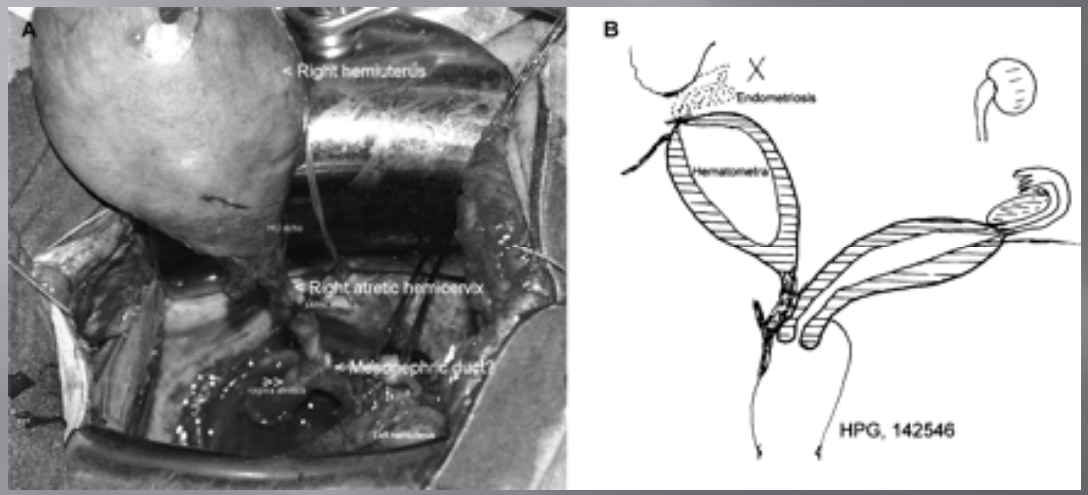
- Two separate fundus
- Dip in the midline
- The two uterii may be same in size or disproportionate
- Cavity well formed communicating with cervix
- History LSCS (repeat) breech - possibility of uterine malformation

Bicornuate Uterus

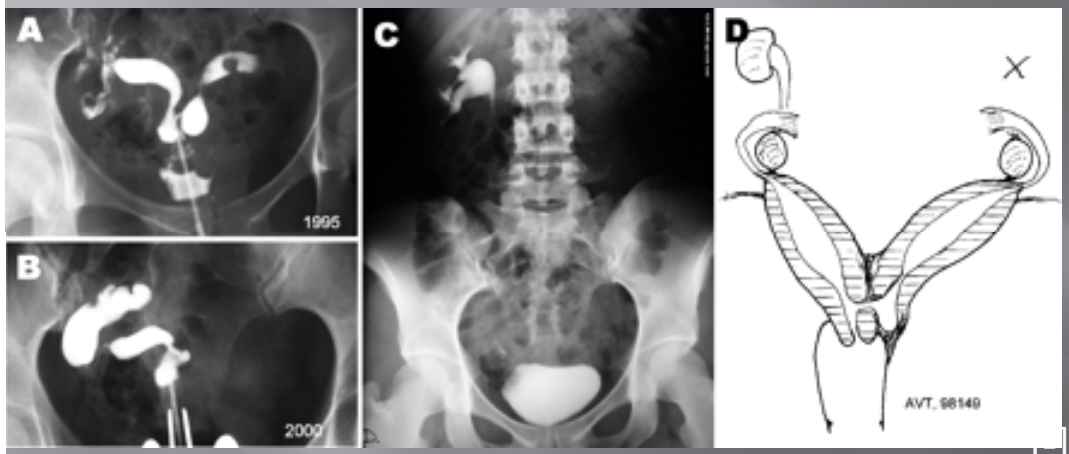

RIC 5-9H/Gynecology
0.0/ 4.7cm / 74Hz
20.04.2005
15:15:24
--- 3D/4D ---
Default
Qual mid2
B137°/V90°
S2.0mm
3D Static
--- 2D ---
Uterus
14.00 - 3.20
Pwr 100
Gn 6
C7 / M5
P2 / E2
A
B
C

Most accurate diagnostic procedures

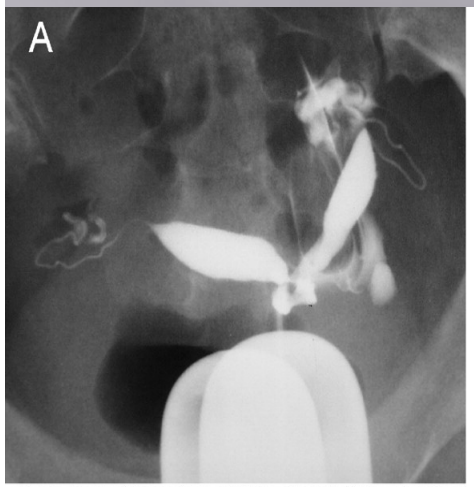
- combined hysteroscopy and laparoscopy
- sonohysterography (SHG)
- possibly three-dimensional ultrasound (3D US).
- Two-dimensional ultrasound (2D US) and hysterosalpingography (HSG) are less accurate and are thus inadequate for diagnostic purposes.
- Preliminary studies (n = 24) suggest magnetic resonance imaging (MRI) is a relatively sensitive tool.

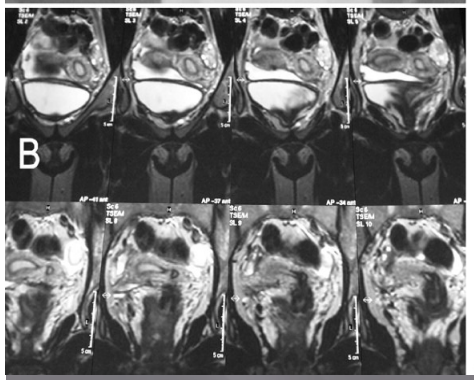


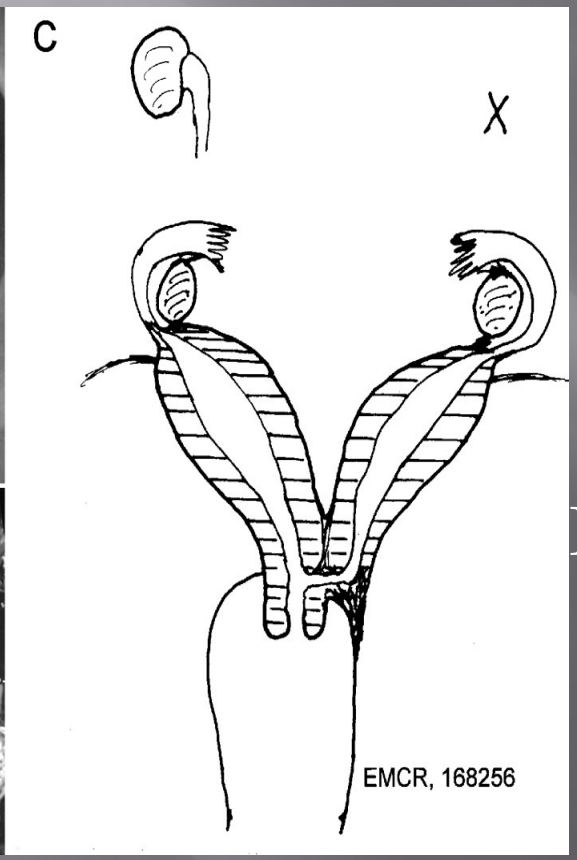
- Right hemiuterus enlarged by hematometra with an atretical hemicervix ending in another atretic duct, probably the mesonephric duct



- Left cervico-vaginal atresia and renal agenesis with bicornuate communicating uterus.
- HSG image before and After operation IVP showing left renal agenesis.







- Left cervico-vaginal atresia and renal agenesis with bicornuate communicating uterus
- HSG and MRI coronal images showing both **uterine** cavities and communication between them

Rudimentary Horn

- As this would warrant removal of the rudimentary horn due to possible rupture, it is of great importance that non-communicating rudimentary horns are correctly identified and differentiated
- By removing rudimentary horns, dysmenorrhoea and endometriosis (caused by retrograde menstrual effluent) may also be reduced or prevented

  (Taylor and Gomel, 2008).

HSG

- HSG does not evaluate the external contour of the uterus and therefore it cannot reliably differentiate between a septate and a bicornuate uterus (Kupesic, 2001 ; Troiano and McCarthy, 2004 ; Braun *et al*., 2005)
- HSG remains a useful screening tool for the diagnosis of a normal or abnormal uterine cavity (Letterie, 1998)

3D Summary

- 3D US is a non-invasive method of investigation
- 3D US works by attaining an initial 2D US image of the uterus and storing it onto a computer
- A vaginal transducer then performs a sweep of transversal sections which are also subsequently stored
- The computer then integrates the images and allows the investigator to view images of three planes simultaneously (Raga *et al*., 1996)
- This 3D image, along with the complete volume scan, can be stored for later viewing and appraisal (Devi Wold *et al*., 2006)
- As discussed above, both 2D and 3D US allow for the uterine dimensions to be measured, which could help in quantifying the morphological defects (Salim and Jurkovic, 2004)

3D Summary

- The introduction of appropriate criteria could improve the homogeneity of diagnoses in the future
- A study by Salim *et al*. (2003b) evaluated the inter-observer variability the results showed a 99% agreement between the two observers, suggesting that this is highly reproducible.

3D Summary

- Not been many reports comparing the accuracy of 3D US to hysteroscopy and or laparoscopy
- Four reports identified in the literature, containing an overall of 679 subjects, all reported 100% sensitivity, specificity, PPV, NPV and accuracy of 3D US in diagnosing congenital uterine anomalies, when compared with hysteroscopy (Wu *et al*., 1997 ; Radoncic *et al*., 2000 ; Makris *et al*., 2007a , b)
- However, in the studies by Makris *et al*. (2007a , b), only a small number of congenital uterine anomalies were identified ($n = 6$) in the groups of women screened

3D Summary

- In conclusion, reports suggest that 3D US has a very high accuracy rate in diagnosing congenital uterine anomalies
- Wu *et al*. (1997) further showed that it is accurate in classifying the anomalies, although further studies are required to confirm this. With the prospect of an introduction of a classification based on 3D US criteria

Which method to use

- Overall, hysteroscopy and laparoscopy, SHG and 3D US are the most accurate investigations and can be used as diagnostic tools
- Three-dimensional US offers the advantage of being non-invasive
- SIS requires the introduction of fluid into the uterine cavity and this can often be uncomfortable
- Hysteroscopy and laparoscopy are both invasive procedure
- However they offer the advantage of concurrent diagnosis and treatment
- Hysteroscopy alone can identify the presence of an anomaly but cannot accurately differentiate between the different subtypes.

Which method to use

- Two-dimensional US is the least accurate method of investigation
- However it is the most widely available and easiest to perform
- If used in conjunction with HSG, it can increase accuracy and serve as a valuable screening tool
- 3D US, and SHG where available
- MRI seems to be more accurate than 2D US or HSG alone, and could potentially be used for screening. However, its diagnostic accuracy remains unclear.
- Disadvantages are that it is more expensive than US and HSG, and is not available in the office setting.