University College London Hospitals NHS
NHS Foundation Trust

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Assessment of cervical length and previous caesarean section scar

PTBC TEAM

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CRAFT

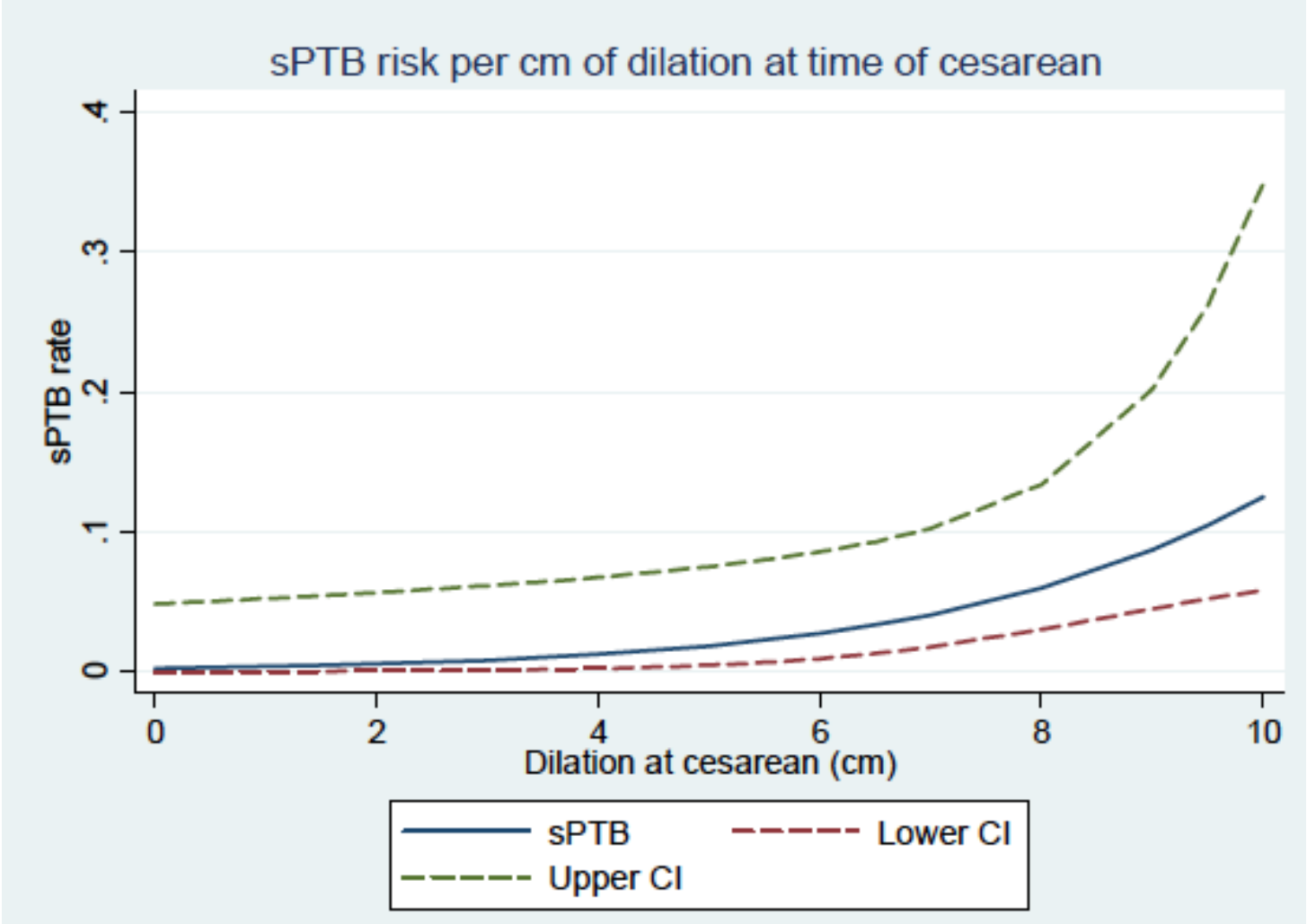
Full Dilatation Caesarean Section and preterm birth

- Full dilatation caesarean section (FDCS) rates are increasing
  - >15% of emergency CS are performed at full dilatation

  (McKelvey et al 2010, Vousden et al 2014, Cong et al 2018)
- FDCS is associated with an increased risk of subsequent spontaneous preterm birth (SPTB)
- NHS England - Saving Babies' Lives Care Bundle recommends screening

FDCS and risk of subsequent SPTB

Author	Study Design	Number	Outcome	SPTB risk
Offringa et al, 2022	Retrospective cohort (France)	9182	SPTB < 37 weeks	**aOR 2.5** (95% CI: 1.2–5.1, *P* = 0.009); 7% vs 3%, FDCS vs vaginal birth
Williams et al, 2020	Retrospective cohort (UK)	16340	SPTB < 37 weeks	**aOR 3.29,** (95% CI 2.02-5.13, *P* < 0.001); 4.5% vs 2.3%, FDCS vs vaginal birth
Wang et al, 2020	Retrospective Cohort (Australia)	1299	SPTB < 37 weeks	**RR 2.18** (95% CI 1.14–4.19; *P* = 0.019); 4.3% vs 2.0%, FDCS vs mid cavity forceps
Cong et al, 2018	Retrospective Cohort (Australia)	19099	SPTB < 37 weeks	**OR 2.2** (95% CI 1.3–3.8, P = 0.003); 3.8% vs 1.7%, FDCS vs 1st stage CS
Wood et al, 2017	Retrospective Cohort (Canada)	189021	SPTB <37 and <32 weeks	**RR 1.57** (95% CI 1.43– 1.73) and **RR of 2.12** (95% CI 1.67-2.68), FDCS vs SVD
Levine et al, 2015	Retrospective Cohort (USA)	887	SPTB < 37 weeks	**OR 5.8** (95%CI 1.08–30.8, P = 0.04), **13.5% vs 2.3% (FDCS vs 1st stage CS)**



Levine et al 2015

Interventions to prevent PTB are less effective

- FDCS associated with **3 fold increased risk of recurrent sPTB** compared to vaginal delivery, in spite of intervention.
  - **RR 3.06** (95% CI 1.22-7.71, p=0.02).
  - 11/29 women received vaginal cerclage in the FDCS group, 45% (5/11) still delivered preterm

Watson et al 2017

Hypotheses of pathophysiology

- FDCS results in greater incidence of maternal and neonatal morbidity.
  - FDCS has >2 fold risk of intraoperative trauma compared to first stage CS (Allen et al 2005)
  - Uterine extension 24%
  - Damage to the cervix or high vagina (reported incidence of 4.4%)

Murphy et al. 2001
McKelvey et al 2010

Post natal TVUS Imaging

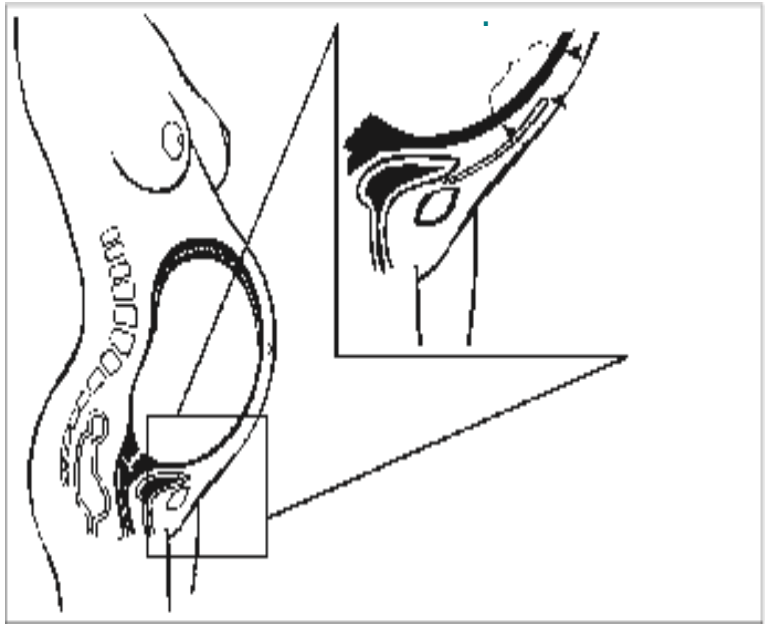
- Caesarean section in advanced labour is associated with lower scars, scars in the cervix and large scar defects.
- Risk of large defect – 9.1% when cervix is closed vs 50% if cervix dilated >8cm

Kamel et al 2020
Osser et al 2010
Zimmer. et al 2004

RCT - Level of Caesarean hysterotomy and the presence of large scar defect

- N=114, emergency CS at cervical dilatation ≥ 5 cm
- TVUS 6–9 months after delivery
- Large scar defects – 4/55 (7%) high-incision group vs in 24/59 (41%) low-incision group
- **OR= 8.7** (95% CI, 2.8–27.4); p < 0.001

Vikhareva et al 2019



Aims

- To validate a method in pregnancy to assess FDCS scar position and characteristics relative to the level of the internal cervical os.

- To examine if there is any association between the site and characteristics of the scar and
  - Cervical Length (CL) shortening
  - Preterm Birth (PTB) risk

- To develop multiparameter screening models for prediction of spontaneous preterm birth

Methods

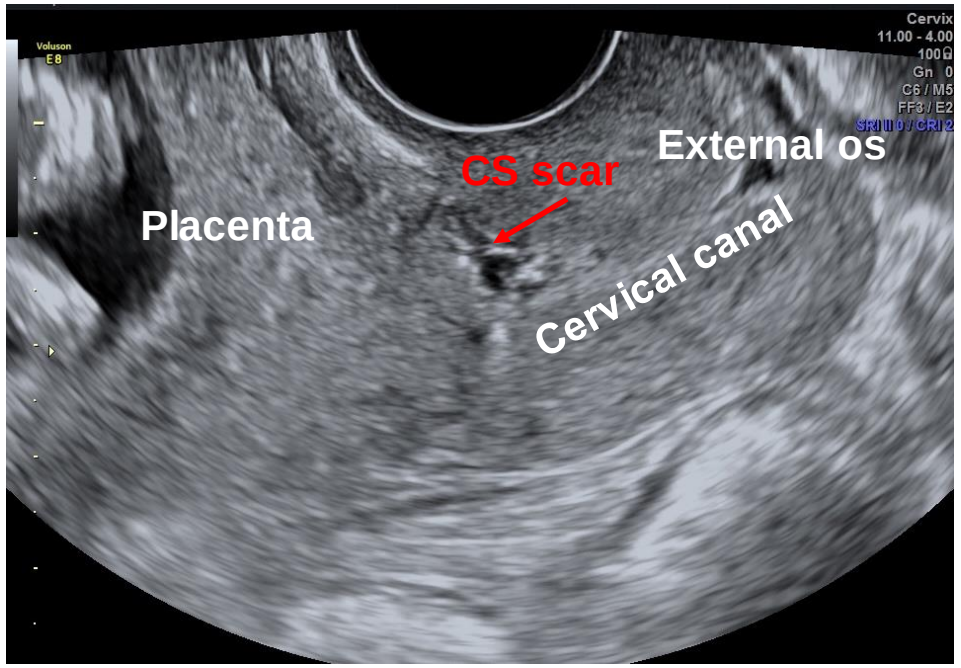
- Prospective cohort study (2017- 2021)
- Singleton pregnant women with previous term FDCS
- Serial TVUS assessment (14-24 weeks gestation)
- Measurements: Cervical length (CL), CS scar distance to internal os and CS niche – length, depth, width
- Prophylactic interventions (cervical cerclage or vaginal progesterone) offered
  - If Cervical Length $\leq$ 25mm
  - To women with a previous history of SPTB/late miscarriage after FDCS

- Primary outcome:
  - prediction of SPTB <37 weeks
- Secondary outcomes:
  - CL $\leq$ 25 mm
  - Need for prophylactic intervention

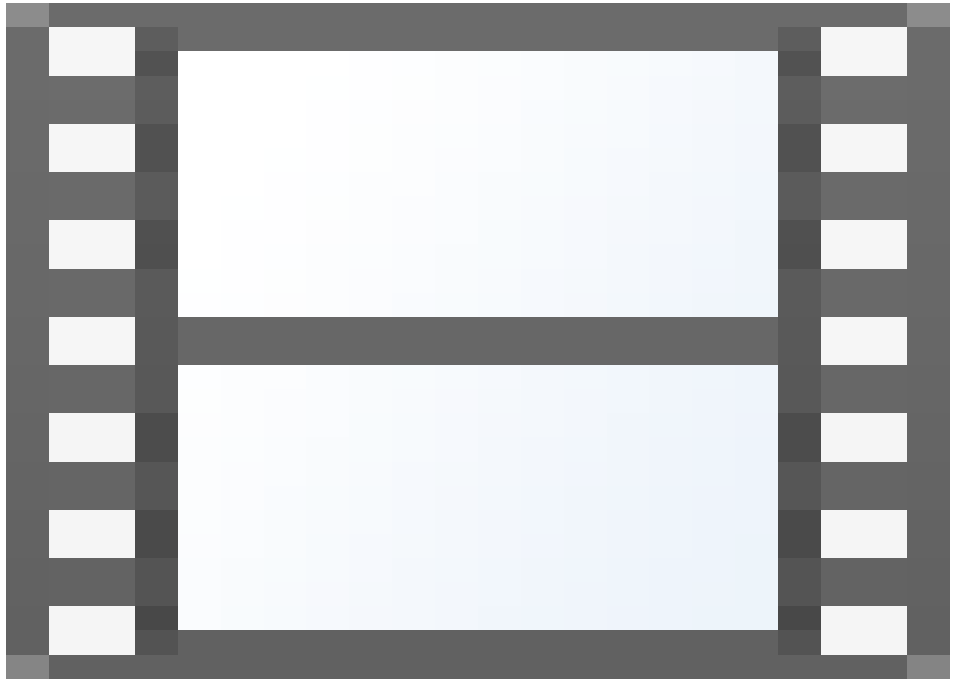
US PROTOCOL

DEFINITIONS

- **Caesarean Section Scar -** hypoechoic (or rarely hyperechoic) discontinuity in the myometrium at the anterior wall of the lower uterine segment or cervix
- **Caesarean Section Niche -** an indentation at the site of the caesarean section (CS) scar with a depth of at least 2mm

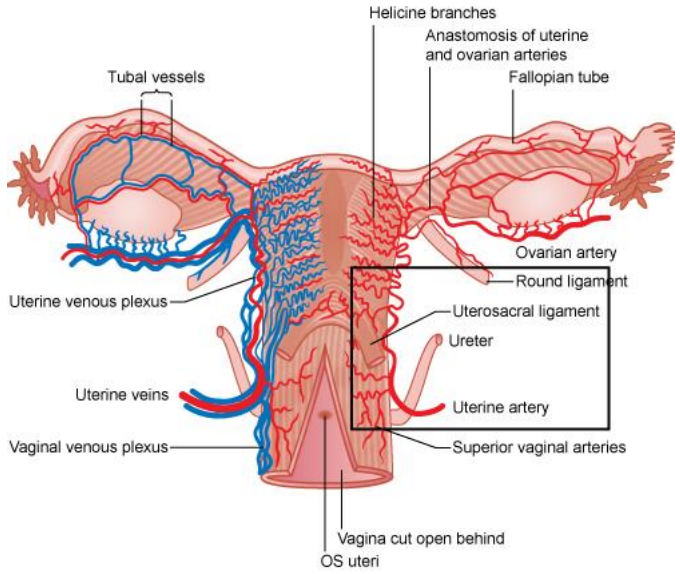


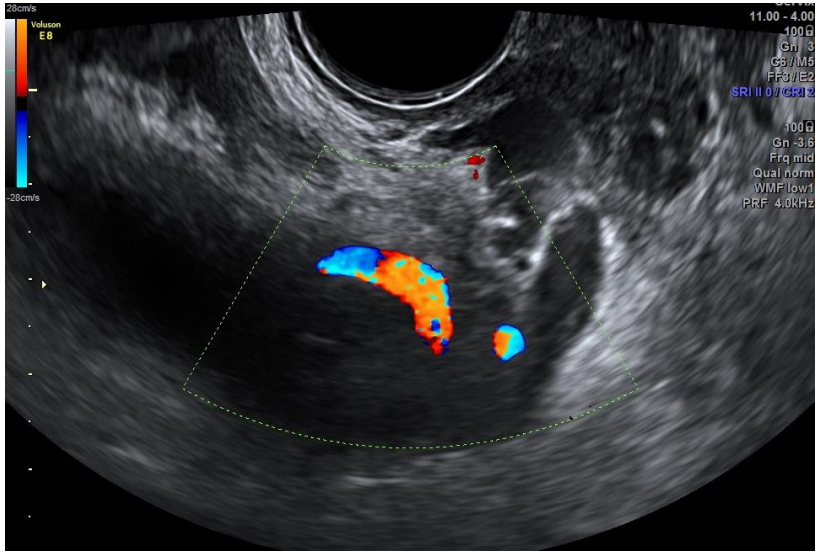
Measurement of cervical length

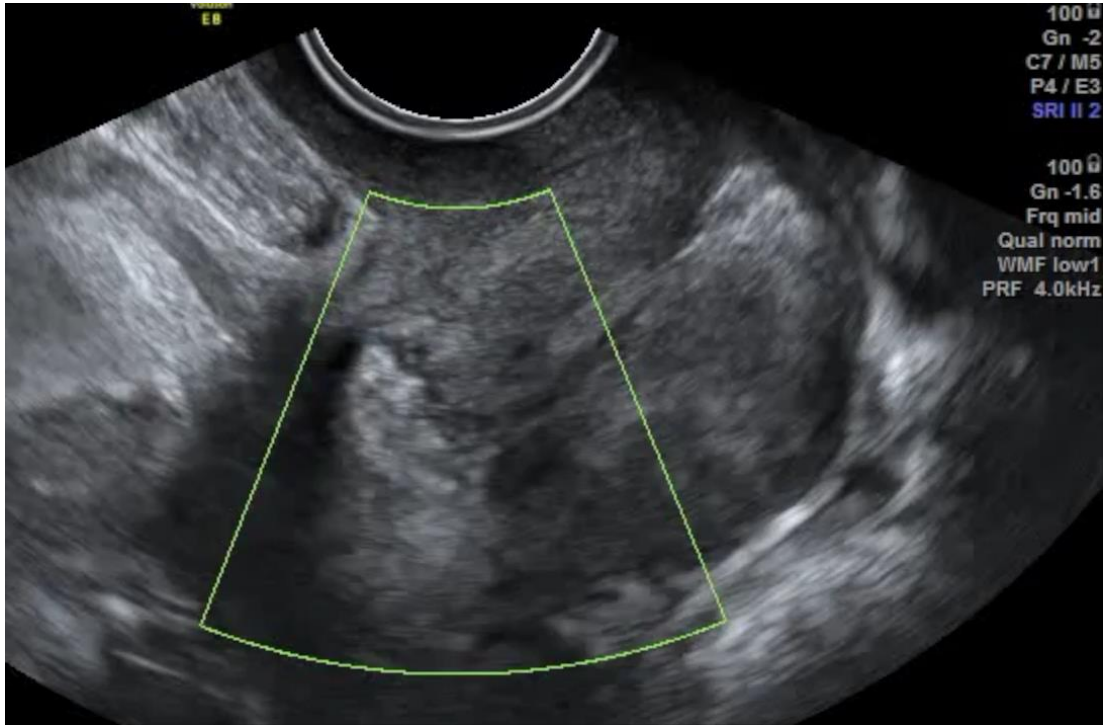


- The patient should be in the dorsal lithotomy position with empty bladder
- Advance the transvaginal probe slowly into the vagina looking at the image as the probe advances
- Obtain a sagittal section of the uterus and cervix with good visualisation of the cervical canal
- Avoid excessive pressure on the cervix by the probe. The anterior and posterior lips of the cervix should be of similar diameter.
- Use zoom to enlarge the view of the cervix. The cervix should occupy approximately 75% of the image.
- Identify the internal os, external os, cervical canal and endocervical mucosa.

Measurement of cervical length

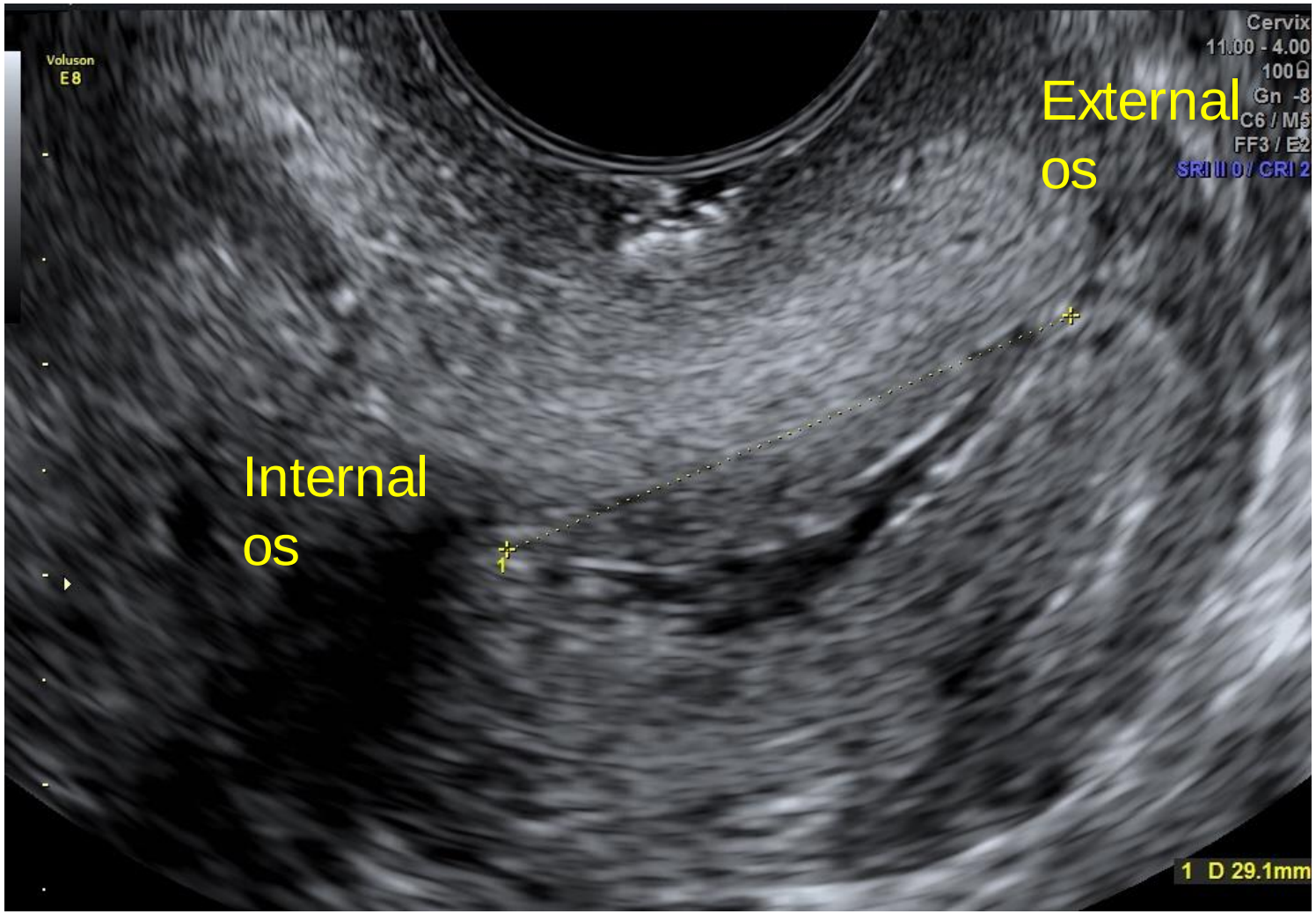




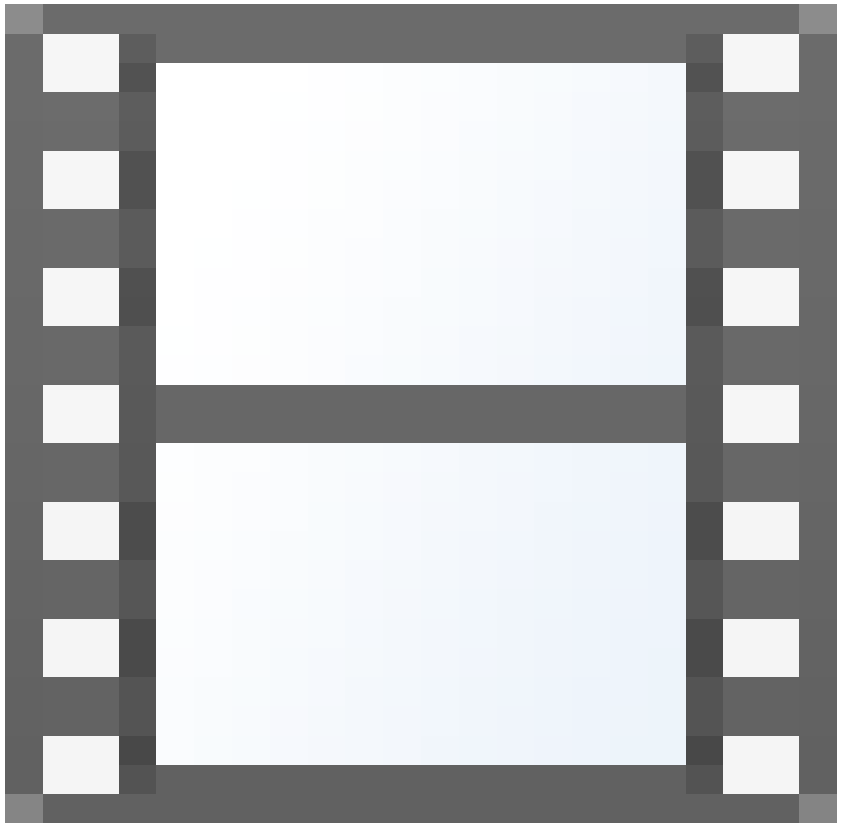


Naji et al 2012.

Measurement of cervical length

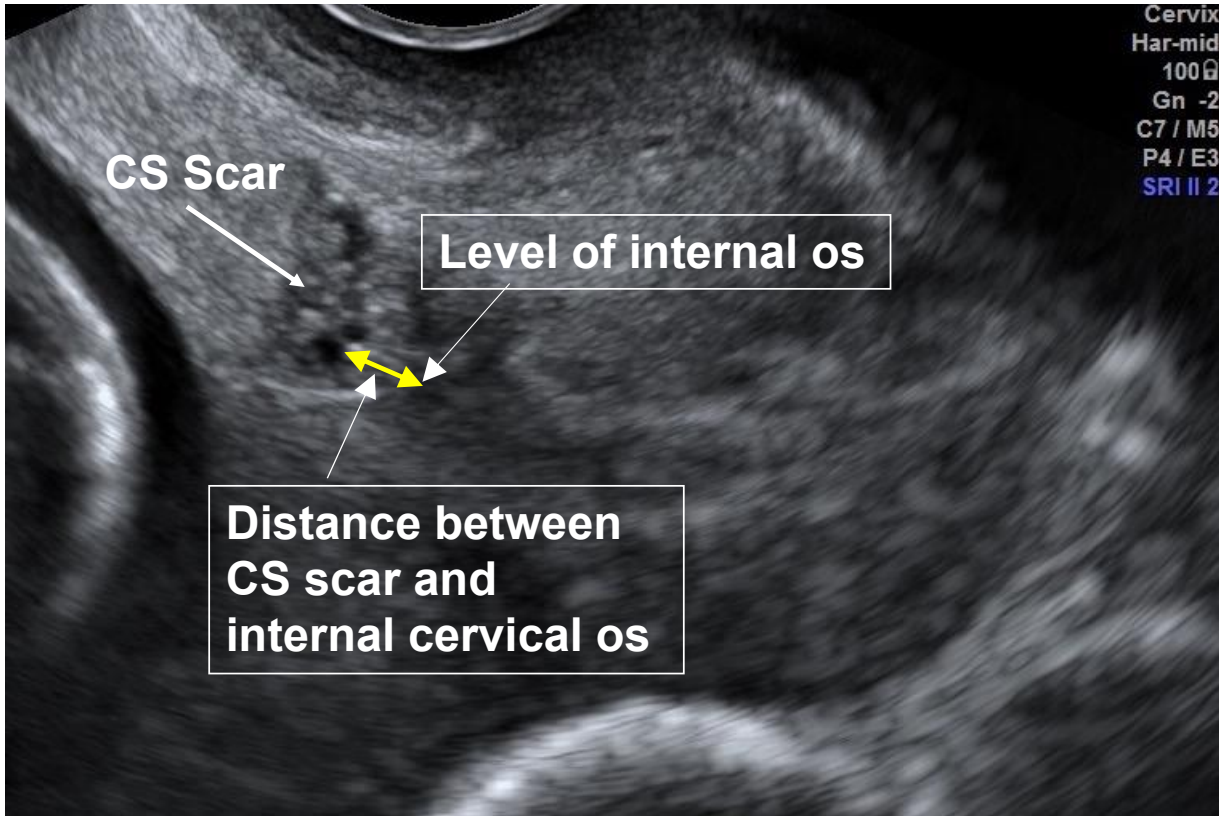


Scan across in the sagittal plane to identify the CS scar

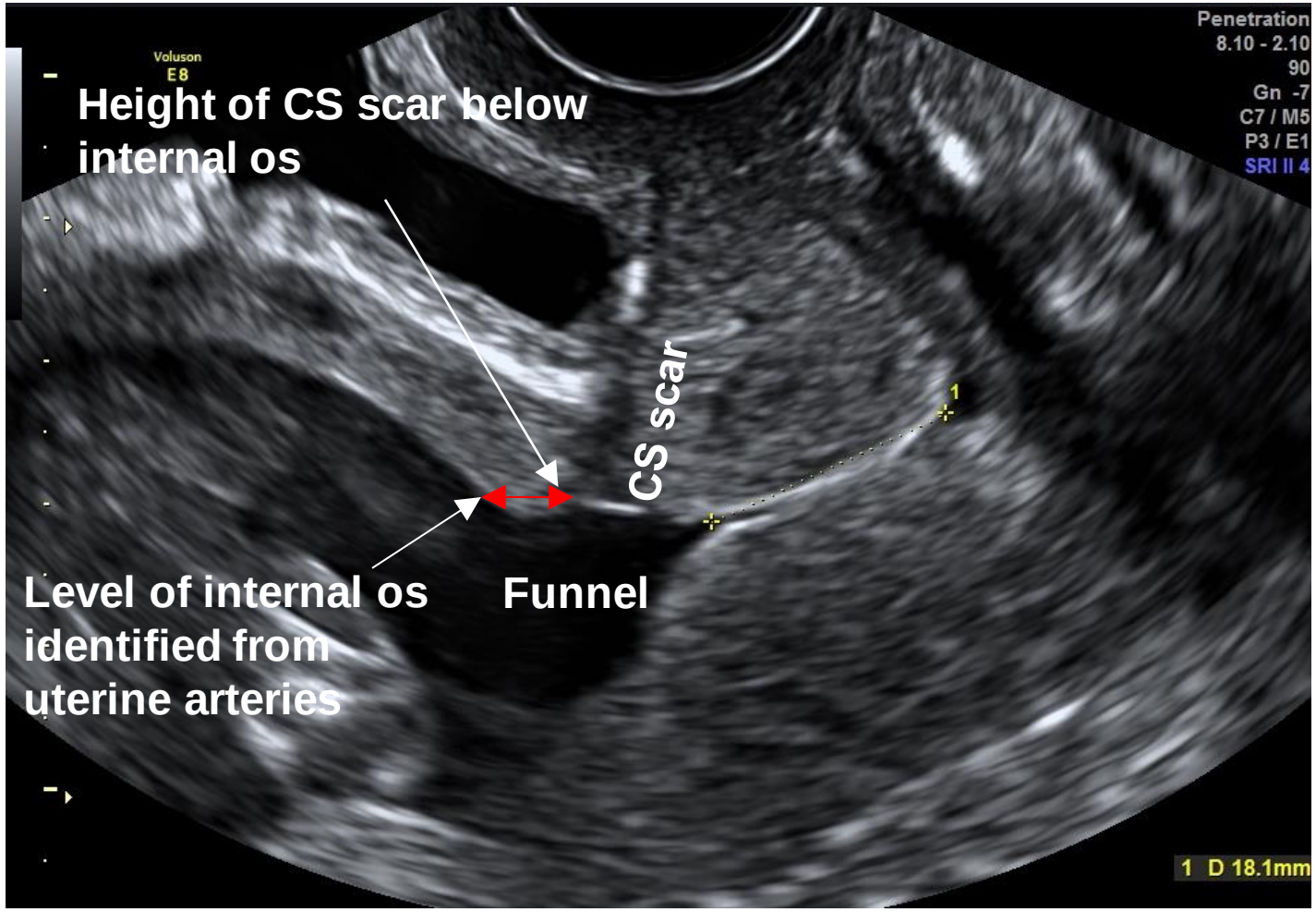


CS scar distance to internal os

- In the sagittal plane record distance between the caesarean section scar and the internal cervical os

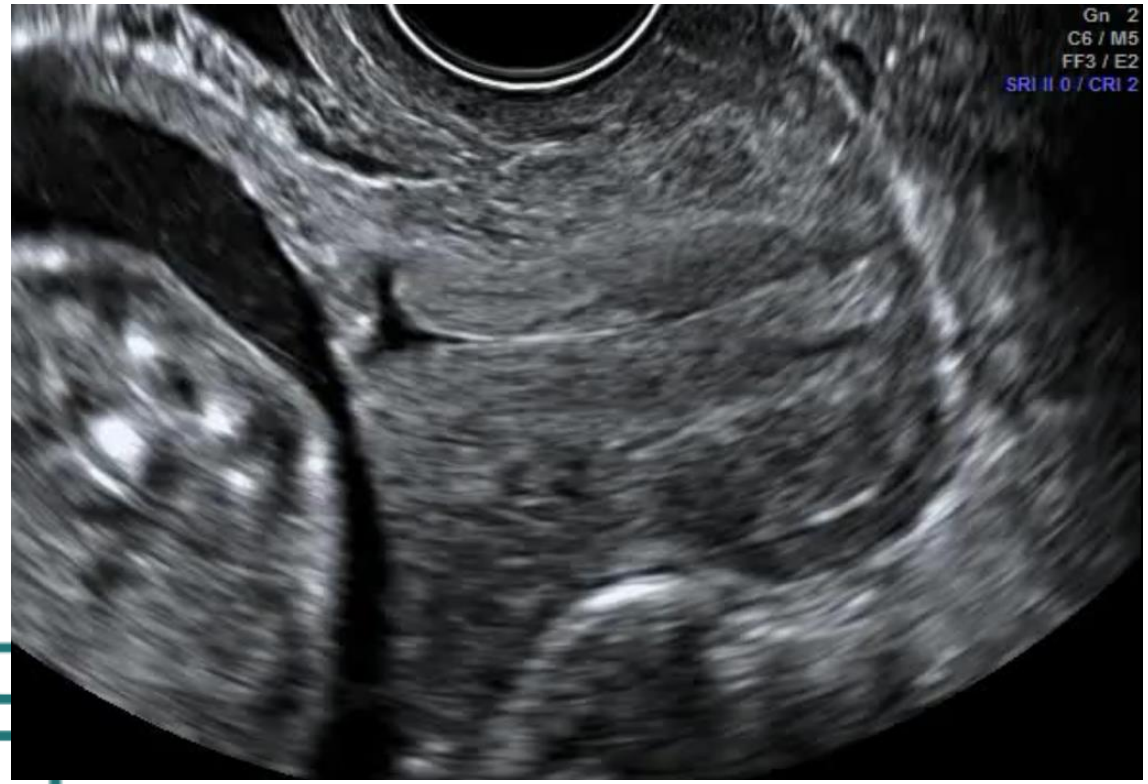


CS scar distance to internal os



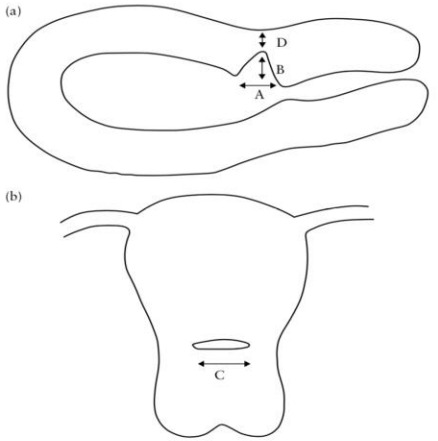
Assessment of CS scar niche

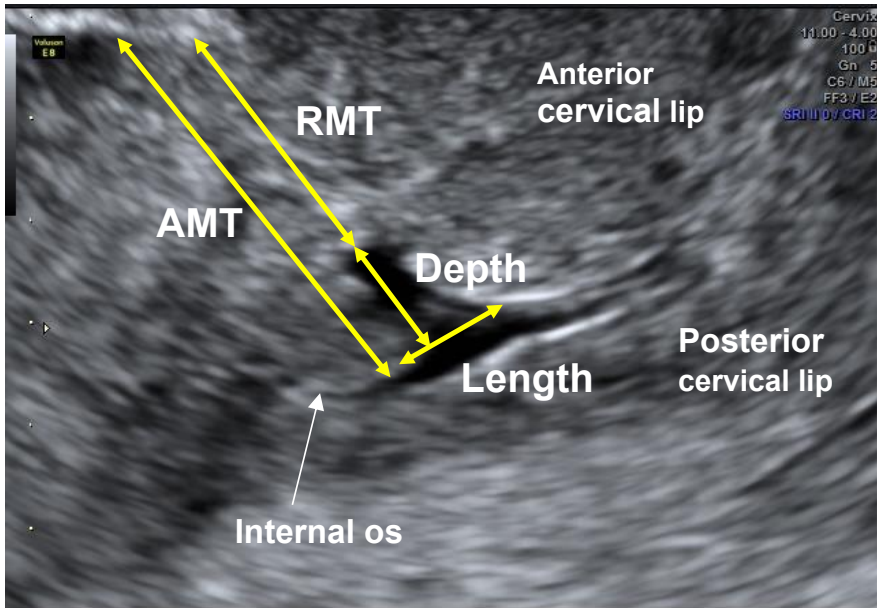
Sagittal plane



Transverse plane

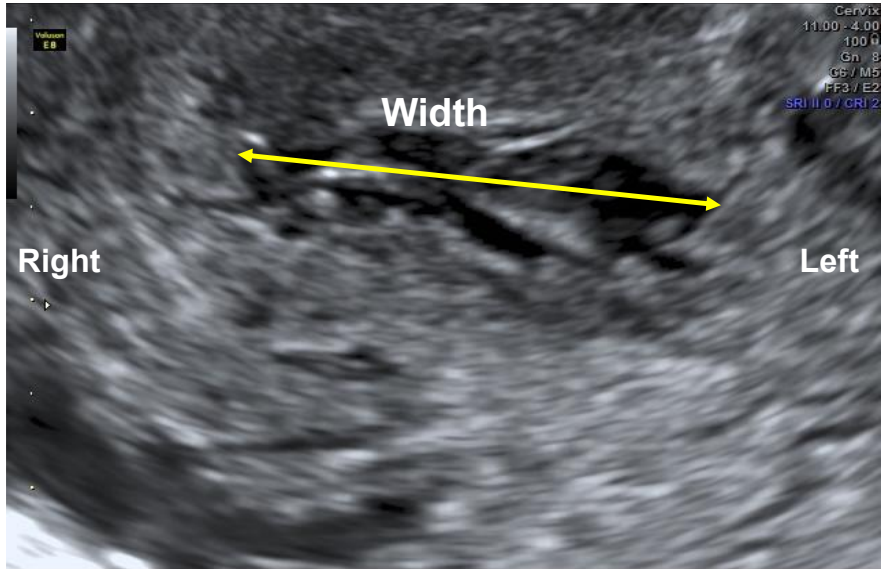
Niche measurements





Sagittal plane

- Length
- Depth
- RMT (Residual myometrial thickness)
- AMT (Adjacent myometrial thickness)



Transverse plane

- Width

Banerjee et al. 2022
Jordans et al 2019.
Naji et al 2012.

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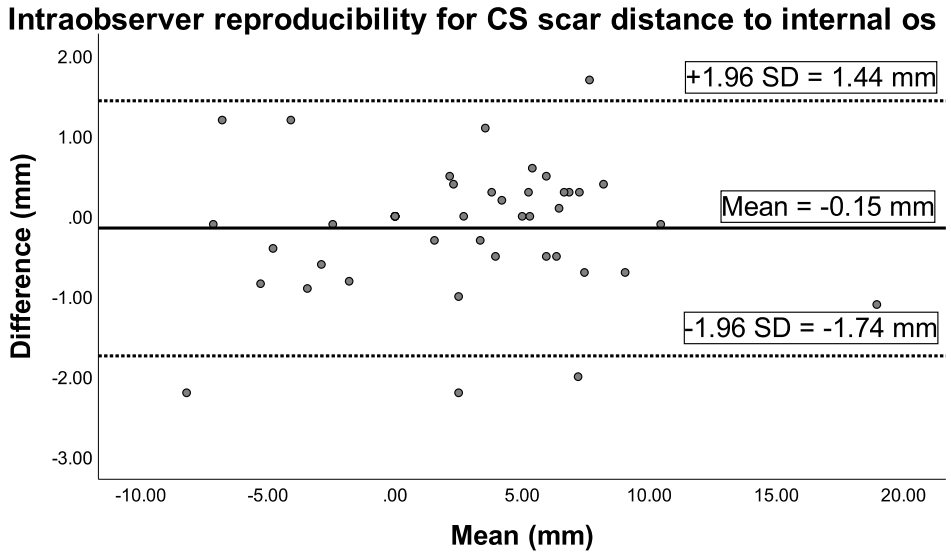
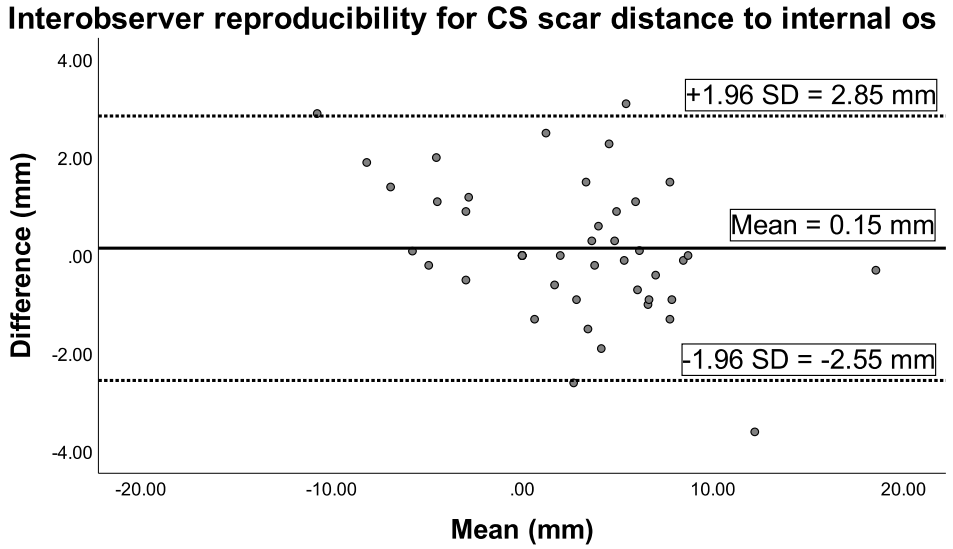
Large niche

Results

Reproducibility study: FDCS scar position relative to internal cervical os

- 55 women – real-time 2D image acquisition and caliper placement
- 2/55 (3.6%) - disagreement between operators on scar visibility





Bland–Altman plots

Real-time 2D images				
	Intraobserver		Interobserver	
FDCS scar niche measurements	Mean Difference (mm)	95% limits of agreement	Mean Difference (mm)	95% limits of agreement
Length (mm)	-0.37	± 2.00	-0.12	±3.59
Depth (mm)	-0.48	± 1.90	-0.70	±3.96
Width (mm)	-1.09	± 1.84	0.36	±5.78

Banerjee et al. 2022 UOG

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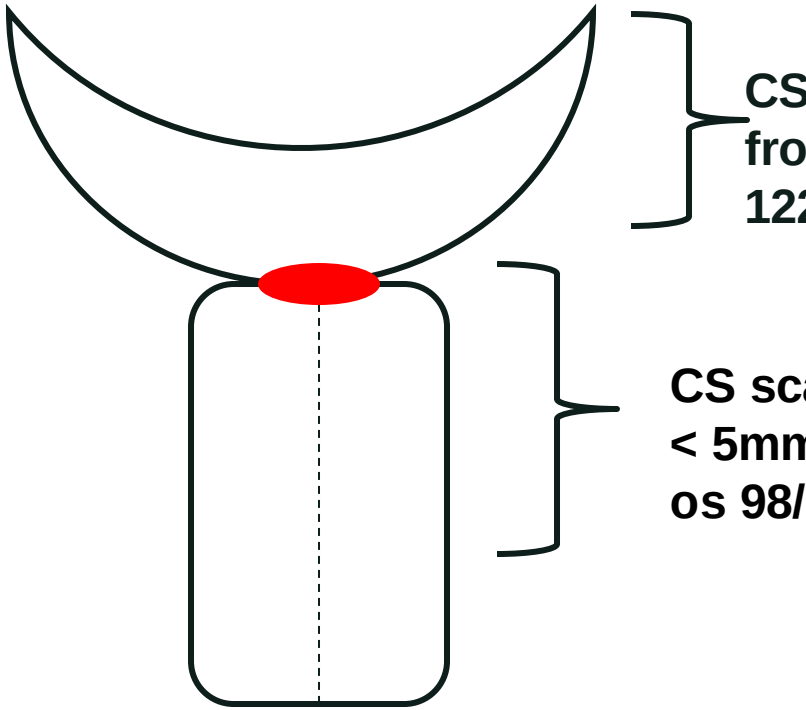
Prospective Study - Results

- Overall SPTB rate was **4.1%** (10/243)
- CL ≤ 25mm in **12.8%** (31/243) of women
- FDCS scar visualised in **220/243 (90.5%)** women

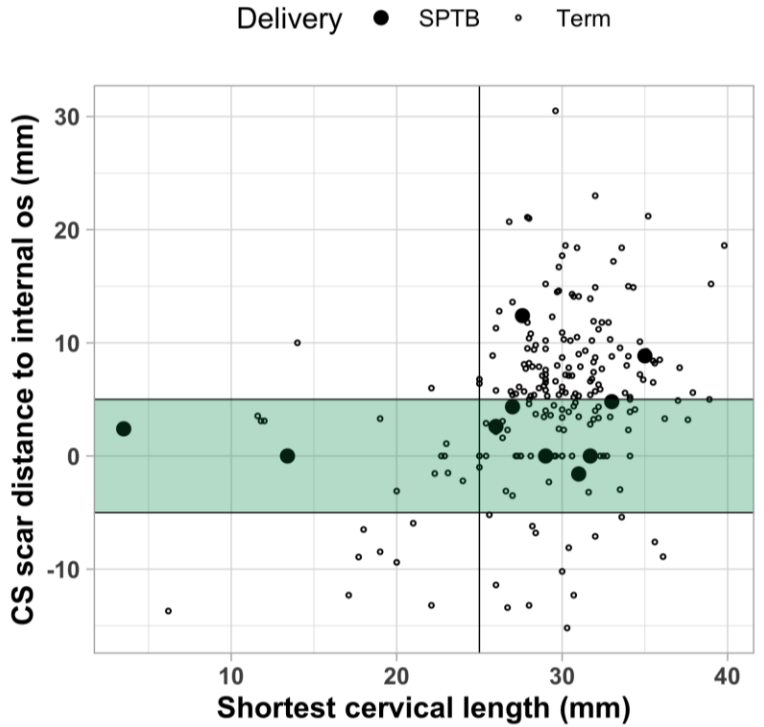
- CS scar not visualised - no spontaneous preterm birth
- Imaging analysis performed on 220 women

Relationship of CS scar location and spontaneous preterm birth



CS scar > 5mm from internal os 122/220 (55.5%)

CS scar in cervix or < 5mm from internal os 98/220 (44.5%)



CS scar position	SPTB		
	No	Yes	aOR 6.87 (1.34-58) P = 0.035
< 5 mm above or below internal os	68	8	
≥ 5mm	142	2	Sensitivity 80% Specificity 68%

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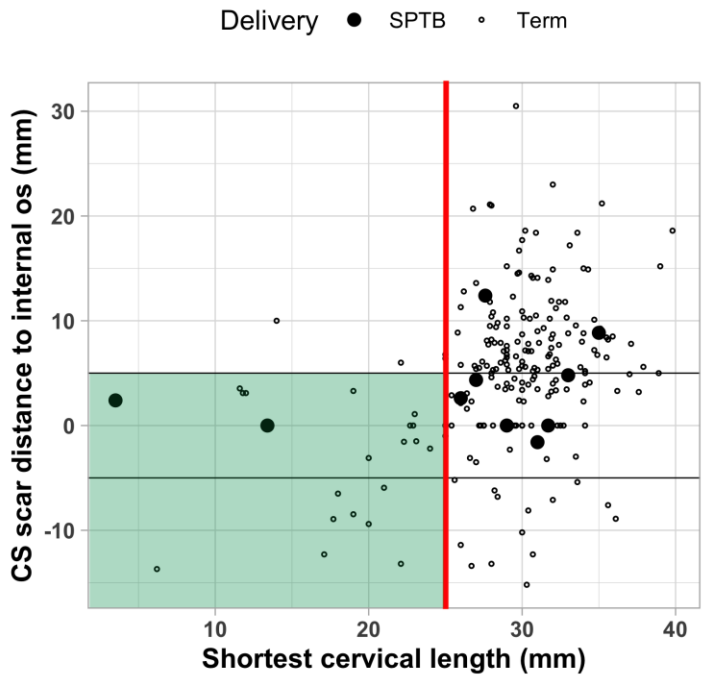
Relationship of CS scar location with shortening cervical length

CS scar position	CL <= 25 mm		
	No	Yes	
In cervix or < 5mm above internal os	72	26	aOR 17.27 (5.52-77.4) P <= 0.0001 Sensitivity 87% Specificity 62%
≥ 5mm above internal os	118	4	



History (n=4) or ultrasound (n=19) indicated cerclage was performed in 23/243 (9.5%) women
- 2/23 (8.7%) women delivered preterm
  - 23+5 following US indicated cerclage at 18 weeks
  - 33+6 following US indicated cerclage at 20 weeks

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Case 1 – HP

34 yrs

South-east asian, BMI 21.6, Non-smoker, spon. conception

PMHx: nil

Obs Hx:

G3 P1 (x1 MTOP)

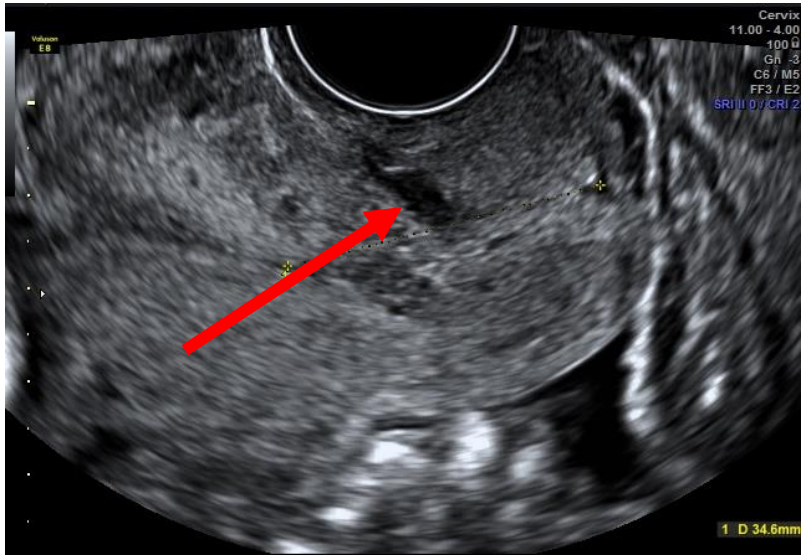
1st pregnancy – 38+3 spon labour - FDCS with no reported complications

- no attempt at instrumental delivery

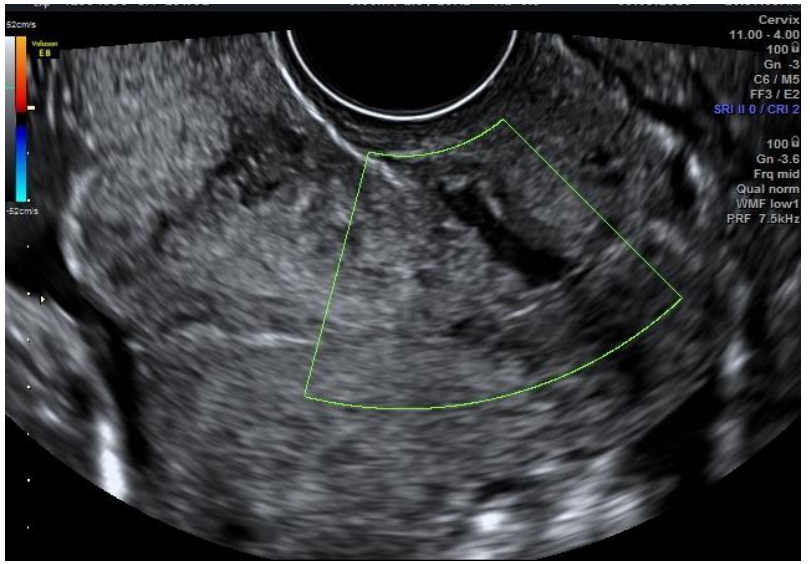
- 2nd Pregnancy booked at UCLH
- USU **11+3** – Normal scan. CL 26.4mm. NIPT – low risk (done privately)

PTB surveillance in subsequent pregnancy

- **PTBC** 15+2 - CS scar defect noted 14mm below internal cervical os. Cx anterior lip was tethered and hitched up anteriorly. CL 33.1mm.



- **PTBC** 18+2 – CL 29mm.
- **USU** 20+2 – CL 34mm.



PTB surveillance in subsequent pregnancy

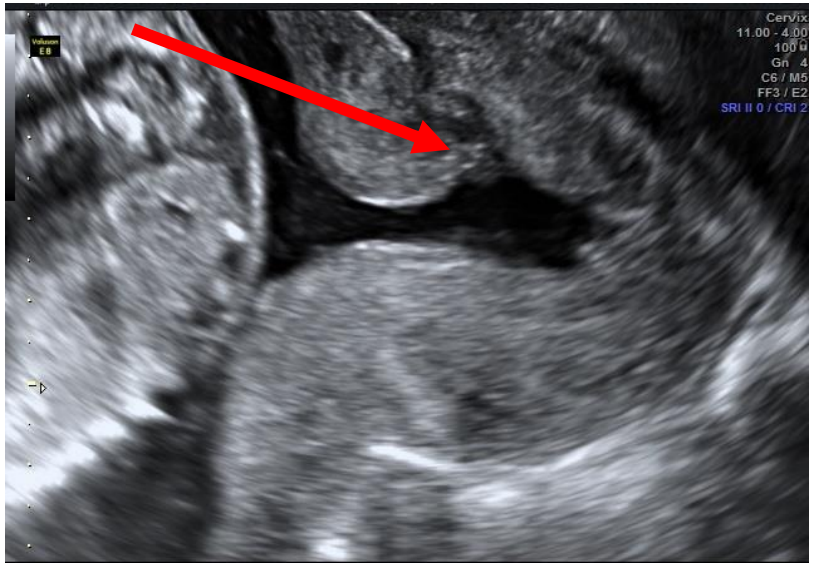
PTBC 22+2 - Dynamic Cx . CL 10 – 31mm. fFN 18ng/mL. Started on progesterone.

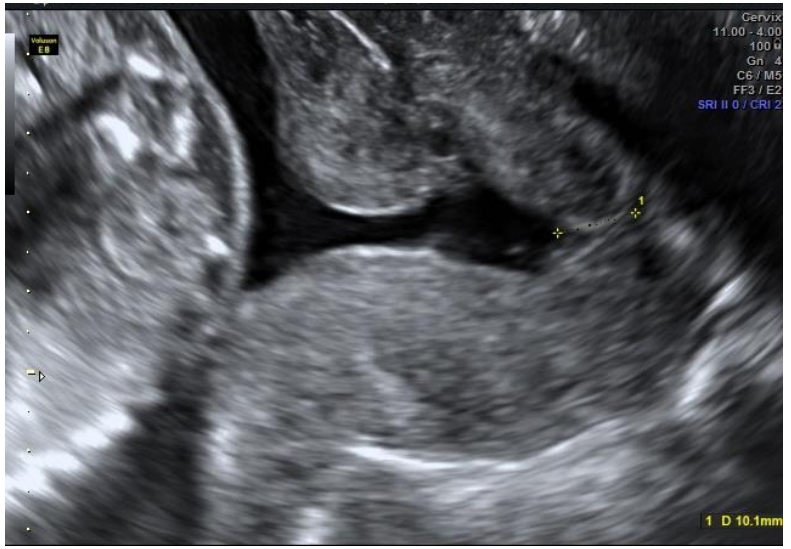
PTBC 23+2 –Dynamic Cx. CL 17mm on left, 6mm on right (site of scar defect). Recruited to CRAFT RCT – conservative management.

PTBC 26+2 - Dynamic Cx. CL 19mm on left, 6mm on right. fFN 211ng/mL. Urine culture - E.Coli.
PTBC 26+2 - Dynamic Cx. CL 17mm on left, 6mm on right. fFN 64ng/mL.
PTBC 29+2 & 32+2 - Dynamic Cx. CL 6-18mm (stable). Discharged from PTBC.

SVD – 38+1

22 weeks





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Case - GB

38yrs

White British, BMI 20.8, Non-smoker, spon. conception

PMHx: nil

Obs Hx:

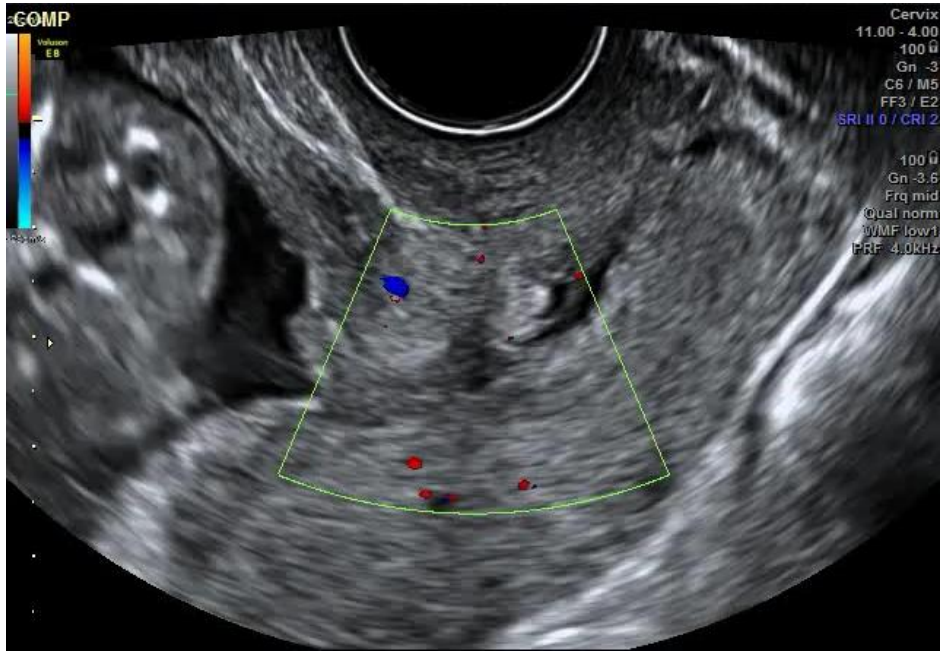
G2P1

1st pregnancy- Spon. labour. 40+3. Undiagnosed Breech. EmCS at full dilatation. BW 3.29Kg. No reported complications.

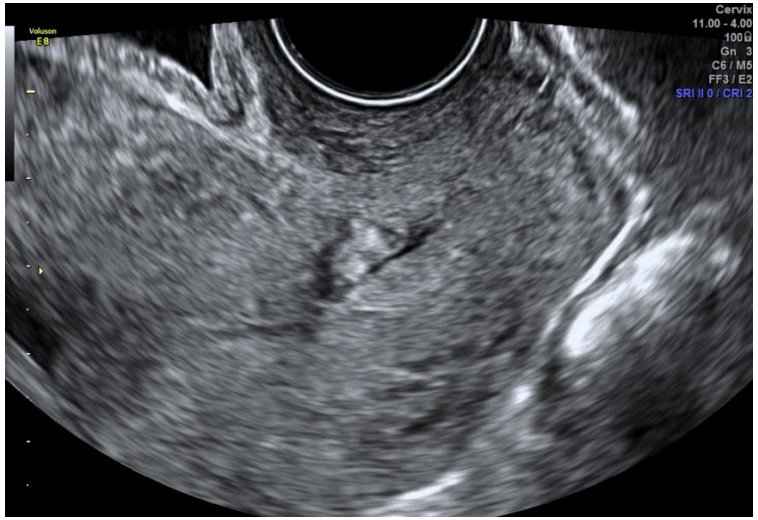
PTB surveillance in subsequent pregnancy

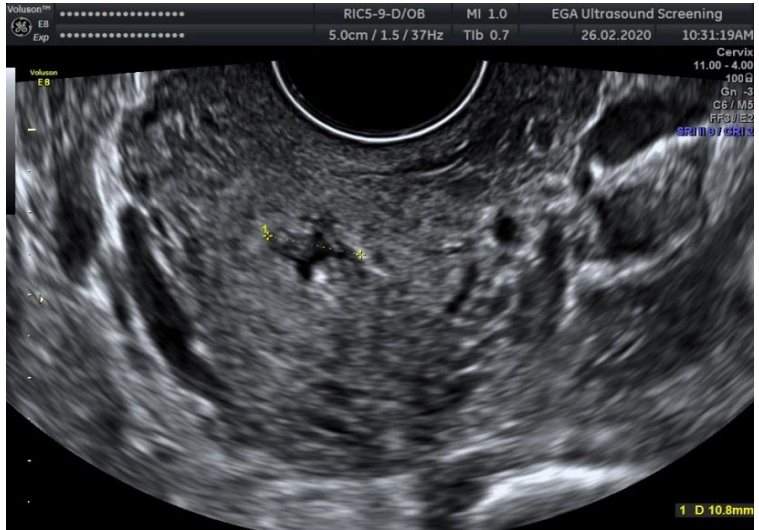
USU 12+5 – Normal nuchal scan and low risk CST

PTBC 13 - 18 weeks - Cx 28 - 31 mm. CS scar at os.



16 weeks





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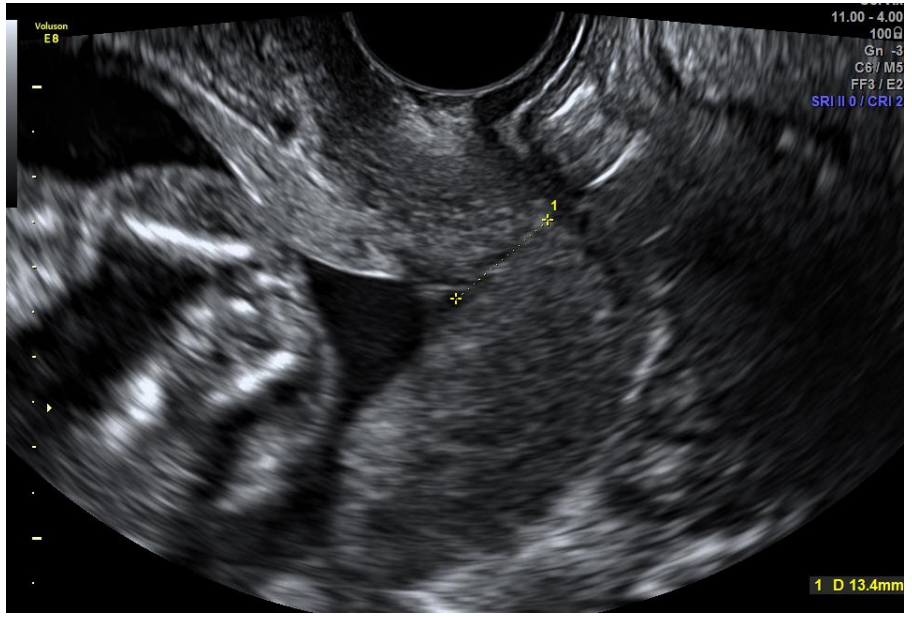
PTB surveillance in subsequent pregnancy

- **USU** 20 weeks - Cx 13mm, funnelling noted. Started on progesterone 200mg od.
  - 20+2 weeks - Macdonald Cerclage placed as very short cervix



- **PTBC** 22 weeks – CL 23mm
- **PTBC** 24 weeks – CL 24mm. fFN 10ng/mL. Discharged from **PTBC**.

- Delivery by emergency CS at 33+6 following admission with contractions.

Case- ME

38yrs

White British, BMI 20, Non smoker, spon. conception

PMHx: nil

Obs Hx:

G4 P2 +1(early misc)

1st Preg – Spon labour at 41+5, OP position manual rotation attempted. Fetal Distress → FDCS. Extension to left uterine angle.

2nd preg – 23+4 presented with 2-3 days of increased discharge. No pain. Noted to have bulging membranes – Cx 2 cm dilated. Underwent rescue cerclage and 2 days later PPROM → SVD (NND)

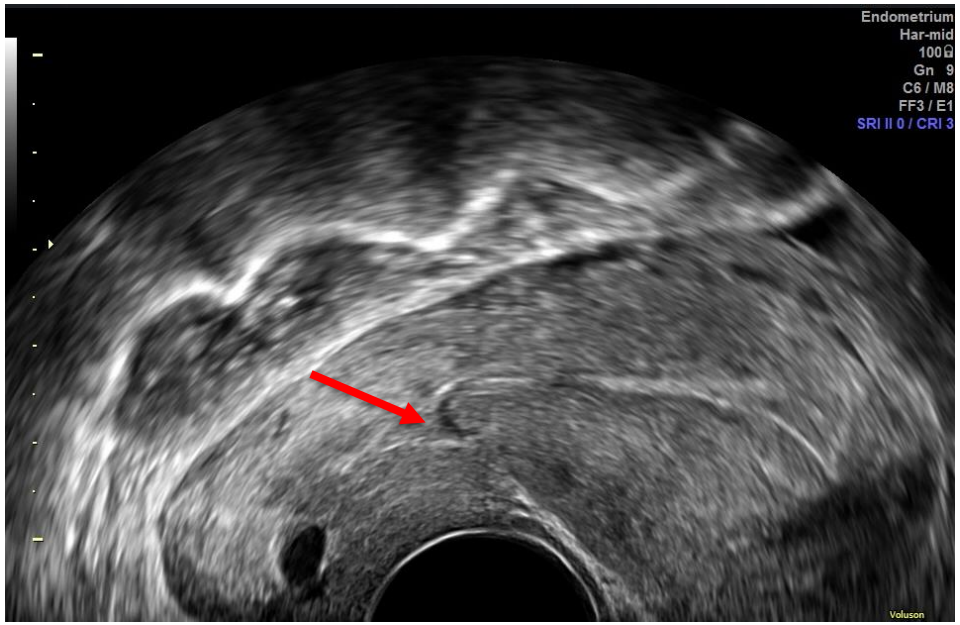
3rd preg – Booked at UCLH

PTBC 12+5 – Normal nuchal scan. CST low risk. Cx 32mm. CS scar 13mm below internal os.

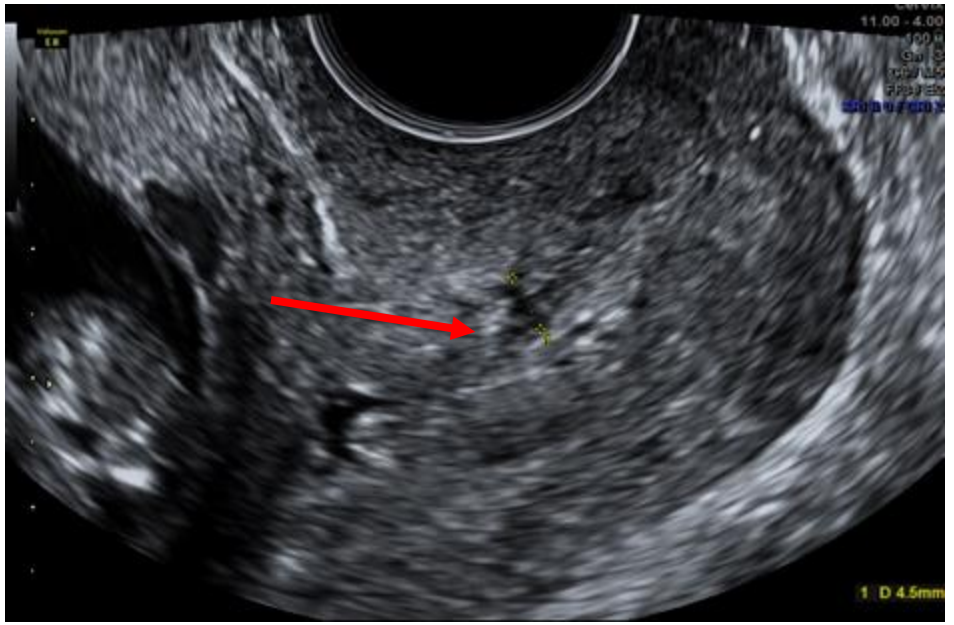
PTBC 13+5 – Shirodkar cerclage

Reviewed in PTB clinic until 27 weeks – CL remained stable around 32-34mm

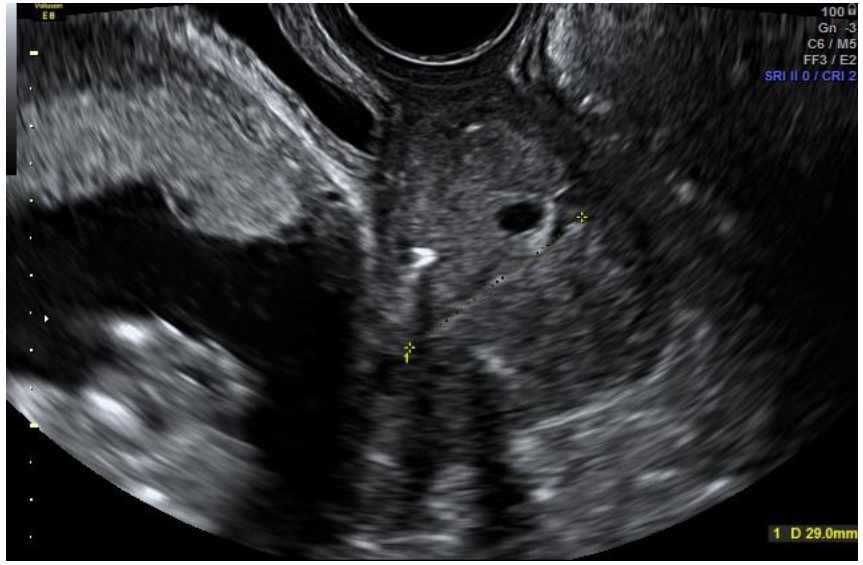
Del – 39 weeks ElCS



Early preg



12 weeks



Post cerclage

Case – SL

- 34 yrs
- White British, BMI 23.4, Non smoker, spon. conception

PMHx: nil

Obs Hx:

- G2P1- IOL for PIH. 40+5 weeks. Fully dilated and pushing for an hour, but no descent. In theatre had failed forceps, 2 pulls. BW - 3.52kg.

14+2 weeks

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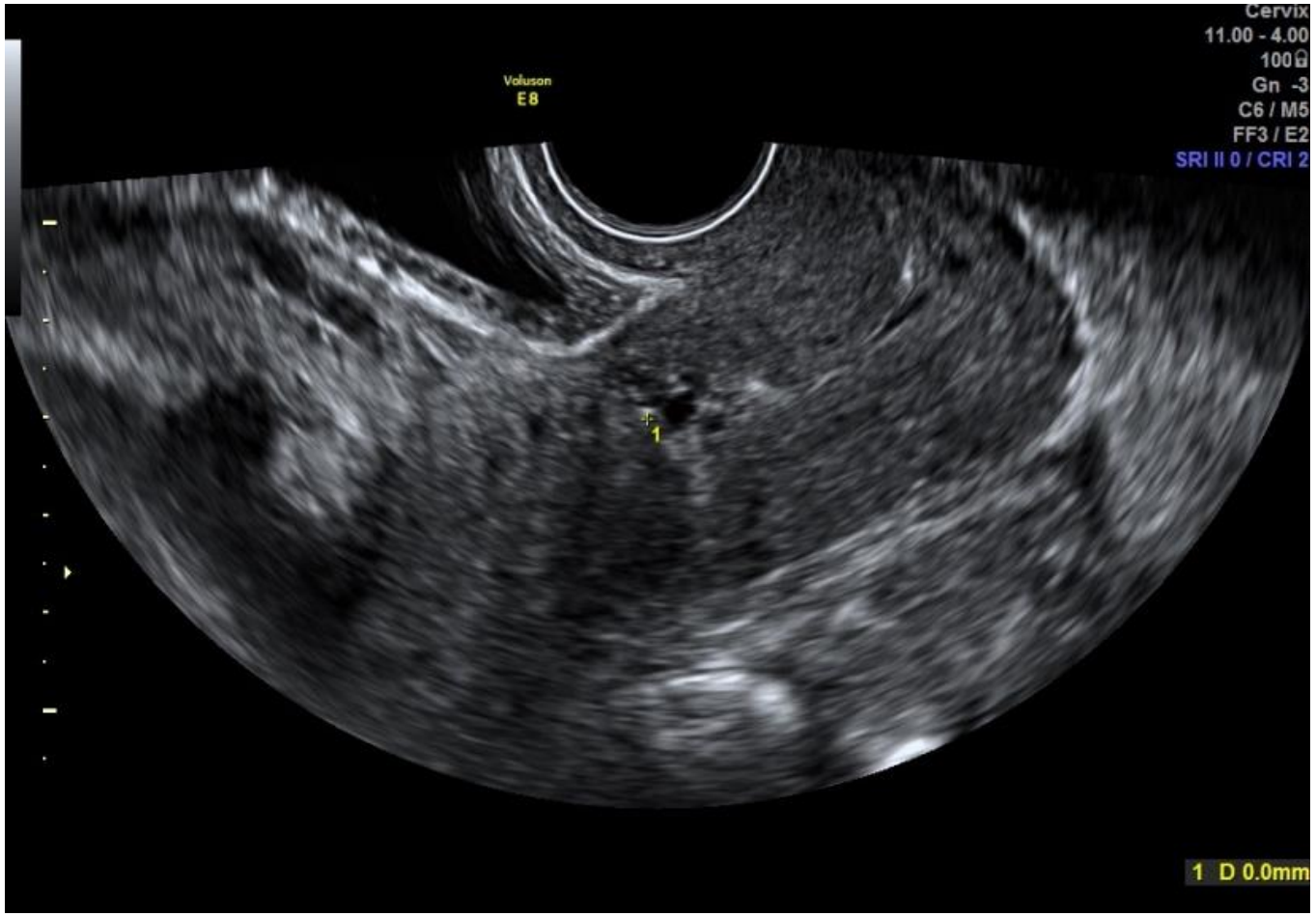
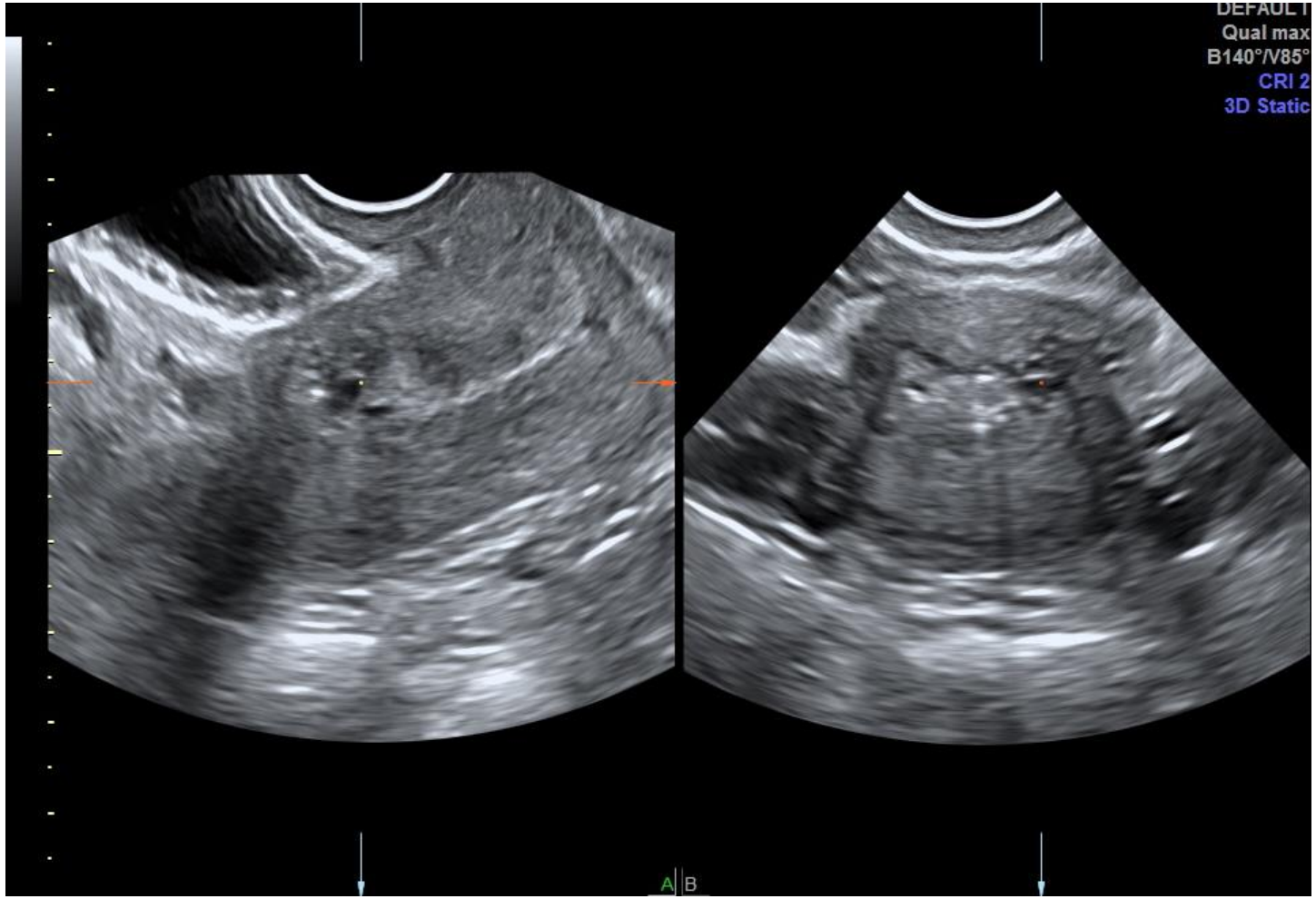
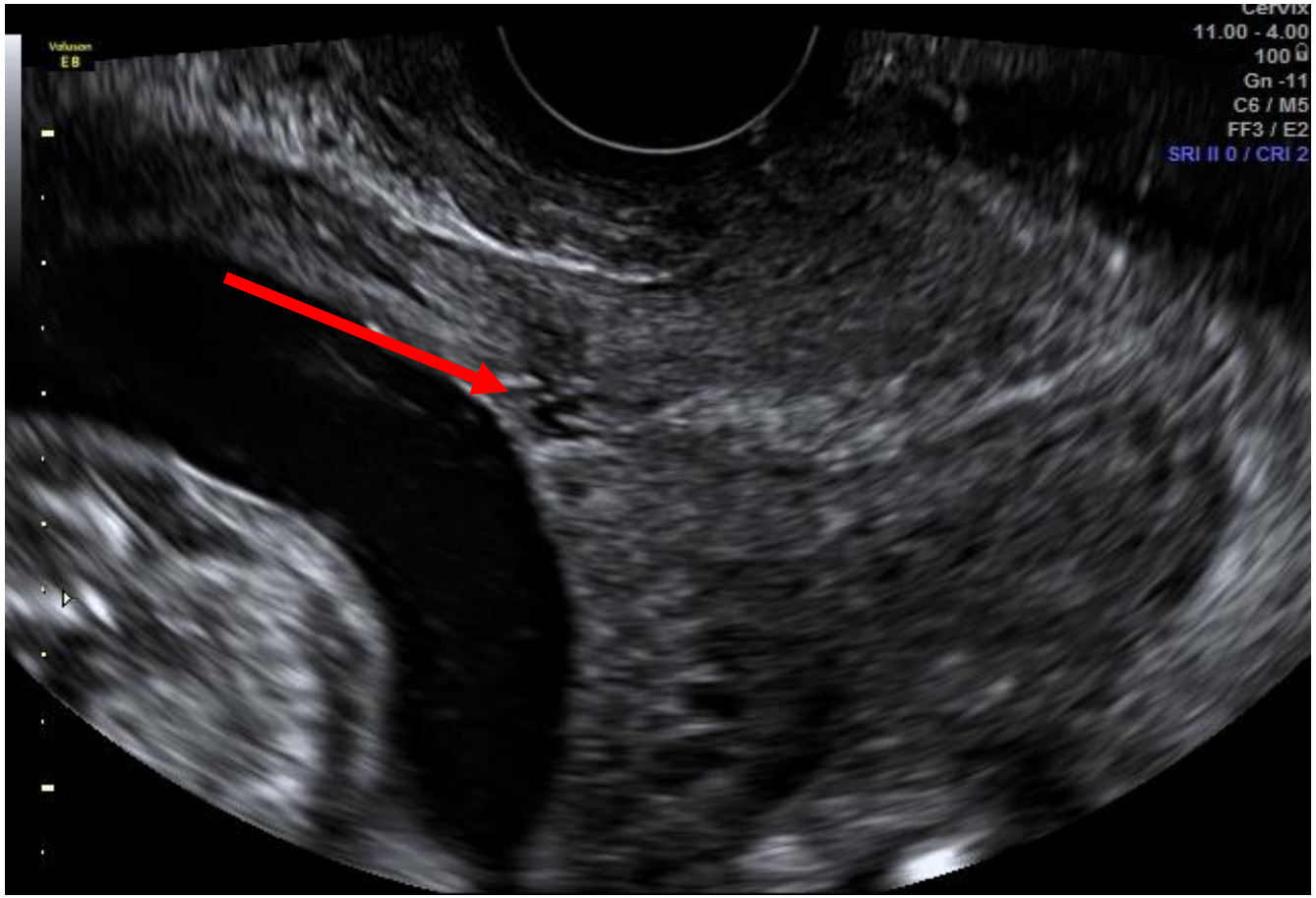
16+2 weeks


Voluson
E8
Cervix
11.00 - 4.00
100
Gn -3
C6 / M5
FF3 / E2
SRI II 0 / CRI 2
1
1 D 0.0mm

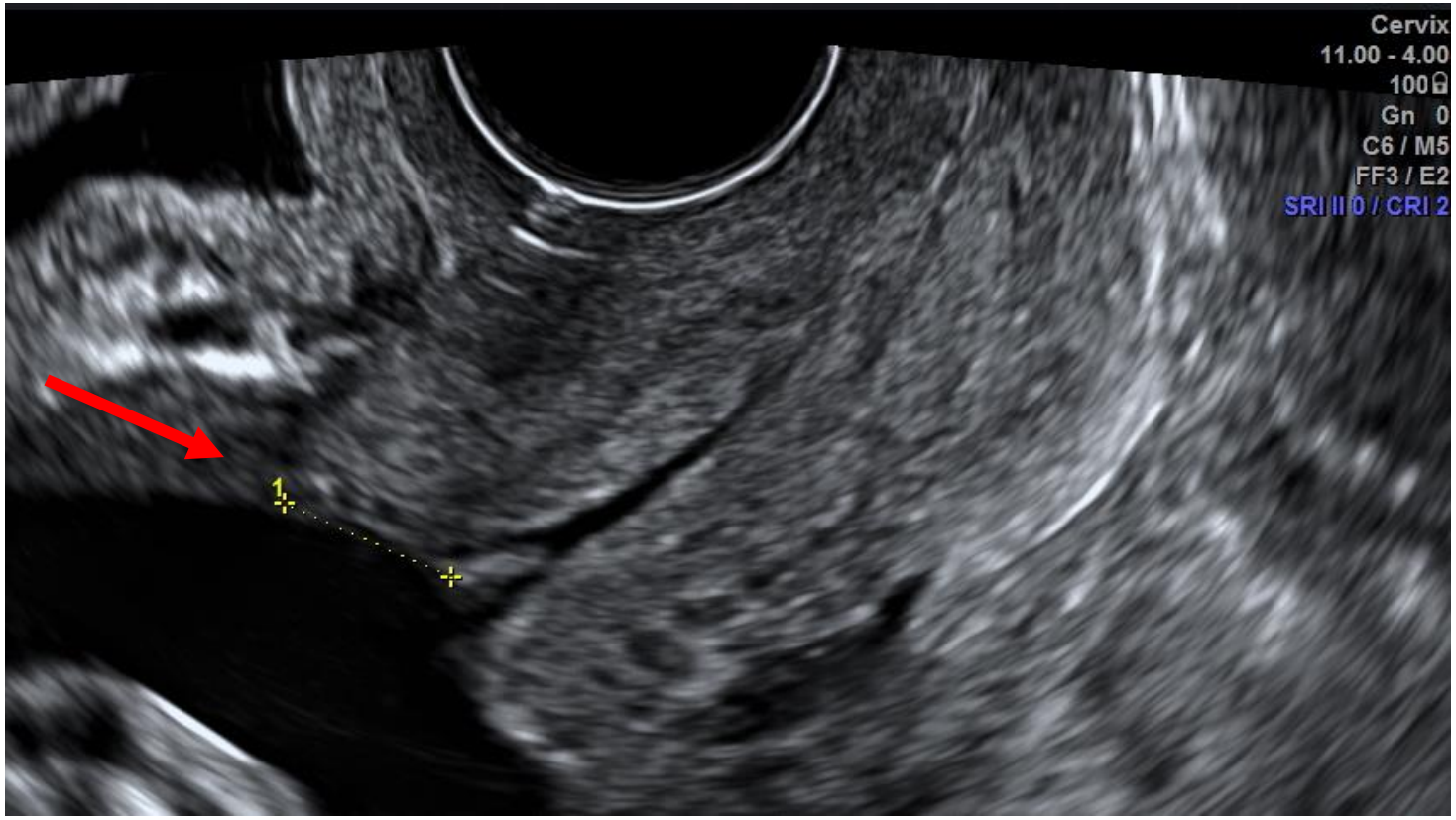
3D – Imaging



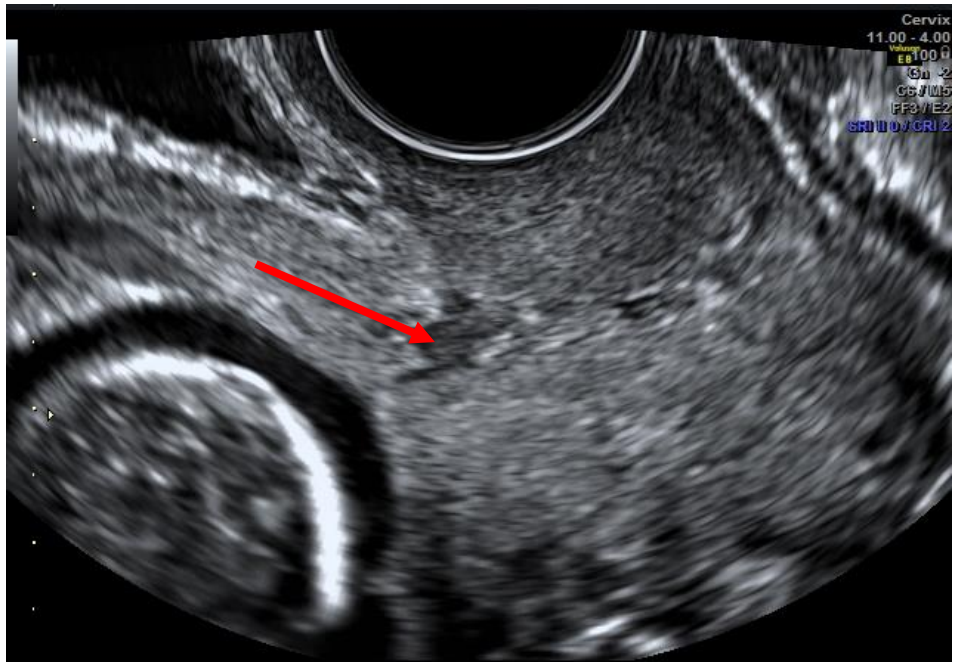
CS scar just above cervix

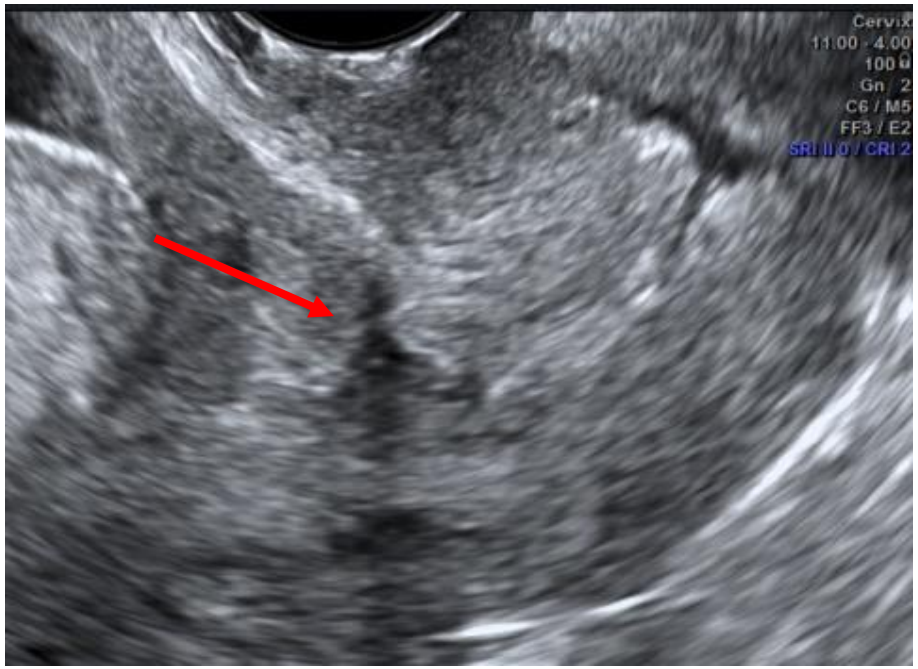


CS scar above cervix

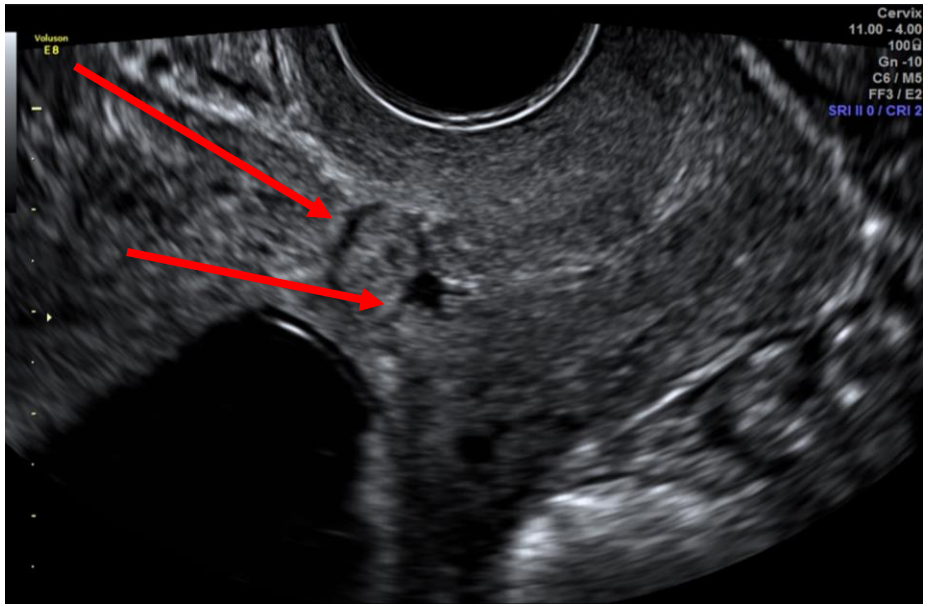


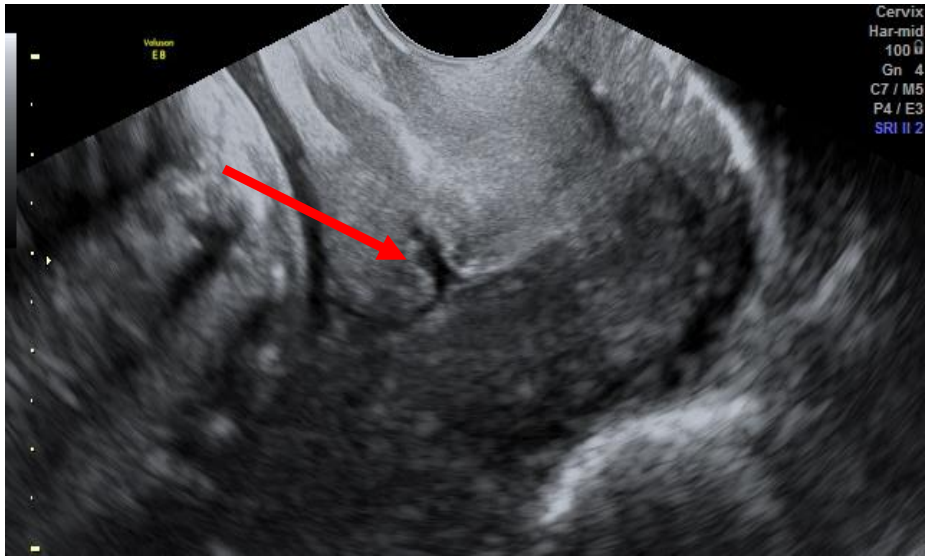
CS scars

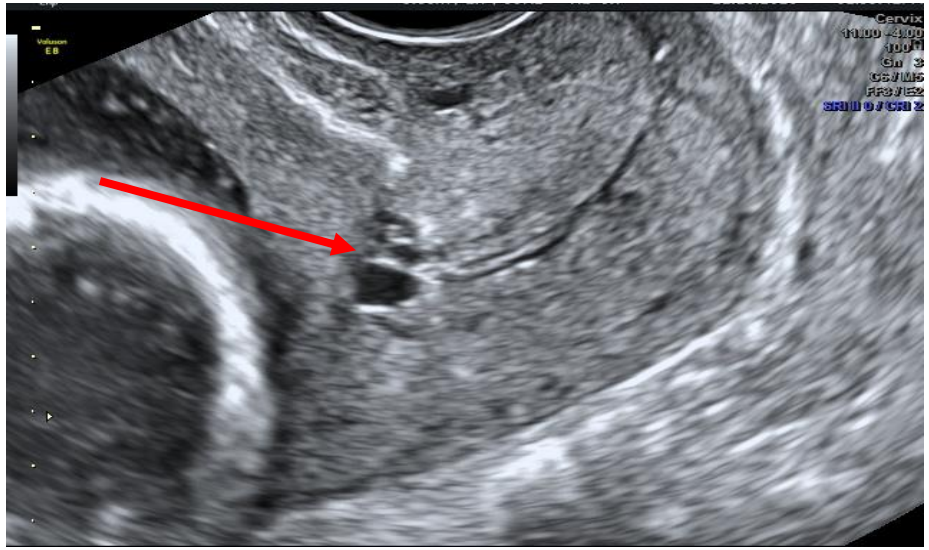

Cervix
11.00 - 4.00
100
Gn 2
C6 / M5
FF3 / E2


Cervix
11.00 - 4.00
100
Gn 2
C6 / M5
FF3 / E2

CS scars

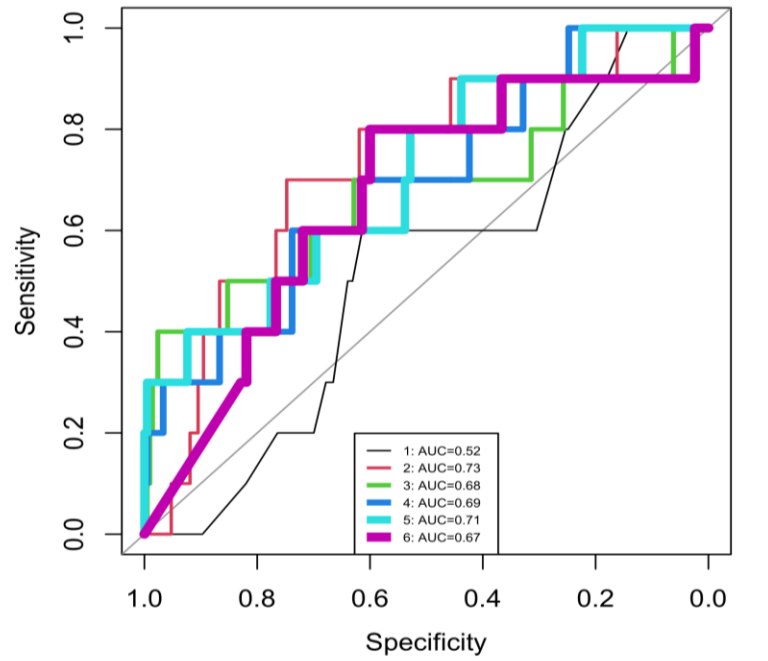

Cervix
11.00 - 4.00
100
Gn -10
C6 / M5
FF3 / E2
SRI II 0 / CRI 2


Cervix
Har-mid
100
Gn 4
C7 / M5
P4 / E3
SRI II 2


Cervix

Multi-parameters models of absolute scar distance from internal cervical os and prediction of SPTB

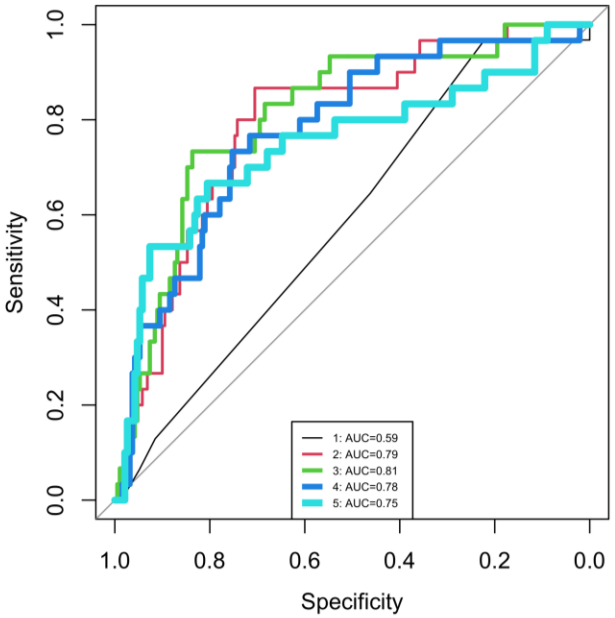
Parameters	AUC (95% CI)	Sensitivity (95% CI) for 75% Specificity
1. Scar visualisation	0.52 (0.36-0.69)	0.2 (0-0.5)
2. Scar distance from os	0.73 (0.57-0.89)	0.6 (0.3-0.9)
3. Scar distance and niche parameters	0.68 (0.46-0.90)	0.5 (0.2-0.8)
4. + cervical length	0.69 (0.52-0.87)	0.5 (0.1-0.8)
5. + previous FDCS parameters	0.71 (0.54-0.89)	0.5 (0.2-0.8)
6. + maternal history parameters	0.67 (0.49-0.85)	0.5 (0.20-0.8)



uclh

Multiparameter models of CS scar distance relative to internal cervical os and prediction of short CL

Parameters	AUC (95% CI)	Sensitivity (95% CI) for 75% Specificity
1. Scar visualisation	0.59 (0.45-0.68)	0.31 (0.20-0.44)
2. Scar location	0.79 (0.71-0.87)	0.73 (0.50-0.93)
3. Scar distance and niche parameters	0.81 (0.73-0.89)	0.73 (0.57-0.90)
4. + previous FDCS parameters	0.78 (0.69-0.87)	0.70 (0.47-0.87)
5. + maternal history parameters	0.75 (0.64-0.86)	0.67 (0.50-0.83)



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Conclusion

- Measuring the CS scar is feasible with CS scar to internal cervical os distance being the most reproducible
- CS scar located within the cervix or <5mm above the internal cervical os is associated with
  - spontaneous Preterm Birth
  - shortening of Cervical Length
- A cerclage in women with a short cervical length following FDCS has good outcomes
- Cervical length screening and CS scar assessment should be undertaken following late stage CS

Thank you

Sonographic examination of uterine niche in non-pregnant women: a modified Delphi procedure

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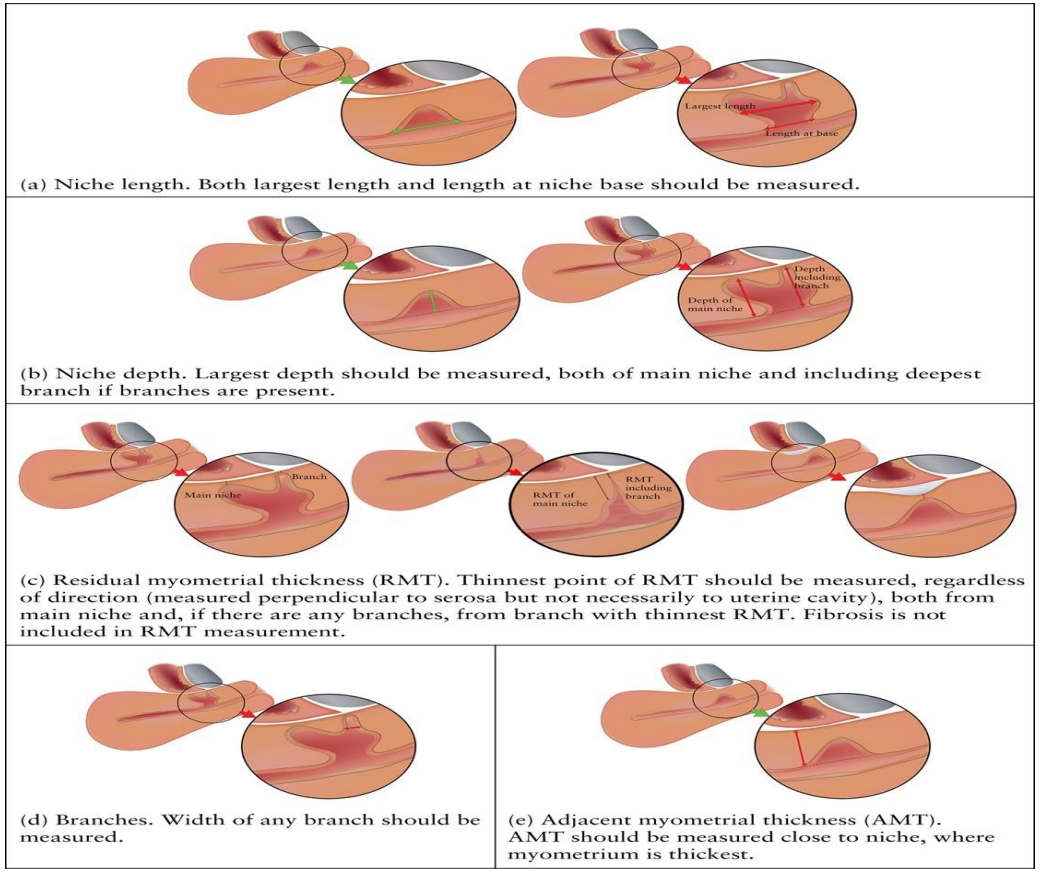


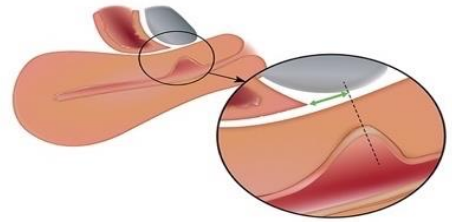
(a) Niche length. Both largest length and length at niche base should be measured.

(b) Niche depth. Largest depth should be measured, both of main niche and including deepest branch if branches are present.

(c) Residual myometrial thickness (RMT). Thinnest point of RMT should be measured, regardless of direction (measured perpendicular to serosa but not necessarily to uterine cavity), both from main niche and, if there are any branches, from branch with thinnest RMT. Fibrosis is not included in RMT measurement.

(d) Branches. Width of any branch should be measured.

(e) Adjacent myometrial thickness (AMT). AMT should be measured close to niche, where myometrium is thickest.



(f) Distance between niche and vesicovaginal (VV) fold. Niche–VV fold distance should be measured from level of top of main niche (where residual myometrial thickness is smallest (dotted line)) to VV fold.

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Standardized approach for imaging and measuring Cesarean section scars using ultrasonography

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Visibility and measurement of Cesarean section scars in pregnancy: a reproducibility study

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