ISUOG Basic Training

Fetal Biometry – Dating, Assessing Size & Estimating Fetal Weight

Learning objective

At the end of the lecture you will be able to:

- List the measurements commonly used in obstetric ultrasound examinations & describe how these are used

Key questions

1. How, & when in gestation, should gestational age be assigned?
2. What are the key features required to measure the the crown rump length (CRL) correctly?
3. What are the key features of the section of the fetal head required to measure the head circumference (HC) & biparietal diameter (BPD) correctly?
4. What are the key features of the section of the fetal abdomen required to measure the abdominal circumference (AC) correctly?
5. What are the key features of the section of the fetal femur required to measure the femur length (FL) correctly?

Topics covered

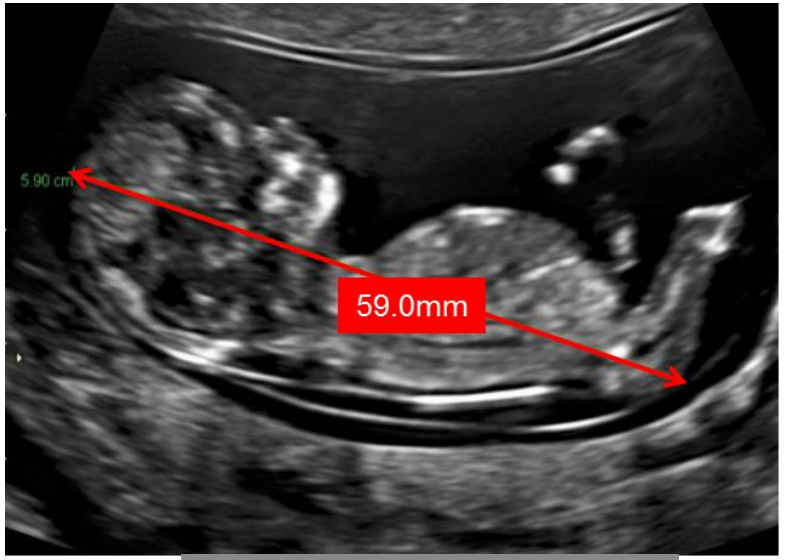
- Estimating gestational age/assessing fetal size
- Standard fetal biometry – CRL, BPD, HC, AC & FL
- Correct anatomical planes for measurement & assessment of head, abdomen & leg
- Components for estimation of fetal weight (EFW)
- 3rd trimester gestational age (GA) assignment - late referral

Estimating gestational age

- Between 4w3d and 5w6d – measure mean sac diameter (MSD) of gestational sac but do not date or assign EDD
- Between 6w and 9w6d - CRL [4 mm – 29.9 mm]
- Between 10w and 13w6d - CRL (30 mm – 84 mm)
- Between 14w and 24w - HC and FL should ‘agree’
- After 24 weeks, assess size not gestational age

ISUOG Practice Guidelines CRL criteria

- Midline sagittal section of whole embryo/fetus
- Oriented horizontally, with CRL measurement line ~90^0 to ultrasound beam
- Fills most of the width of the screen
- Neutral position – neither flexed nor hyperextended
- End points of crown & rump clearly defined
- Avoid inclusion of structures such as yolk sac
- Amniotic fluid visible between chin & chest (to ensure fetus not flexed)



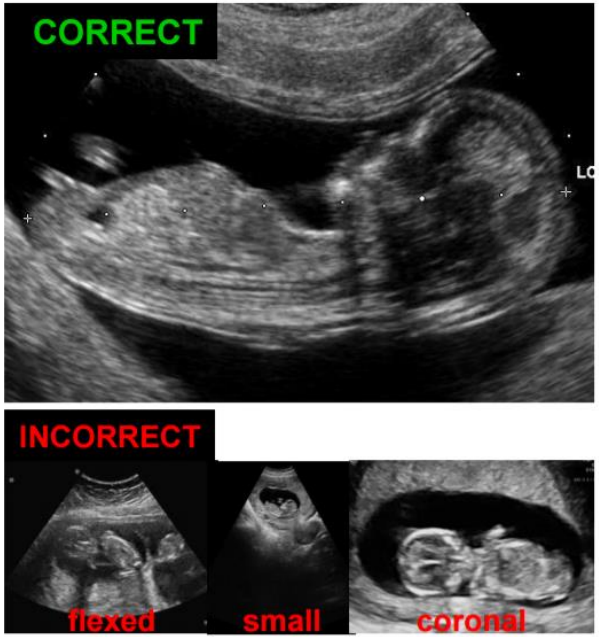
EDD +/- 5 days (95% of cases)

59mm = 12w3d

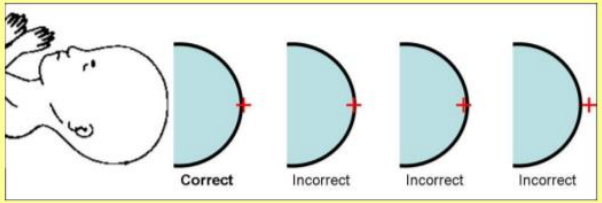
Ultrasound Obstet Gynecol 2013; 41: 102-113

INTERGROWTH-21st CRL criteria

CRL Key points on accurate measurement



- Good magnification
- Mid-sagittal section
- Neutral position
- Fetus is horizontal
- Crown and rump clearly seen
- Callipers placed correctly:

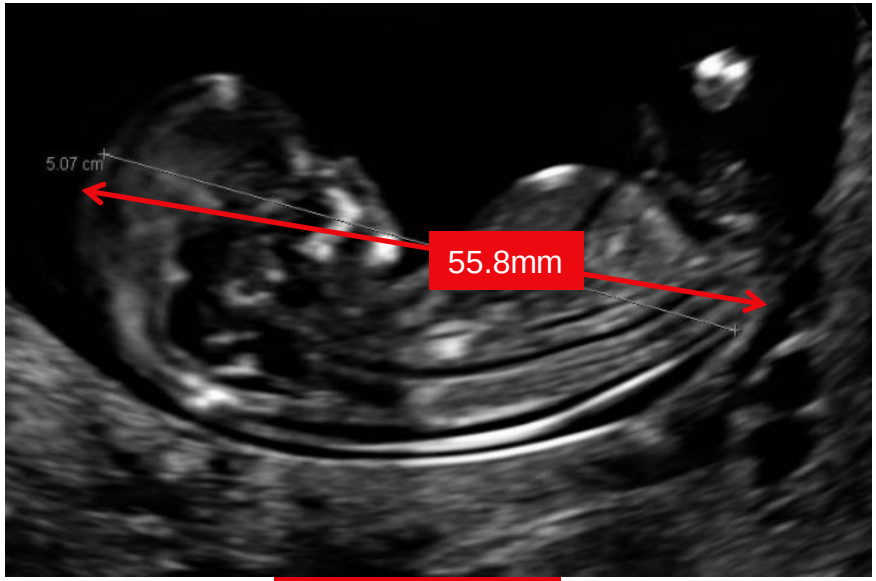


- Best of three measurements

Ioannou C et al BJOG 2013,120 (Suppl.2): 38-41

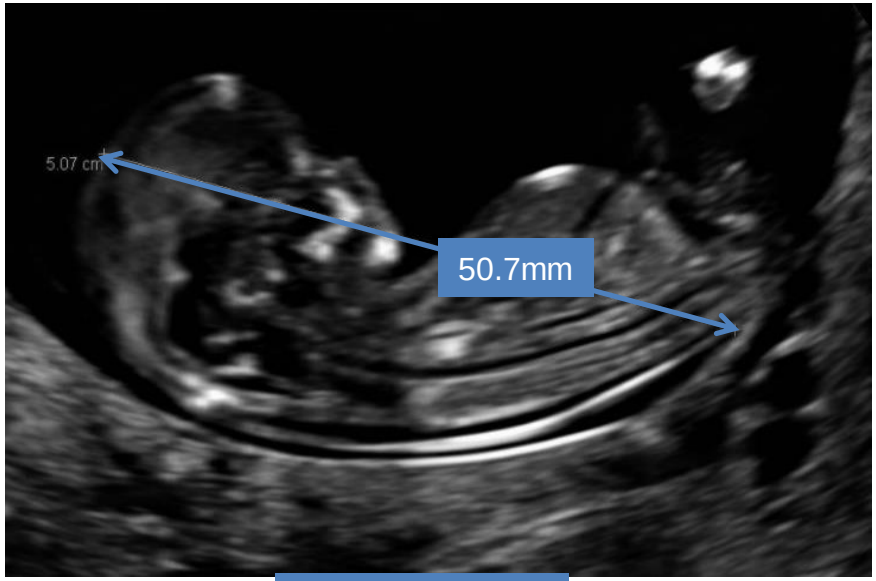
Correct caliper placement

Correct



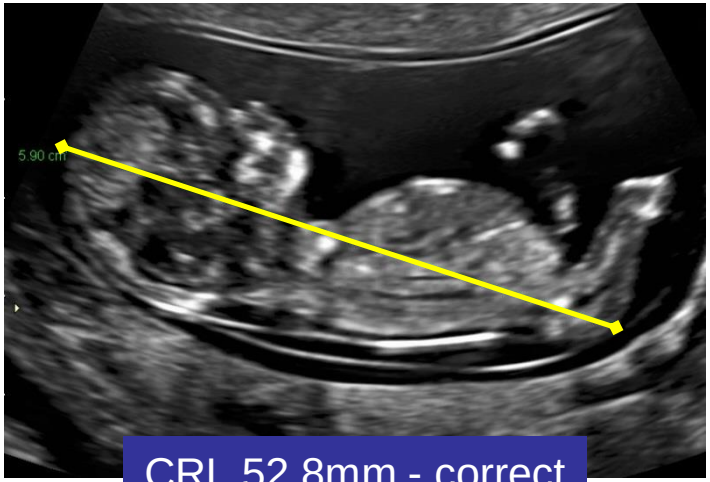
55.8mm = 12w1d

Incorrect

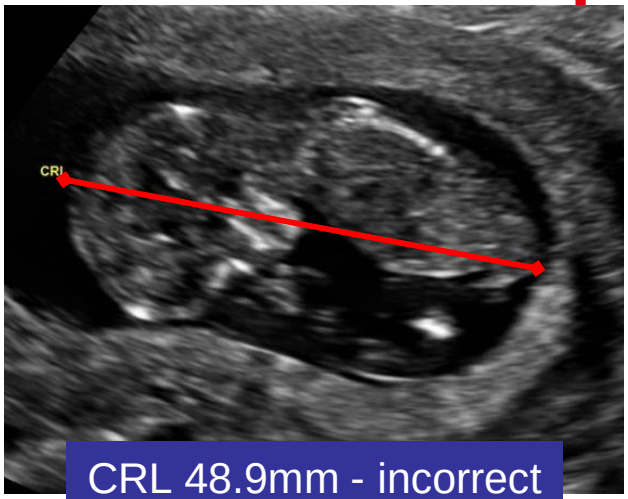


50.7mm = 11w5d

Practical implications of poor CRL technique



CRL 52.8mm - correct



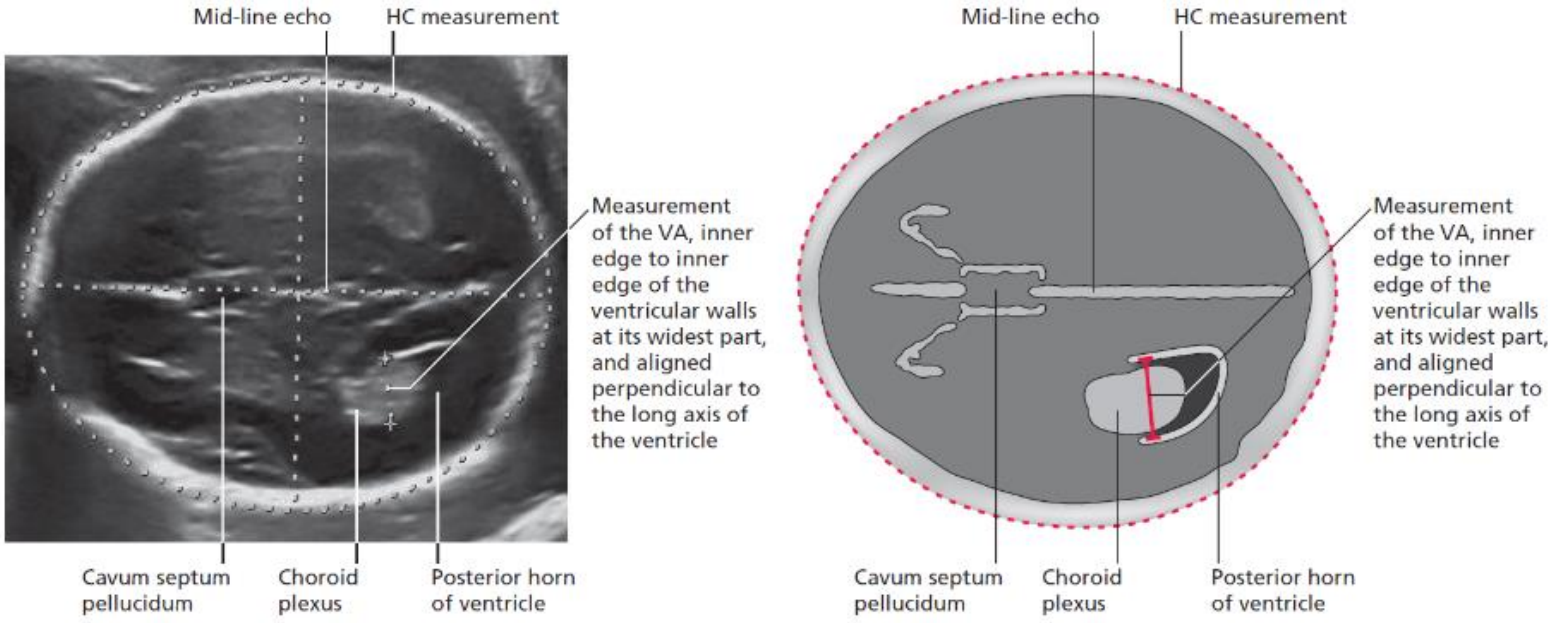
CRL 48.9mm - incorrect

30 yrs, NT 2.4mm, dating by CRL ***(Tri 21 risks at term)***

CRL	GA	Background risk	Adjusted risk
52.8	11w6d	1:906	1:182
48.9	11w4d	1:906	1:143

Correct anatomical plane HC/BPD

Head circumference (HC) and ventricular atrium (VA)



http://fetalanomaly.screening.nhs.uk/standardsandpolicy

Correct anatomical plane HC/BPD

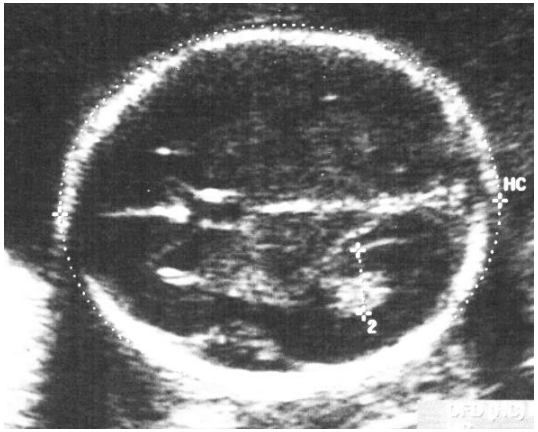
1. Cross section at level of lateral ventricles/ thalami *(slide)*
2. Midline (falx cerebri) horizontal *(dip)*
3. Midline equidistant from upper & lower parietal bones *(angle)*
4. Cavum septum pellucidum bisects midline, 1/3 from synciput (front) to occiput (back)
5. Rugby football shape, rounded at back, more pointed at front *(rotate)*
6. Skull contour regular *(angle)*

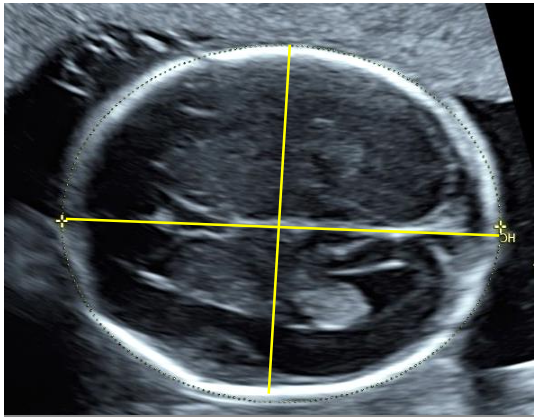
Dating by HC

- Cross section of head at level of lateral ventricles/thalami
- HC from ellipse round outer skull border
- HC calculated from measurement of

  BPD (outer to outer) + OFD (outer to outer)

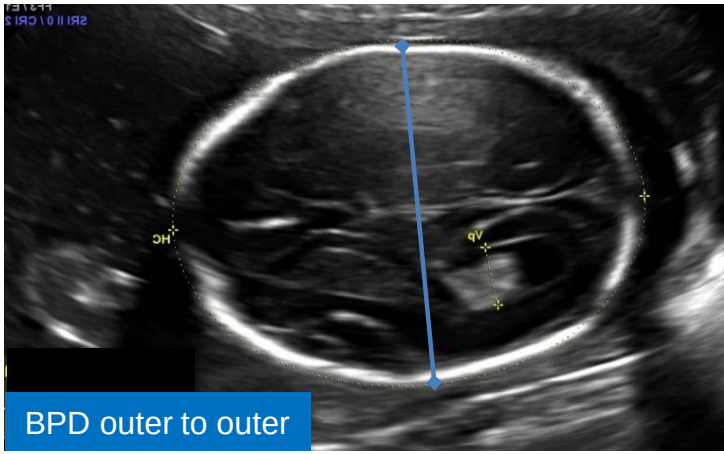
  HC = (BPD + OFD) x 1.62

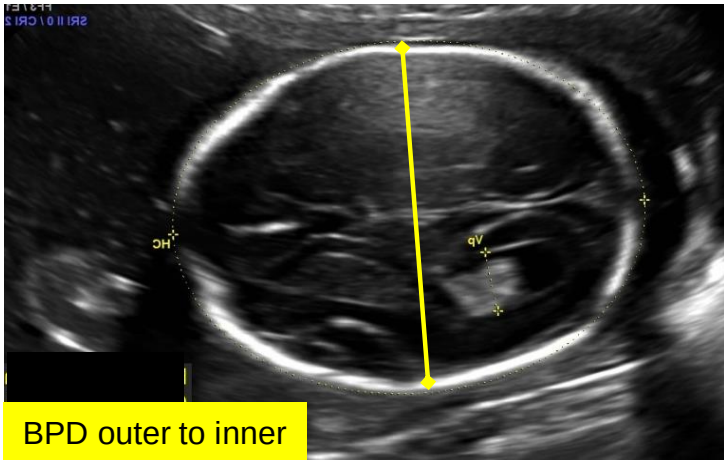




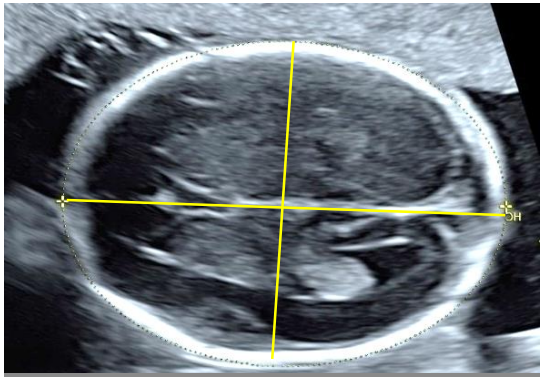
Dating by BPD

- Cross section of head at level of lateral ventricles/thalami
- BPD from linear calipers across widest diameter between parietal bones
- Upper caliper on OUTER border of upper skull
- Lower caliper on either OUTER or INNER border of lower skull, depending on BPD chart used
- Skull thickness at 20 weeks~3 mm, equivalent to ~3 days of gestation





Dating by HC

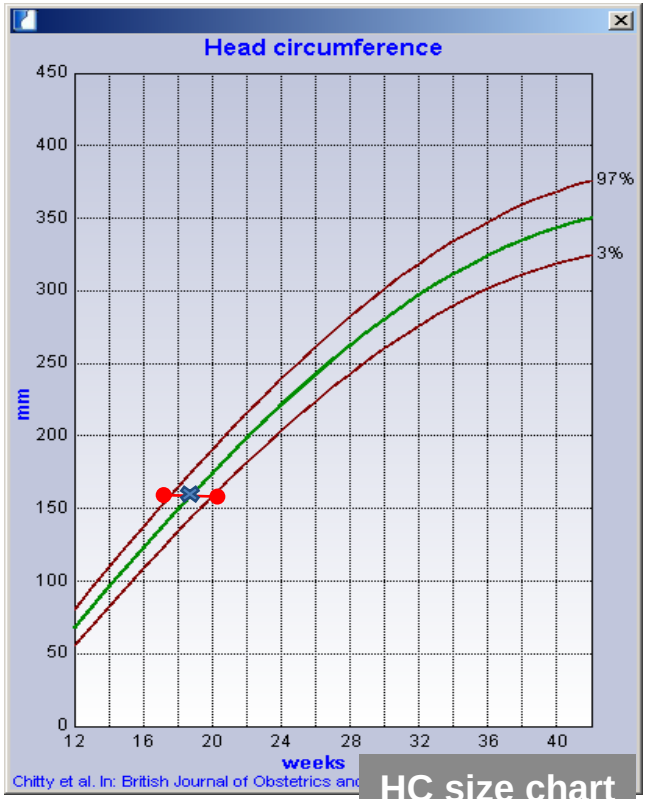


HC = 158 mm = 19w

- Look-up table to date
- Size chart for reporting

length (mm)	GA(wks + days)	5th centile	95th centile
80	12+4	11+3	13+5
85	12+6	11+6	14+1
90	13+2	12+2	14+4
95	13+5	12+4	15+0
100	14+1	13+0	15+3
105	14+4	13+3	15+5
110	15+0	13+6	16+1
115	15+3	14+2	16+4
120	15+6	14+5	17+0
125	16+2	15+1	17+3
130	16+4	15+4	17+6
135	17+0	15+6	18+2
140	17+3	16+2	18+5
145	17+6	16+5	19+1
150	18+2	17+1	19+3
155	18+5	17+4	19+6
160	19+1	17+6	20+2
165	19+3	18+2	20+5
170	19+6	18+5	21+1
175	20+2	19+1	21+4
180	20+5	19+3	22+0
185	21+1	19+6	22+3
190	21+4	20+2	22+6
195	22+0	20+4	23+2
200	22+2	21+0	23+5
205	22+5	21+3	24+2
210	23+1	21+5	24+5
215	23+4	22+1	25+1
220	24+0	22+4	25+5
225	24+3	22+6	26+1

HC dating table



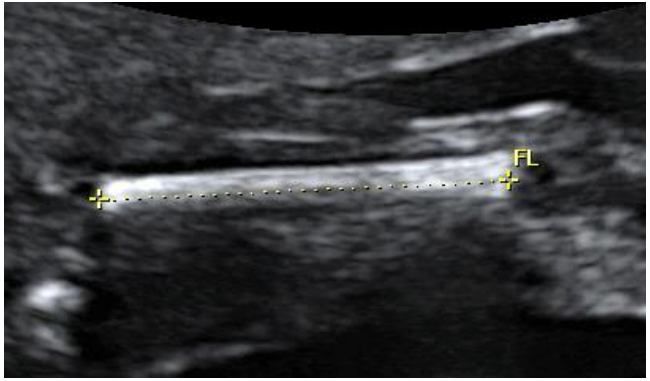
HC size chart

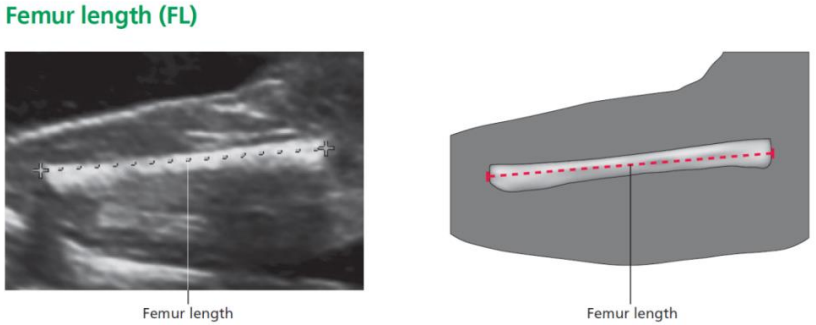
Loughna et al Ultrasound 2009, 17(3):161-167

isuog.org

Correct anatomical plane FL

1. Both ends of ossified metaphysis clearly visible *(rotate + slide)*
2. Longest axis measured
3. Distal femoral epiphysis if visible or spur artefacts should not be included
4. Angle of femur to incident beam should correspond to technique of reference chart *(dip)*
5. Recommend 0^0-15^0 to horizontal

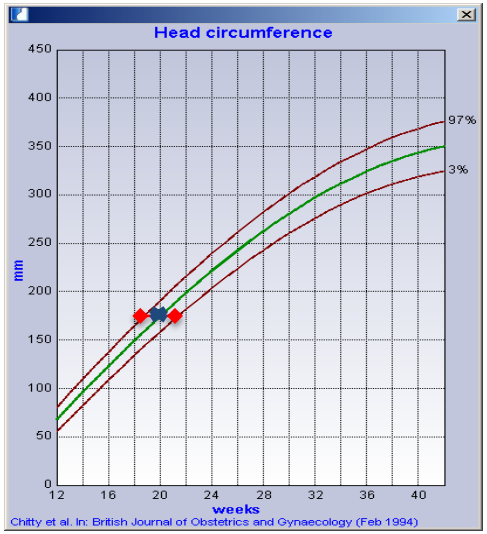


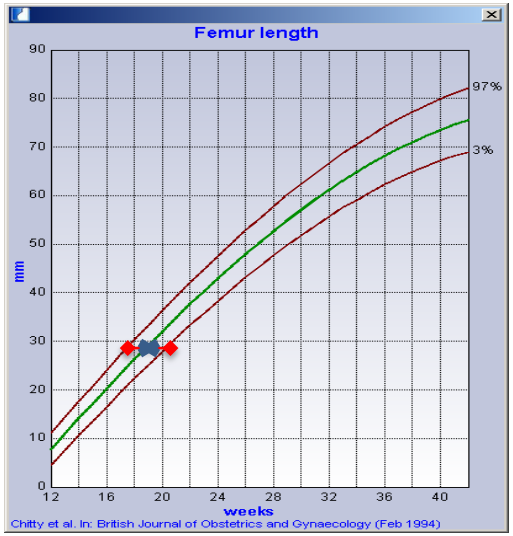


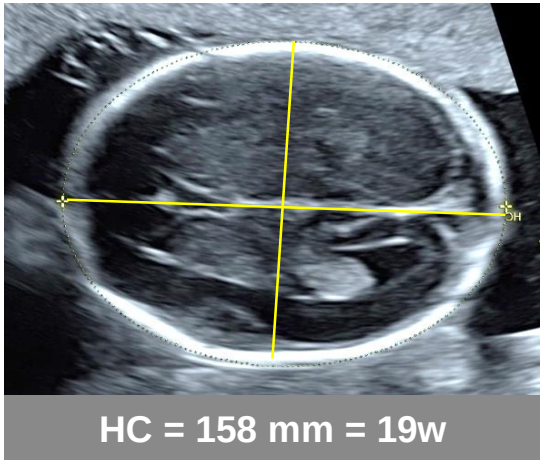
http://fetalanomaly.screening.nhs.uk/standardsandpolicy

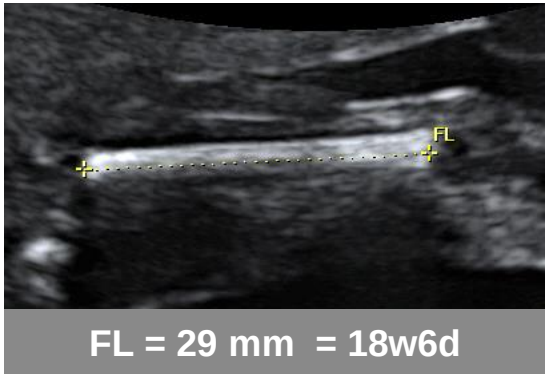
Dating by HC & FL

- Assigning GA accurately requires GA from HC & FL to ‘agree’
- Both 50th centile – straightforward





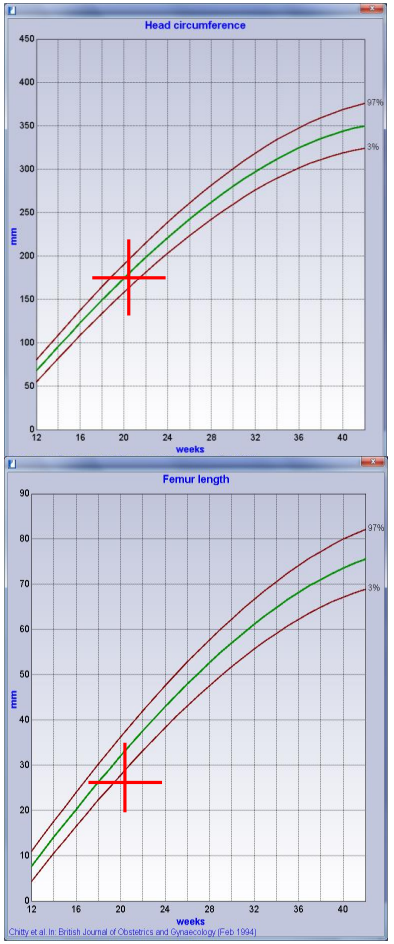




Dating by HC & FL

- Assigning GA accurately requires GA from HC & HC & FL to ‘agree’
  - same centile?
  - +/- 10 centiles?
  - +/- 45 centiles?

- Where HC & FL ‘disagree’
  - review HC & FL sections & caliper placements
  - repeat sections & re-measure
  - consider significance of genuine discrepancy



HC & FL discrepancy

- ✓Review HC & FL sections & caliper placements
- ✓Repeat sections & re-measure
- ✓Consider significance of genuine discrepancy

Small FL (below 5th centile)

- Skeletal dysplasia
- Down's syndrome
- ?early FGR

Refer for further assessment

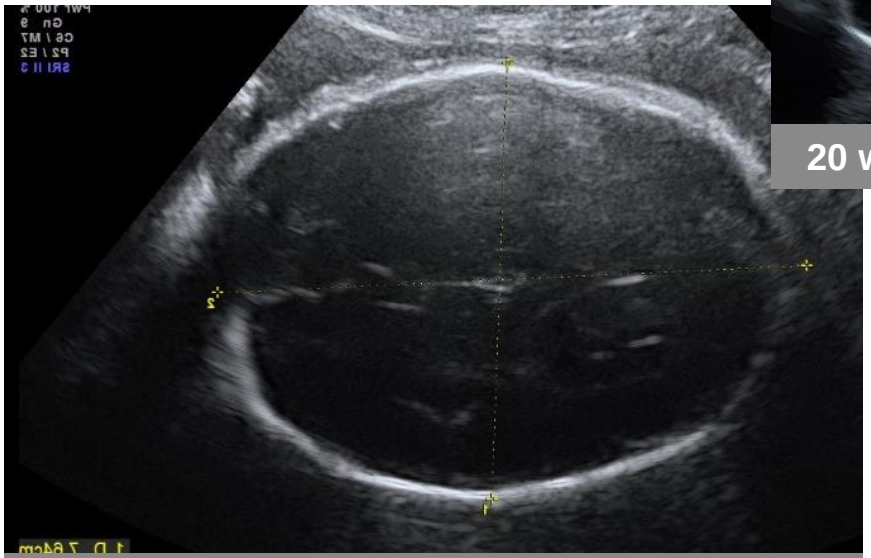
Small HC (below 5th centile)

- Microcephaly
- Spina bifida

Refer for further assessment

Landmarks & gestational age

20 week landmarks



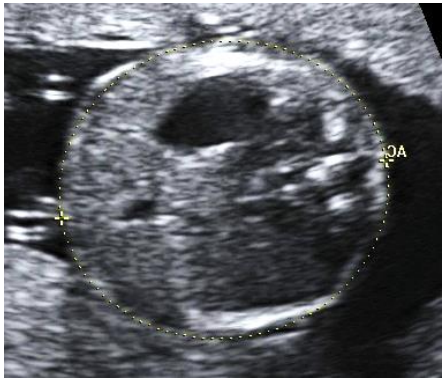
32 week landmarks

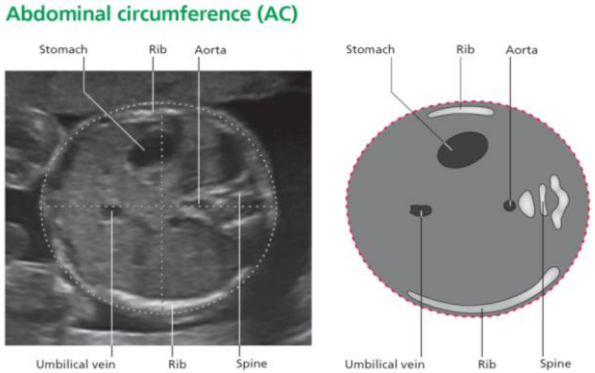
33 week landmarks

Correct anatomical plane AC

Transverse section of fetal abdomen

1. As circular as possible *(rotate or angle)*
2. Short length of umbilical vein/at level of portal sinus *(usually rotate)*
3. Stomach ‘bubble’ visualised *(slide)*
4. Kidneys should not be visible *(slide)*





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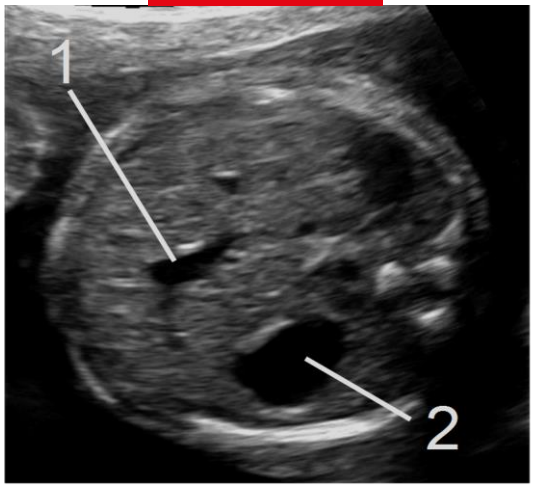
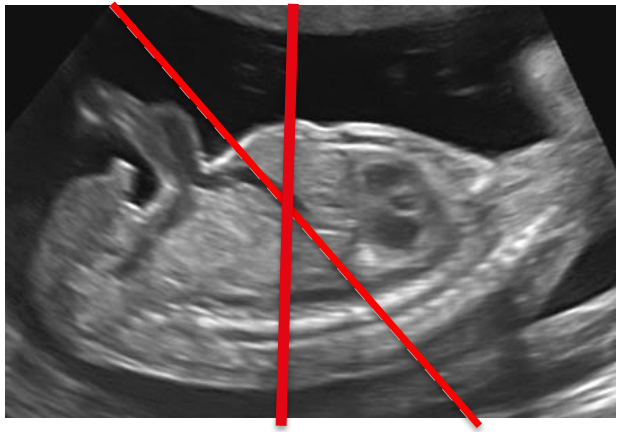
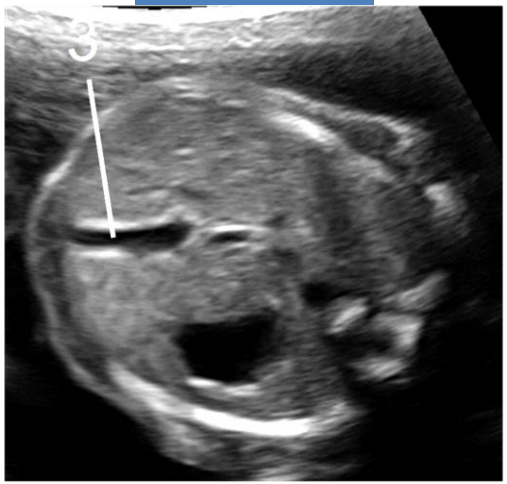
AC sections

Correct





Incorrect



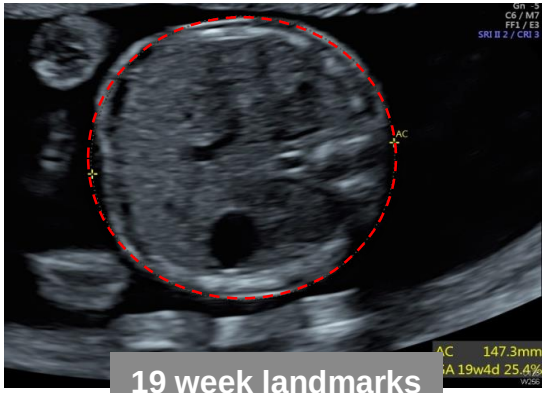
1. Correct short length of umbilical vein
2. Stomach ‘bubble’ visualised
3. Incorrect long length of umbilical vein

Measurement of AC

- Caliper(s) at outer surface of skin line

a. Ellipse

b. Linear
  - anteroposterior diameter (APAD)
  - transverse abdominal diameter (TAD)
  - diameters 90^0 to each other, outer to outer
  - AC = (APAD + TAD) x 1.57



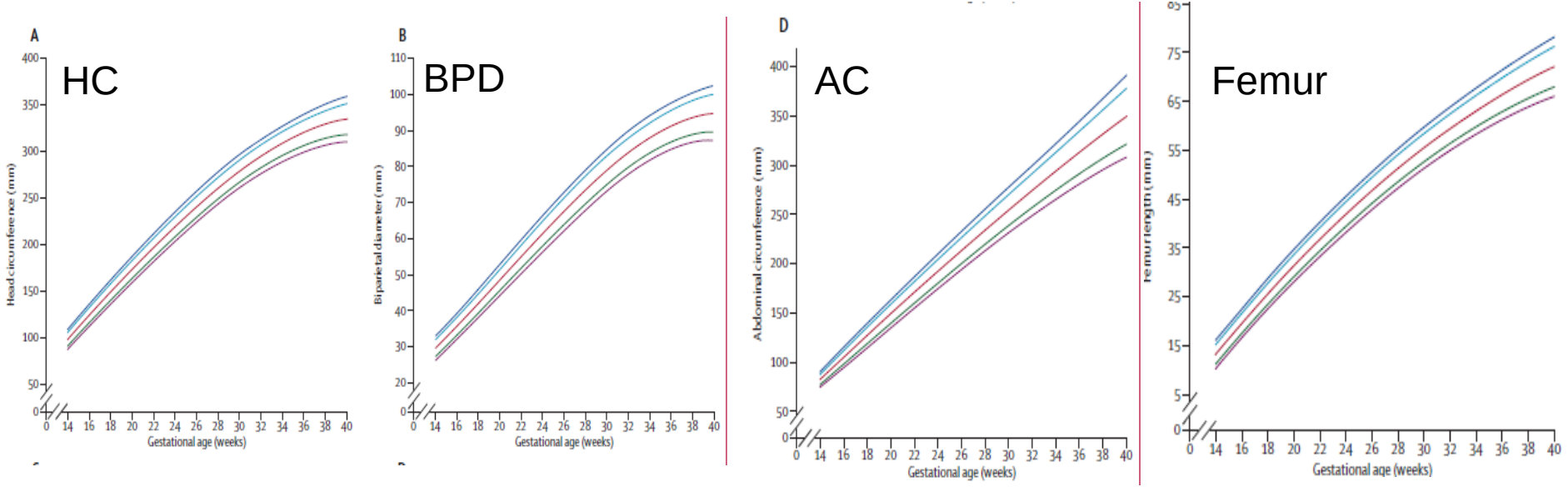
19 week landmarks

31 week landmarks

Assessing fetal size

- Once the EDD has been assigned (CRL), fetal biometry is used to assess
  - Fetal growth velocity
  - Fetal size
  - Fetal weight
- Measurements should not be used to reassign the EDD
- Time interval between scans - at least 2 weeks

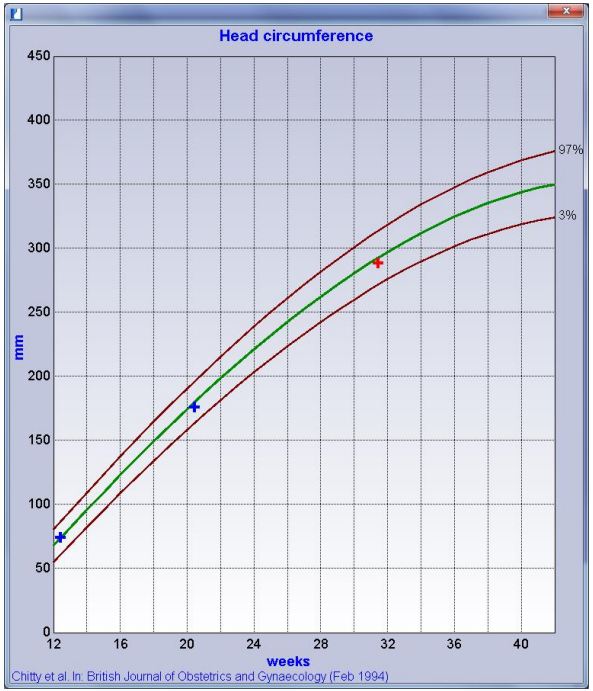
Fetal growth

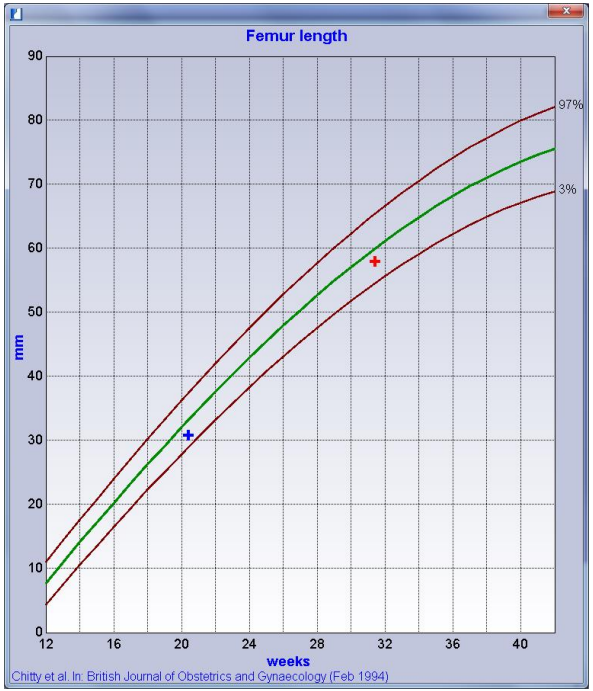


International standards for fetal growth based on serial ultrasound measurements: the Fetal Growth Longitudinal. Study of the INTERGROWTH-21st Project

Papageorghiou et al Lancet 2014, 384:869-79

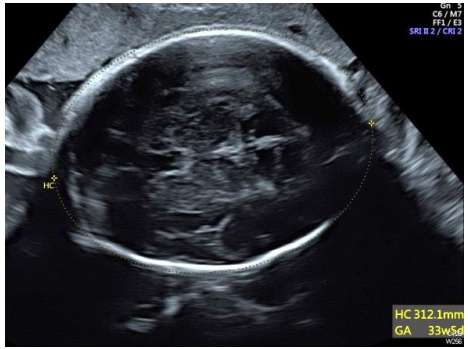
Fetal growth

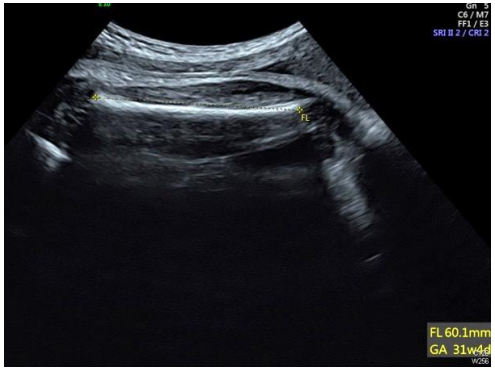


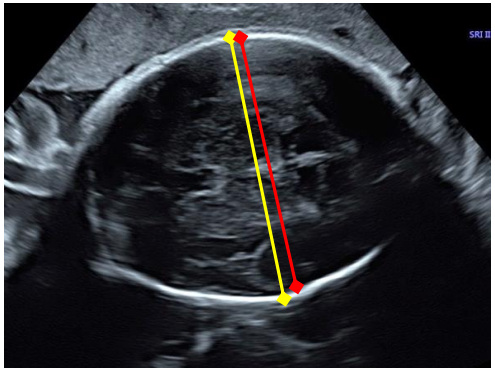


Components for EFW

- AC alone
- AC, HC
- AC, HC, FL
- AC, HC, FL, BPD

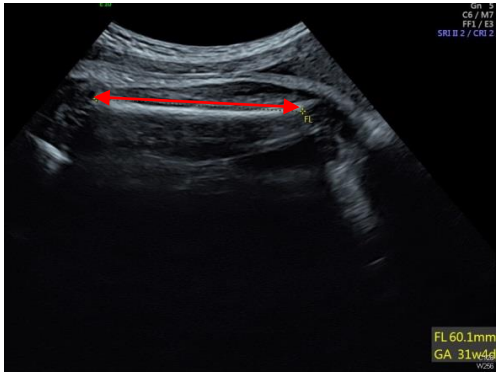


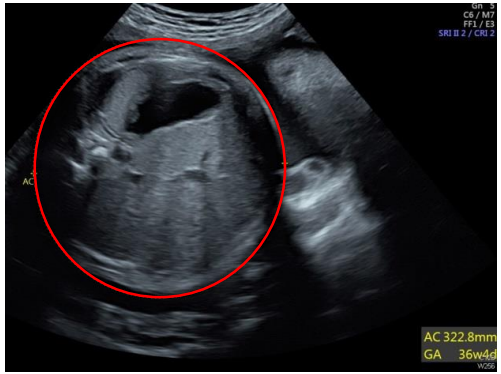




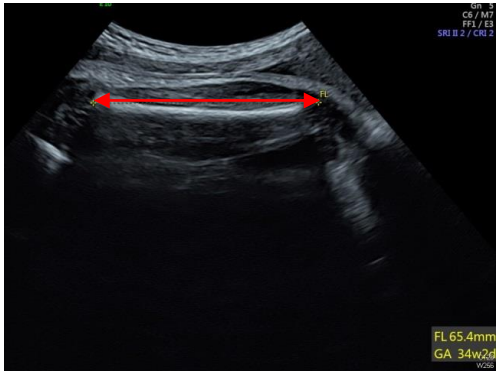
Caliper placement & estimating fetal weight

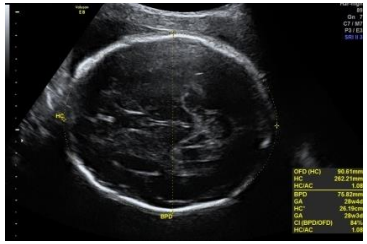
AC 310.3mm
FL 60.1mm
EFW (Hadlock) = 2299g

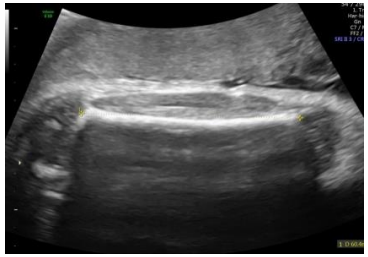




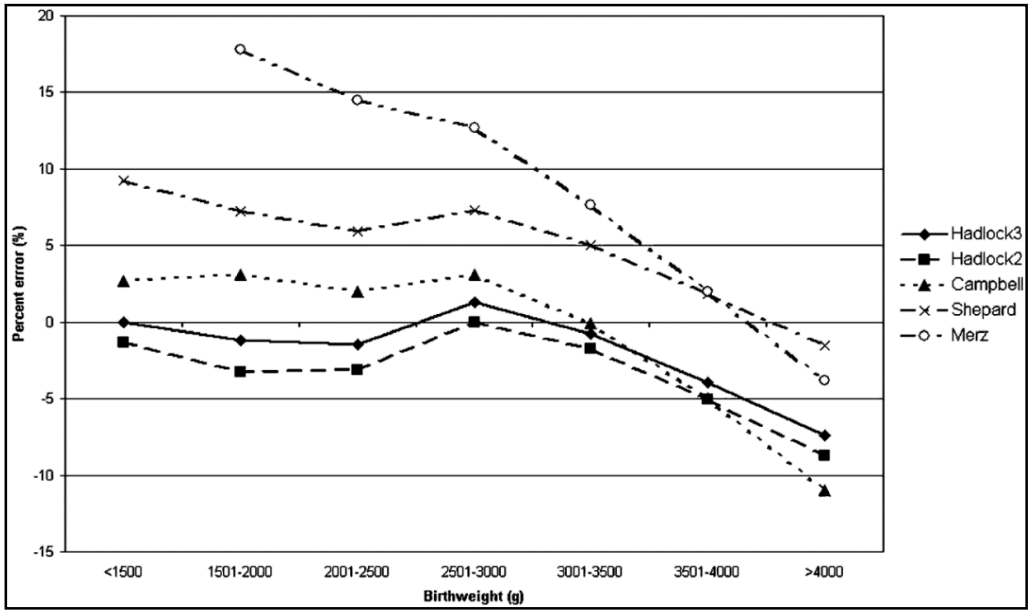
AC 322.8mm
FL 65.4mm
EFW (Hadlock) = 2837g







Estimated fetal weight



Hadlock 2 and 3 - most reliable formulae
- > 3 kg, % error increases

Kurmanavicius et al J Perinat Med 2004, 32:155-61

3rd trimester GA assignment (late referral)

- Biometry used to assess fetal size (& wt), not gestational age
- Subsequent examination(s) to assess growth velocity

3rd trimester GA assignment (late referral)

- Pregnancy dating >24 weeks unreliable
  - ?average 30 weeks
  - ?small 32 weeks
  - ?large 28 weeks

- Biometry used to assess fetal size (& weight), not gestational age
- Subsequent examination(s) to assess growth velocity

Key points

1. Correct the incorrect level by sliding the probe, the shape by rotating the probe, the symmetry of the contents by angling the probe and the position of the structures relative to the horizontal by dipping the probe
2. Ideally pregnancies should be dated by CRL, between 10w and 13w6d, i.e. 30 mm – 84 mm
3. Pregnancies scanned for the first time between 14 and 24 weeks should be dated by HC or FL. These two parameters should ‘agree’
4. Gestational age should not be assigned if scanning a pregnancy for the first time after 24 weeks

Key points

5. Accurate dating, assessment of size &/or estimating fetal weight requires
   - The correct section(s) to be obtained
   - The calipers to be placed correctly as described by the relevant reference chart(s)

6. It is preferable not to report an inaccurate measurement than to provide potentially clinically misleading ultrasound information

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