Importance of first trimester scan – 1 of 4

Pregnancy dating – why, when and how

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Introduction

The calculation of gestational age and the expected date of delivery is not just a social issue but have considerable medical implications. For many centuries it has been accepted that the normal gestation period for humans is ten lunar, or nine calendar months. Franz Carl Naegele (1778-1851), Professor of Obstetrics at the University of Heidelberg, is credited with developing a simple calculation to determine the EDD by adding 7 days to the first day of the LMP and then subtracting 3 months[1]. This calculation commonly referred to as Naegele's rule and has been routinely used to date the pregnancy.

However, dating a pregnancy by menstrual history may not be accurate. Because up to 40% of women are uncertain of their menstrual dates or ovulation may not exactly correspond with the mid menstrual cycle[2]. Gestational age based on the last menstrual period is subject to both random error and a systematic error[3].

Why

First trimester aneuploidy screening using ultrasound measurement of fetal nuchal translucency (NT) and maternal biochemistry (combined test) has become part of routine antenatal care in many countries[4,5]. Accurate dating of pregnancy is critical to the quality of screening programmes because of the distribution of NT and serum markers (PAPP-A, HCG etc.) are varied according to the gestational age. A difference of one or two days gestational age can alter a Down's screening result from high risk to low risk. Further, a policy of universal ultrasound dating for women undergoing second trimester Down syndrome screening using biochemistry (triple and quadruple test) substantially increases the detection rate and reduces the false-positive rate compared with menstrual dating[6-8]. Correct timing of invasive fetal testing is important as high complication rates have been reported when performed in early gestations[9].

Confirmation of small for gestational age is made once fetal abdominal circumference is below the 10th centile for gestational age. However, interpretation and management of fetal growth problems in later gestations may be difficult if correct early pregnancy dating has not been done.

Overestimation of true gestational age by menstrual history increases the prevalence of post dated pregnancy[10]. Dating pregnancy by ultrasound examination in the first trimester of pregnancy using crown-rump length (CRL) has proven more reliable than methods based on the date of the last menstrual period to predict the date of delivery and it can reduce the percentage of post term pregnancies up to 60%[11-16]. Second trimester pregnancy dating is not accurate as first trimester dating. Number of post term pregnancies can be reduced significantly if the pregnancy has been dated by first trimester ultrasound rather than second trimester ultrasound[17] (Figure 1). The National Institute of Clinical Excellence (NICE) has recently recommended that all pregnancies should be dated by fetal crown-rump length (CRL) between 11 and 14 weeks of gestation and by head circumference (HC) thereafter[18].

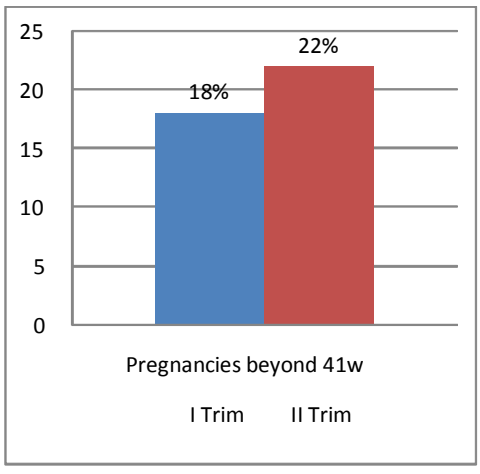

Figure 1. **First versus second trimester ultrasound dating and percentage of post term pregnancies** (Caghey *et al. AJOG* 2008)[17].

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When

Normally the earliest fetal parameters (CRL) are the most accurate for dating purposes because the rate of fetal growth in early gestation is much faster than the intra and inter observer measurement error. Once the gestational age has been assigned, subsequent measurements should only be used to assess fetal size and should not normally be used to reassign gestational age (Figures 2 and 3).

The fetal measurements of choice for pregnancy dating are gestational age dependent (Table 1).

Table 1. Measurements for pregnancy dating

Measurement	*Gestational age range*
Crown-rump length (CRL)	8 to 13 completed weeks
Head circumference (HC)	14 to 25 completed weeks

How

Crown-rump length - CRL (8-14 weeks)

There are many formulae available to convert CRL measurement in to a gestational age but none of them are perfect. The widely accepted equation for calculation of gestational age from crown rump length is the Robinson's formula[14] (Table:1).

$$GA = 8.052 \times (CRL \times 1.037)^{1/2} + 23.73$$

Technique for CRL

CRL measurements can be obtained trans-abdominally or trans-vaginally. Whole fetus should be horizontal on the screen so that the line between crown and rump is at 90° to the ultrasound beam and following criteria should be met (Figure 4).

- A long axis of the fetus in mid-sagittal (median) section is obtained.
- A fetus should be in neutral position
- Measurements are taken from
  - o The top of the head (crown) to the end of the trunk (rump) using the onscreen callipers.

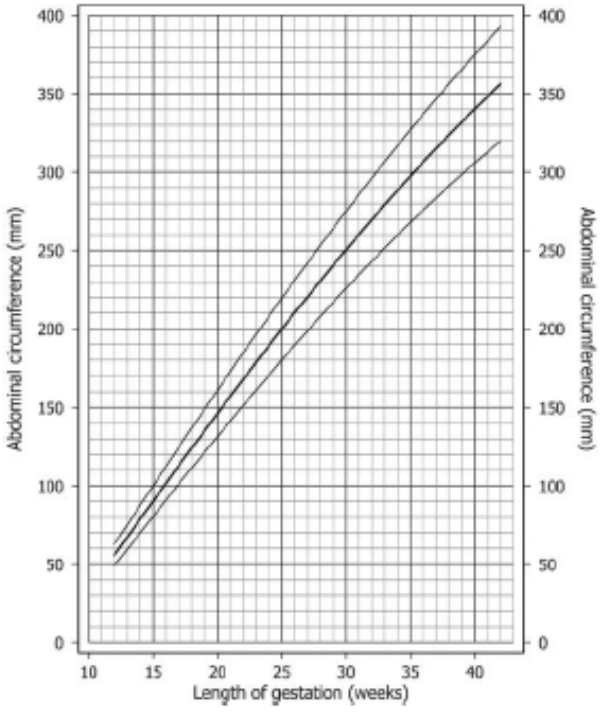

Figure 2. **Head circumference size chart** (Chitty *et al.* and Loughna *et al.*)[19,21]

Figure 3. **Abdominal circumference size chart** (Chitty *et al.* and Loughna *et al.*)[20,21]

Table 2. CRL dating table
(Adopted from Loughna *et al.*)[21]

CRL (mm)	*50th Centile*
16	8+1
17	8+2
18	8+3
19	8+3
20	8+4
21	8+5
22	8+6
23	9+0
24	9+1
25	9+2
26	9+3
27	9+3
28	9+4
29	9+5
30	9+6
31	9+6
32	10+0
33	10+1
34	10+2
35	10+2
36	10+3
37	10+4
38	10+4
39	10+5
40	10+6
41	10+6
42	11+0
43	11+0
44	11+1
45	11+2
46	11+2
47	11+3
48	11+4
49	11+4
50	11+5
51	11+5
52	11+6
53	11+6
54	12+0
55	12+1
56	12+1
57	12+2
58	12+2
59	12+3
60	12+3
61	12+4
62	12+4
63	12+5
64	12+5
65	12+6
66	12+6
67	13+0
68	13+0
69	13+1
70	13+1
71	13+2
72	13+2
73	13+3
74	13+3
75	13+4
76	13+4
77	13+5
78	13+5
79	13+6
80	13+6

Figure 4. **Mid sagittal section of the fetus in neutral position.**

Head circumference - HC (14-26)

Head circumference measurement can be calculated from the biparietal diameter (BPD) and the occipital-frontal diameter (OFD) using the formula:

$$HC = \pi(BPD + OFD) / 2$$

Modern ultrasound machines can calculate the HC directly from the diameters of the head using the ellipse facility. Deriving the head circumference in this way is acceptable provided that the above equation is used.

Gestational age should be estimated from HC using the following formula[19] (Table 3):

$$\log_e(GA) = 0.010611HC - 0.000030321HC^2 + 0.43498 \times 10^{-7}HC^3 + 1.848$$

Technique for HC

The image should be frozen when the following landmarks are identified (Figure 5).

- A cross-sectional view of the fetal head at the level of the ventricles should be obtained.
- A rugby football-shaped skull, rounded at the back (occiput) and more pointed at the front (synciput).
- A long midline equidistant from the proximal and distal skull echoes.
- The cavum septum pellucidum bisecting the midline one-third of the distance from the synciput to the occiput.
- The two anterior horns of the lateral ventricles symmetrically placed about the midline.
- All or part of the posterior horns of the lateral ventricles symmetrically placed about the midline.

Table 3. Head Circumference dating table
(Adopted from Chitty *et al.* and Loughna *et al.*)[19,21]

Head circumference (mm)	*50th Centile*
100	14+1
105	14+4
110	15+0
115	15+3
120	15+6
125	16+2
130	16+4
135	17+0
140	17+3
145	17+6
150	18+2
155	18+5
160	19+1
165	19+3
170	19+6
175	20+2
180	20+5
185	21+1
190	21+4
195	22+0
200	22+2
205	22+5
210	23+1
215	23+4
220	24+0
225	24+3
230	24+6
235	25+3
240	25+6

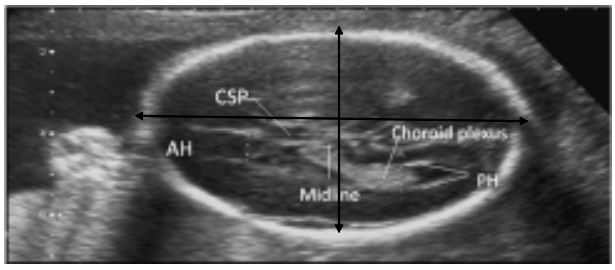

Figure 5. **Standard HC view at transvetricular view of the fetal head (outer to outer).**

CSP: cavum septum pellucidum
AH: anterior horn of the lateral ventricle
PH: posterior horn of the lateral ventricle

To measure the OFD the intersection of the callipers should be placed on the outer border of the occipital and frontal edges of the skull at the point of the midline ('outer to outer') across the longest part of the skull (Figure 5). To measure the BPD, the intersection of the callipers should be placed on the outer border of the upper and lower parietal bones ('outer to outer') across the widest part of the skull (Figure 5).

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