

# Ultrasonic measurement of biparietal diameter and femur in foetal age determination

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## Summary

Our objective was to verify ultrasonic measurement of biparietal diameter and femur in foetal age determination in the second and third trimester of pregnancy. The prospective cross sectional study was carried out at the ultrasound department of Aberdeen Maternity Hospital Scotland. The study population consisted of 716 pregnant Scottish (Caucasian) women who were certain of their gestational ages and had their gestational ages confirmed in the first trimester by ultrasound. The findings revealed: (1) Linearity through out pregnancy using the femur length measurements while that of the biparietal diameter demonstrated poor correlation after 32 weeks of gestation. (2) The standard deviation and the correlation coefficient of the femur length measurements were 0.0042 and 0.9920 respectively while the corresponding values for biparietal diameter were 0.0045 and 0.9850 respectively. (3) The standard error for femur length estimate was 0.2251 as against 0.3009 for biparietal diameter estimate.

The results suggest that femur length measurement is a more reliable index of late third trimester gestational age prediction than biparietal diameter.

**Keywords:** Gestational age, Prediction, Biparietal diameter, Femur length.

## Résumé

Notre objectif était de vérifier le diamètre foetal bi-pariétal et la mesure de la longueur du femur au moyen de l'ultrason dans détermination de l'âge du foetus dans le second et le troisième trimestre de la grossesse. L'étude prospective échantillonnée a été effectuée au département de d'ultrason de la maternité d'Aberdeen en Ecosse (Aberdeen Maternity Hospital, Scotland). La population étudiée était de 716 femmes Scottish (Caucasian) enceintes, connaissant l'âge de leur foetus au premier trimestre de la grossesse et qui a été confirmé par l'ultrason. Les resultants ont révélé: (1) une linéarité dans les mesures de la longueur du fémur pendant la grossesse alors qu'il n'ya a eu qu'une faible corrélation dans le cas du diameter bi-pariétal après 32 semaines de grossesse. (2) L'écart type et le coefficient de corrélation des mesures du femur étaient respectivement de 0.0042 et 0.9920, alors que dans le cas du diameter bi-parital ces grandeurs avait pour valeurs respectives 0.0045 et 0.9850. (3) L'erreur standard pour la longueur du femur était de 0.2252 contre 0.3009 pour l'estimation du diameter bi-pariétal.

Les résultats suggèrent que, pour la prédiction de l'âge du foetus vers la fin du troisième trimestre de grossesse, la mesure de la longueur du femur est plus fiable que le diamètre bi-pariétal.

## Introduction

It has been documented by various workers that fetal biparietal diameter measurement in the determination of fetal

gestational age before 30 weeks can provide accuracy but the precision decreases there after.<sup>1-3</sup> It has also been documented that accurate measurement of fetal biparietal diameter can be difficult under certain conditions such as deeply engaged fetal head, direct occipito-anterior or occipito-posterior position, and in breech presentation.<sup>4,5</sup>

The measurement of fetal femur length is however easily done with the use of improved real time Ultrasound scanners under the conditions in which biparietal diameter is difficult to measure.<sup>7</sup>

This study examined the accuracy of gestational age assessment based on biparietal diameter and femur length measurements from 14 - 40 weeks gestation.

## Materials and methods

The study population consisted of pregnant women who had ultrasound done at the ultrasound scan unit of Aberdeen Maternity Hospital, United Kingdom. All the patients included were certain of their date and had their gestational ages confirmed in the first trimester by ultrasonic measurement of crown rump length.

The ultrasound machine used for this study was ultramark 4 real time ultrasound equipped with 5MHz linear transducer. All the scan were performed by the first author. The biparietal diameter measurements were obtained at the level of the thalamus according to the standard technique Patricia et al.<sup>8</sup> The femur length was measured electronically with calipers along the axis of the calcified points at both ends of the femur. The largest measurement was used for this study as recommended by Mahoney and Hobbins,<sup>9</sup> and Mongelli and Gardosi.<sup>10</sup> An average of three different measurements of both biparietal diameter and femur lengths were obtained.

Altogether there were 716 measurements recorded. It was a cross sectional study and each patient was measured once at a particular gestation after the first trimester. The data was analysed by SPSS-PC (Release 5.0, SPSS Inc, Chicago, IL, USA) using a method of least square linear regression. The predicted gestational ages for both biparietal diameter (BPD) and femur length measurements (FL) were determined from the regression results using the following equations respectively.

$$GX1 = BDP(b1) + b2$$

$$GX2 = FL(b3) + b4$$

GX1 = Predicted gestational age for BPD measurements

BPD = Mean of biparietal diameter at a particular gestation

b1 = Regression coefficient (slope) of BPD

b2 = Regression constant or intercept of BPD

GX2 = Predicted gestational age for femur length measurements

FL = Mean of femur length at a particular gestation

b3 = Regression coefficient of femur length (slope)

\* Correspondence

b4 = Regression constant or intercept of femur length.

**Results**

Table 1 shows clearly that the predicted gestational age using femur length measurements were closer to that of the menstrual age in both the second and third trimester. The predicted gestational ages using biparietal diameter, however, varied from that of the menstrual age after 32 weeks of gestation.

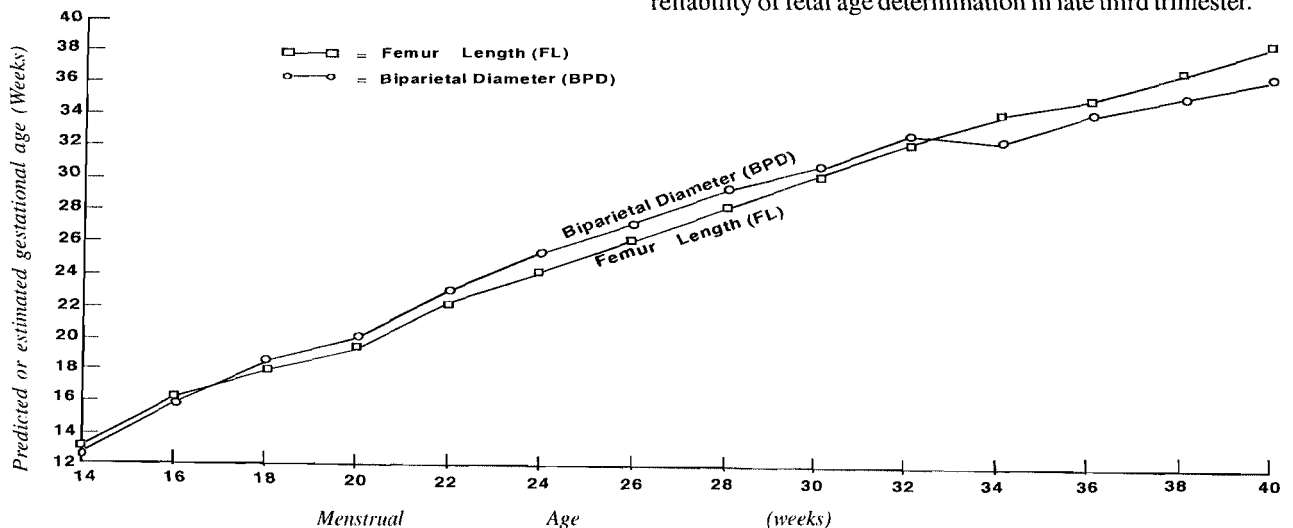
**Table 1 Comparison between femur length and biparietal diameter (BPD) estimates for predicted gestational ages and the menstrual ages.**

Femur length (mm)	Menstrual age (wks)	Predicted gestational age (wks)	BPD (mm)	Menstrual age (wks)	Predicted gestational age (wks)	N
15.8	14	13.1	27.2	14	13.0	48
23.5	16	16.3	35.9	16	16.1	56
28.1	18	18.1	42.8	18	18.5	52
31.3	20	19.5	47.9	20	20.2	54
39.2	22	22.7	56.5	22	23.1	50
43.7	24	24.6	62.1	24	25.2	48
48.5	26	26.6	68	26	27.2	54
53.8	28	28.8	74.5	28	29.6	50
58.5	30	30.7	80.7	30	31.8	52
62.1	32	32.1	83.3	32	32.6	48
66.8	34	34.1	83.4	34	31.7	52
70.7	36	35.7	87.2	36	34.1	48
74.7	38	37.4	92.2	38	35.8	50
77.3	40	38.5	95.4	40	36.9	54

**Table 2 Parameters estimates for least squares regression line for relationship between gestational age biparietal diameter and femur length**

	Gestational age versus Biparietal	Gestational age versus femur diameter
length		
Regression coefficient	0.3493 (B1)	0.4129 (B3)
Regression constant	1.6033 (B2)	6.5398 (B4)
Standard deviation	0.0045	0.0042
Standard error	0.3009	0.2251
Correlation coefficient	0.9850	0.9920

Figure 1 also demonstrates stronger linearity in femur length



**Fig. 1 Comparison between femur length and biparietal diameter (BPD) estimates for predicted gestational age and menstrual age.**

measurements as compared to biparietal diameter in late third trimester. Table 2 shows that the standard deviation and the standard error for femur length 0.0042 and 0.2251 respectively were smaller than that of the biparietal diameter which were 0.0045 and 0.3009 respectively. There was also a stronger significant coefficient of correlation between femur length measurement and gestational age ( $r = 0.9920$ ) than that of biparietal diameter ( $r = 0.9850$ ).

**Discussion**

The prediction of gestational age by biparietal diameter measurements before 30 weeks gestation can provide accuracy but its precision declines thereafter.<sup>3,11</sup> It has been documented that proper measurement of biparietal diameter can often be difficult under the following conditions: deeply engaged fetal head, direct occipito-anterior and occipito-posterior positions and in breech presentation.<sup>1</sup> Furthermore, with the aid of real time ultrasound, the femur length can easily be measured under the conditions in which biparietal diameter measurement is difficult.<sup>12</sup>

This study was designed to compare the accuracy of predicting gestational age by the measurements of biparietal diameter and femur length in the second and third trimester.

The results demonstrate a linear relationship between the predicted and the menstrual ages throughout the second and third trimester using the femur length measurements, whereas there was a considerable variation with that of biparietal diameter measurement after thirty-two weeks of gestation. This study reaffirms the findings of previous workers.<sup>1,2,7</sup> These findings also reaffirm the fact that the growth rates of Biparietal diameter and femur length follow a characteristic pattern with maximal growth rate at different gestation.<sup>4</sup>

Although the measurement of femur length by ultrasound is not intended to replace biparietal diameter measurements of fetal age determination, it nevertheless would add to the reliability of fetal age determination in late third trimester.

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