

ORIGINAL RESEARCH

Comparing Foot Length with Femur Length as a New Emerging Parameter in Fetal Sonography

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ABSTRACT

Life cannot be imagined without ultrasonography these days and when it comes to antenatal examination, it plays a very crucial role to detect the growth of fetus and various congenital anomalies. Because of various abnormalities like femur achondroplasia, brachycephalic / dolicocephalic head and IUGR there is a need of new parameters which can be considered in cases of abnormalities. This study has been done to consider Foot Length as a new reliable parameter and compared it with Femur Length in 150 pregnant women. Results showed a significant correlation between foot length and gestational age.

Keywords: Foot Length, Femur Length.

INTRODUCTION

Determination of gestational age is crucial in obstetric care, mainly in the evaluation of fetal growth and the detection of intrauterine growth restriction.¹

Gestational age (GA) refers to the length of pregnancy after the first day of the last menstrual period (LMP) and is usually expressed in weeks and days. This is also known as menstrual age.²

The 2 basic methods used to help estimate gestational age (GA) are- Menstrual history and Clinical examination. But they are subject to considerable error and should only be used when ultrasonography facilities are not available.

Over the past three decades, numerous equations regarding the relationship between fetal biometric parameters (gestational sac mean diameter, crown rump length, femur length, biparietal diameter and abdominal circumference) and gestational age have been described and have proven early antenatal ultrasound to be an objective and accurate means of establishing gestational age.

So, the purpose of this study is to find out the other parameters which can be used to determine the gestational age either more accurately or can be used in other conditions having congenital defects¹

LITERATURE STUDY

Streeter et al in 1920, showed that the fetal foot has a characteristic pattern of normal growth and could be used to estimate gestational age.³

Campbell et al in 1988 evaluated the fetal femur/foot length ratio and found that it was a useful parameter to help differentiate fetuses that have dysplastic limb reduction from those whose limbs are short because of constitutional factors or intrauterine growth retardation.⁴

CA Mandarim de Lacerda et al in 1990 studies the foot length against age, crown-rump length (C-R) and body weight (W) in eighty human fresh fetuses (staging from 14 to 38 weeks post conception).⁵

Kustermann A et al in 1992 CRL was measured in 183 fetuses, BPD in 201, HC in 162, AC in 160, femur length in 133 and foot length in 62. The best description of the relation of CRL to gestational age was achieved by a quadratic function ($y = -3.98 - 0.308x + 0.0117x^2$). Mean values thus derived were virtually identical to those obtained by Robinson & Fleming in 1975 with transabdominal static scanning. Fetal BPD, HC, AC and femur length correlated more closely with CRL than gestational age. Reference ranges (mean and 95% data intervals) were constructed for each biometrical measurement in relation to gestational age and CRL. The HC/AC and femur/foot length ratios did not show any significant variation with gestational age or CRL.⁶ Molly S Chatterjee in 1994 conducted a prospective study on 53 normal pregnant women. The relationship between fetal foot length and gestational age is shown. A significant linear relationship between those parameters ($R^2 = 0.89$, $p < 0.0001$) was present.⁷

MATERIALS AND METHODS

The present study was done in 150 normal pregnant women. Ultrasonographic measurement of Foot Length was done without prior knowledge of gestational age. Fetal foot can be visualized sonographically around 15 weeks of gestation and measured from heel to great toe. Then the gestational age was confirmed by an early abdominal ultrasound by measuring femur length. After obtaining the gestational age in weeks by femur length; values of foot length were correlated with gestational age and the two parameters were then compared graphically.

Fig 1: This ultrasonogram shows the measurement of fetal foot length at 30 weeks of gestation



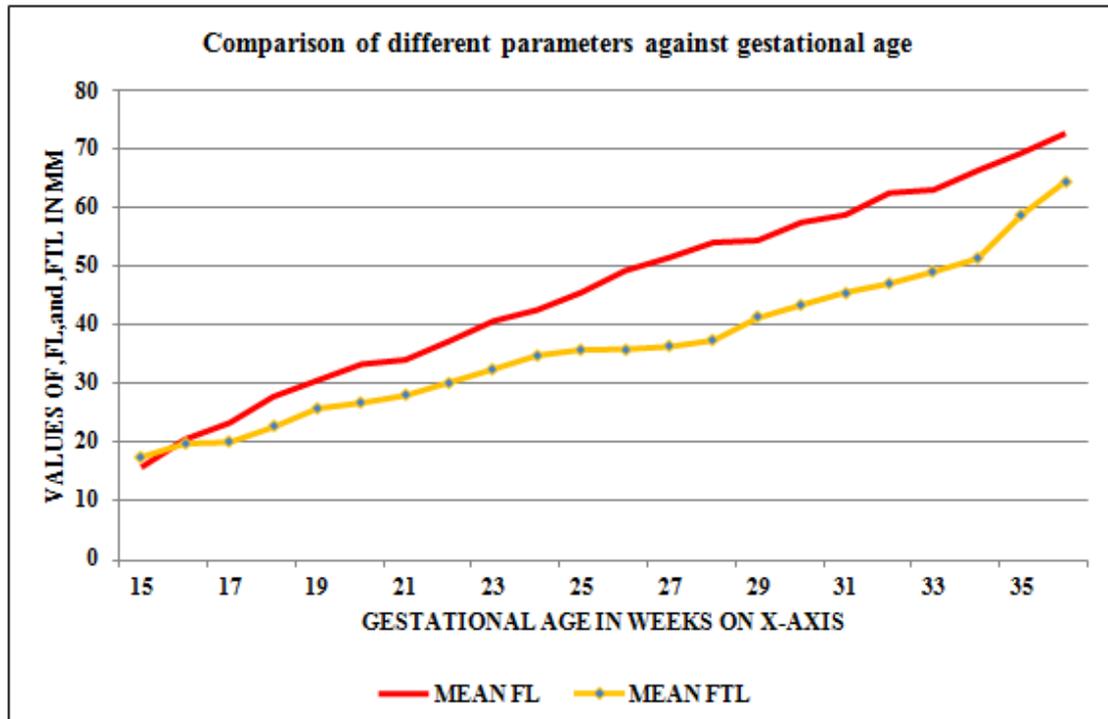
Table 1: Mean Values Of Foot Length And Femur Length (Cases=150)

GA	NO. OF CASES	MEAN FTL ± SD	MEAN FL ± SD
15	6	18.50 ± 1.27	17.75 ± 1.50
16	6	20.75 ± 0.50	20.50 ± 0.37
17	6	21.00 ± 0.80	24.25 ± 0.95

18	7	22.60 ± 2.00	27.80 ± 0.44
19	6	25.35 ± 0.50	31.50 ± 1.00
20	9	26.52 ± 1.96	33.33 ± 1.21
21	6	29.00 ± 0.80	35.00 ± 0.81
22	5	30.10 ± 1.07	37.20 ± 1.30
23	6	32.10 ± 1.02	40.66 ± 1.00
24	8	34.80 ± 0.53	42.60 ± 0.89
25	7	35.95 ± 0.43	44.50 ± 1.00
26	7	36.80 ± 1.28	48.20 ± 1.30
27	7	37.25 ± 1.06	51.50 ± 1.00
28	6	38.33 ± 1.21	54.00 ± 2.52
29	7	41.06 ± 1.09	54.40 ± 1.14
30	6	43.10 ± 1.44	57.40 ± 0.89
31	7	45.50 ± 2.19	56.75 ± 0.65
32	8	47.00 ± 2.05	62.40 ± 1.07
33	7	49.00 ± 2.76	63.00 ± 2.58
34	8	51.05 ± 0.95	64.25 ± 0.60
35	7	55.75 ± 3.78	65.25 ± 1.60
36	8	64.30 ± 2.28	68.60 ± 1.22

Fig 2: This ultrasonogram shows the measurement of fetal femur length at 30 weeks of gestation



Fig 3: Comparison of different parameters against gestational age RESULTS AND

DISCUSSION

The knowledge of gestational age is important for Obstetricians and Neonatologists, and it is routinely estimated. Goldstein I, Reece EA, Hobbins JC et al in 1988 found a significant correlation between fetal foot length and gestational age ($r = 0.9$, p less than 0.0001) and between fetal foot length and femur length ($r = 0.9$, p less than 0.0001).⁸

R. Mhaskar et al in 1989 demonstrated a strong correlation on comparison of linear regression of foot length versus gestational age.⁹

Smolin et al in 2008-foot length was measured from the heel to the first or second toe, whichever was longer. Length of the foot was analyzed in relation to gestational age.¹⁰

Molly S. Chatterjee et al in 1994 similarly showed significant linear relationship between fetal foot length and gestational age ($R^2 = 0.89$, $p < 0.0001$).⁷

Ji E K et al in 2001 concluded that fetal foot length during the second trimester of a normal pregnancy in Korean women is a reliable parameter for use in the assessment of gestational age.¹¹

Rajesh Bardale et al in 2008 observed a statistically significant linear relationship between fetal hand length (HL) and gestational age ($r = 0.978$, $p < 0.0001$).¹²

K S Joshi et al in 2011 showed linear relationship between foot length and gestational age (foot length in mm = $2.494 \times$ gestational age in weeks - 15.46) with significant correlation ($r = 0.970$ and $p = 0.00$).¹³

Hirst JE, Jeffery HE et al in 2012 demonstrated the accuracy of fetal foot length in predicting gestational age which was affected by growth restriction but not fetal gender, maceration, or congenital anomalies.¹⁴

BA Malik et al in 2017 also studied foot length and foot width and showed a significant relationship.¹⁵

HS Wong et al in 2017 also studied the different parameters and found a linear relationship between foot length and gestational age.¹⁶

On comparing with the previous studies, our study showed a significant correlation of foot length with gestational age

CONCLUSION

On the basis of the observations made during study the following conclusions were drawn.

1. Fetal foot length was measured in mm in normal pregnancy (150 cases) and correlated with gestational age.
2. From regression analysis a strongly significant relationship has been observed between fetal foot length and gestational age.
 $y = 6.950 + 0.602 x$ where $y =$ gestational age in weeks $x =$ foot length in mm
3. Scatter diagram plotted between gestational age and fetal foot length, shows linear relation of fetal foot length with gestational age, which makes present study statistically significant.
4. Fetal foot length also correlated with femur length and have a statistically linear relationship with fetal foot length.
5. The correlation coefficient between fetal foot length and femur length is 0.927 with $p < 0.0001$.
6. The correlation coefficient between fetal FL and gestational age is 0.993 with $p < 0.0001$.
7. The regression analysis between FL and gestational age is $y = 7.564 + 0.391 x$ where $y =$ gestational age in weeks $x =$ femur length in mm

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