

Accuracy of Foetal Foot Length and Femur / Foot Length Ratio in USG Estimation of Gestational Age

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A B S T R A C T

Introduction: Many measurements are there for accurate calculation of the gestational age with use of sonography, but the foetal foot length can be used accurately to estimate gestational age. Foetal femur and foot length ratio helps in demarcating the fetuses having short limbs due to dysplasia, from short limbs because of constitutional factors or in utero growth retardation. This study was done to measure the fetal foot length for gestational age and to evaluate fetal femur to foot length ratio in pregnant ladies of 25-36 weeks gestation.

Material and Methods: One hundred normal singleton pregnant women of 25-36 weeks gestation were examined for routine obstetrics ultrasound. In these patients foetal foot length and femur length measurements were taken and the gestational age was assessed. In addition, foetal femur length to foot length ratio was calculated in each patient.

Results: Pearson's correlation coefficient value of 0.920 between gestational age and foot length and 0.864 between foot length and femur length with a significance $p < 0.001$ was obtained. Femur length/ Foot Length ratio was between 0.9 and 1 in all of the cases.

Conclusion: There is a linear relationship and good correlation between foot length and gestational age and femur length and foot length. Foetal foot length is other method to measure gestational age. Femur length/ Foot Length ratio is nearly constant during pregnancy. Foetal foot length is a trustworthy method for assessment of gestational age and femur length/ foot length ratio is roughly 1 and a ratio of < 0.92 will be used in finding most cases of dysplasias.

Keywords: Foot Length, Femur length, Ratio, Gestational Age

INTRODUCTION

Accurate assessment of gestational age is pivotal in management of any obstetric case. Multiple anatomical parameters are used in the assessment of gestational age, which are foetal crown rump length, bi-parietal diameter, head circumference, abdominal circumference and femur length. However, in foetuses with anencephaly, hydrocephalus and short limb dysplasias, it is difficult to assess gestational age. Review of literature suggests that foetal foot has a characteristic pattern of normal growth and it is easily measured, so it can be used to estimate gestational age.¹ The assessment of the foetal femur/ foot length ratio can also be useful to differentiate foetuses having short limbs due to dysplasia, from short limbs because of constitutional factors or in utero growth retardation.² Mercer et al³ found that foetal foot length is a trustworthy parameter in assessment of gestational age. Platt et al⁴ also proved that the measurement of foetal foot length is a reliable tool and is related to the menstrual age of the foetus. Mhaskar et al⁵ also found that foot length is a reliable indicator of gestational age. The present prospective study is planned to relate gestational age

of fetus with sonographic estimation of the fetal foot length in pregnant ladies between 25-36 weeks of pregnancy and to know the fetal femur to foot length ratio, to exclude the dysplasias. The aim of this study was to find about fetal foot length assessment is trustworthy for gestational age and calculate the relationship between the foetal femur length and foot length.

MATERIAL AND METHODS

This study was carried out on one hundred normal singleton pregnant women attending the Department of Radio-Diagnosis and Imaging at A.M.C. Met Medical College and L.G. hospital, Maninagar, Ahmedabad for a routine antenatal ultrasound examination in September and October 2018 in a prospective manner. Study was carried out after ethical committee approval and informed consent was taken from participants.

The gestational ages of patients were between 25 weeks and 36 weeks, decided by last menstrual period of the lady. All these ladies had a sonography study at or before 14 weeks of gestation to decide the gestational age. Cases of oligohydramnios, polyhydramnios, IUGR and skeletal

dysplasias were excluded from the study. Ultrasound was performed on GE LOGIQ P5 machine using a 4 MHz curvilinear transducer. The foetal foot was calculated from skin edge lying over heel to the distal end of the longest toe, either 1st or 2nd toe, on plantar or sagittal views by electronic callipers (Fig 2).

The Femur diaphyseal length was calculated by measuring the ossified portions of diaphysis, and the femur length/ foot length ratios were calculated for each.

Statistical analysis

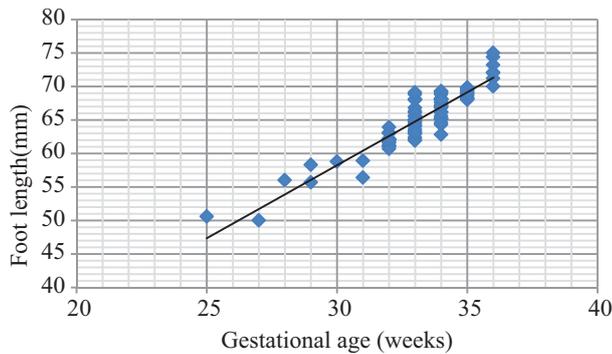


Figure-1: Relationship between foetal foot length (mm) and gestational age (weeks).
 $y = 2.1798x - 7.1563$

Results were analyzed using SPSS version 21.0 software (IBM). The foot length and femoral length were analyzed as the dependent variable paired with gestational age. Linear Pearson’s correlation and regression coefficient was calculated between gestational age and foot length as well as between gestational age and femur length. P value <0.05 was considered important. We also calculated femur length/ foot length ratio.

RESULTS

Simple linear regression analysis as per fig-1 shows linear relationship between foot length and gestational age [foot length (mm) = 2.180 x Gestational age (weeks)-7.156] with high degree of correlation (r=0.920 and P<0.001). We found a linear relationship between foot length and femur length [foot length (mm) =0.841xfemur length (mm) +9.972] with high degree of correlation (r=0.864 and P<0.001). Table 1 summarizes relationship of fetal foot length with gestational age and femur length. As shown in table-2 Femur/ Foot Length ratio was fairly constant throughout gestation.

DISCUSSION

Reliable assessment of gestational age is very vital in obstetrics. Gestational age can be measured from the first

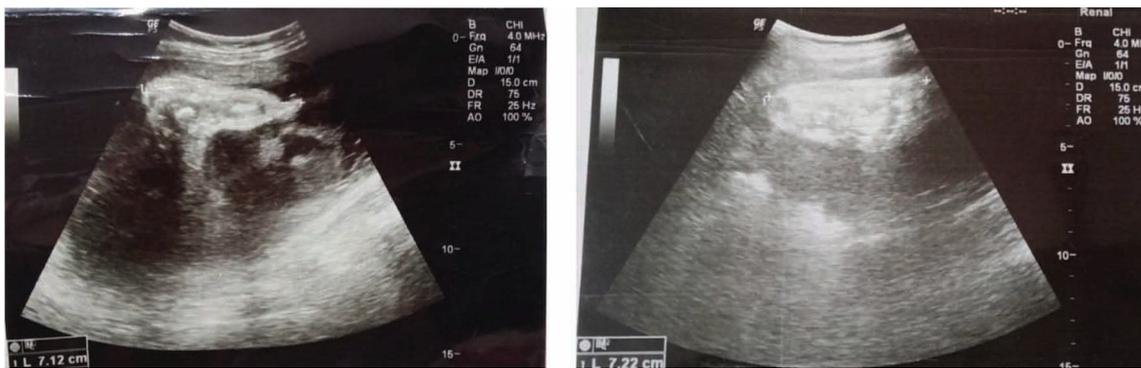


Figure-2: Foetal foot length measurements (Sagittal and plantar view at 32 and 33 weeks of gestation respectively)

y-axis	x-axis	Regression Formula	Correlation Coefficient	P value
Foot length	GA	2.180xGestational age (weeks)-7.156	0.920	P<0.001
	Femur length	0.841xfemur length (mm) +9.972	0.864	P<0.001

Table-1: Summary of relationship of foetal foot length and GA and Femur length

Gestational age	No. of foetuses	Femur length Mm (50th percentile)	Foot length mm (50th percentile)	Ratio of femur length to foot length
25	1	50	50	1
27	1	50	50	1
28	1	53	56	0.95
29	2	66	65	1
30	1	57	59	0.97
31	2	59	58	1
32	15	67	66	1
33	26	67	66	1
34	27	67	66	1
35	16	68	66	1
36	8	72	71	1

Table-2: Summary of Femur length and foot length ratio

day of last menstrual period and from the uterine height on assessment. If there is a discrepancy in LMP than there are chances of mistakes and in cases of more than one fetus in utero, oligo/polyhydramnios etc. In present era most of the gayness rely on sonography for accurate assessment of gestational age. Most of the foetal parameters change with gestational age.⁶ Many measurements are there to asses gestational age. MSD, CRL, BPD, HC, AC and FL are in general use based on the duration of gestational age. Normally, these parameters are adequate for results. However in cases of macrocephaly/ hydrocephalus/ anencephaly, BPD and HC cannot be used to assess GA. Similarly in short limb dwarfism, FL gives errors and similarly AC in IUGR. HC/ BPD cannot be accurately measured when there head engagement, there are problems even in normal pregnancy. So we have to find out alternatives. One such useful alternative is measuring foetal foot length. In our experience, foetal foot length measurement is relatively simple and can be easily performed in daily practice with good reliability. Shalev et al⁷ tested the reliability of sonographic measurement of the foetal foot with good results. Our study showed a linear relationship between foetal foot length and gestational age with significant correlation between these parameters, which was consistent with previous studies.^{3,4,5} Recent study by K.S. Joshi et al⁸ also endorsed our findings. By this study, we can use foetal foot length for assessment of gestational age; but only when other routine parameters are inconclusive. Meirowitz et al⁹ suggested limitations for the use of foetal foot length for gestational age assessment, particularly in foetuses with growth anomalies, the measurement of foot length is still useful in these circumstances to know femur/ foot length ratio which can be a helpful another parameter for further evaluation of these foetuses. Campbell et al² found the femur/foot length ratio to be approximately 1 throughout the gestation ages between 14-40 weeks and ratio will help differentiate foetuses with short limbs due to dysplasia, from short limbs because of constitutional factors or in utero growth retardation, if foetus is constitutionally small or there is symmetric IUGR, the ratio is greater than or equal to 0.9 and in most skeletal dysplasias in which there is limb shortening, the ratio is generally less than 0.9 due to hands and feet are spared.¹⁰ Johnson et al¹¹ found this ratio as a marker for identification of foetuses at increased risk for trisomy 21. Our observation showed femur/ foot length ratio of ≥ 0.9 in all cases, which was consistent with studies done by K.S. Joshi et al⁸ and Mukta Mital et al.¹² IUGR was ruled out by ultrasound/ MCA Doppler. Congenital anomalies were also ruled out by sonography. In this study fetuses with femur/ foot length ratio of ≥ 0.9 is probably due to constitutionally small fetuses as compared to Western population.

CONCLUSION

The study also showed linear relationship and good correlation between foot length and gestational age and Foot Length and Femur Length. Foetal foot length can thus be used as an alternative foetal parameter to assess gestational age is useful when other methods cannot assess gestational age like foetal hydrocephalus or anencephaly. Femur/ foot length

ratio of ≥ 0.9 can be told normal due to constitutionally small foetuses in our country provided mild IUGR is ruled out.

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