
Research Article

Radiological Evaluation of Fetal Femur Length for Assessment of Gestational Age

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Abstract:

Introduction: Femur length (FL) is a fetal biometric parameter used for estimation of gestational age. Gestational age determination by ultrasonography (USG) is very essential as it gives an accurate estimation.

Aim and Objectives: This study is an attempt to measure FL of the fetus for the prediction of gestational age in the IInd and IIIrd trimester of pregnancy by USG. **Materials and Methods:** Five hundred pregnant women in the IInd and IIIrd trimester with the single live fetus and having no other complications either in mother or fetus, were selected for the study. Fetal FL was measured, and results were analyzed for accuracy in estimation of gestational age and were compared with findings of other workers.

Observation and Results: Gestational age estimated from FL in 500 cases between 20 and 36 weeks of gestation showed that in the mean FL in each week of gestation the maximum difference of ± 0.7 mm was found in the IInd trimester and ± 2 mm was in the IIIrd trimester. The accuracy of the correctly diagnosed cases and *P* value decreases as pregnancy advance.

Conclusion: Sonographic examination was found to be effective to assess the accurate FL parameter for different weeks of gestation. FL was found to be more appropriate in predicting gestational age in the IInd trimester and its reliability decreases in the IIIrd trimester.

Keywords: Femur length, Gestational age, Ultrasonography.

Introduction

Morphometric analyses are performed to record the parameters of fetal anatomical features as well as to describe the developmental changes and are useful in planning appropriate care for the fetus, especially when dealing with growth restricted or large for date babies.^[1] Fetal femur length (FL) can be used in estimating gestational age and as a screening device for the detection of congenital anomalies. Articles have shown that ultrasonographic measurement of FL is not only an accurate indicator of gestational age but also it has a stronger correlation with gestational age.^[2-4] An average normal gestational age, which is the length of the pregnancy, is approximately 40 weeks, with a normal range of 38–42 weeks. Reliable estimation of gestational age is essential as it allows appropriate scheduling of a woman's antenatal care, informs obstetric management decisions and facilitates the correct interpretation of fetal growth assessment.^[5] Abnormal fetal growth patterns such as growth restriction or macrosomia may be missed or diagnosed incorrectly if gestational age is unknown or incorrect. The lack of accurate gestational age estimation means that preterm delivery and small-for-gestational-age rates are mere approximations in many parts of the world.^[6] In the IInd and IIIrd trimester of pregnancy, the fetus has grown sufficiently in size so that anatomic details are clearly identified, visualized, and measured. Optimal imaging can be difficult in

some clinical situations, such as in a late pregnancy abnormal lie when the head is deep in the maternal pelvis or maternal obesity.^[7]

Materials and Methods

The aim of the present study is to measure FL of the fetus for the prediction of gestational age in the IInd and IIIrd trimester of pregnancy by ultrasonography. The objectives of the present study are to study the role of USG for estimation of gestational age and to estimate the gestational age by USG measurement of FL. This study was carried out in the Department of Anatomy and in the Department of Radiodiagnosis, Vedanta Institute of Medical Sciences, Palghar Maharashtra, India. All the patients were referred from the Department of Obstetrics and Gynaecology. USG machine with Transducers (Convex, Linear, TVS), Ultrasonic jelly is required to conduct this study. The normal healthy 500 pregnant females with single and viable fetus, between 20 and 36 weeks of gestation attending the Ante Natal Clinic in the Department of Radiodiagnosis, Vedanta Institute of Medical Sciences, Palghar for routine checkup were taken as subjects. Twin pregnancy and Pregnancy complicated by medical disorders such as anemia, diabetes mellitus, etc. in mother and congenital disorders of the fetus were excluded from the study. Ultrasonographic examination comprised of recording the Femur Length. All examinations were performed by using

USG Machine employing a 3.5 MHz convex transducer [Figure 1].

Figure 1: USG machine with transducer



For the measurement of FL the transducer was placed at right angle to the fetal spine and passed down the fetus, maintain this angle to the caudal end because the distal femur was visualized. A clear image of the femur was obtained, the freeze frame was employed and with the help of multidirectional electronic calipers the FL was measured

Results

Table 1: Comparison of Femur Length Measurement with Western Nomogram

Weeks of Gestation	Number of Cases	Western Nomogram ^[8]	Mean Femur Length	Level of Significance p-Value
20	15	31	30.40	0.006 (Significant)
21	10	34	33.30	
22	6	36	36.66	
23	7	39	39.42	
24	15	42	42.60	0.012 (Significant)
25	19	44	44.84	
26	11	47	48.72	
27	22	49	49.59	
28	31	52	51.41	0.074 (Not Significant)
29	27	54	55.11	
30	29	56	56.65	
31	36	59	57.66	
32	35	61	60.60	0.0001 (Significant)
33	43	63	63.95	
34	60	65	66.16	
35	63	67	68.19	
36	71	68	70.00	
Mean	500	51	58.62	
Standard Deviation		11.96	11.39	

Table 1 shows the comparison of the present study values of FL measurement with Western Nomogram (chart formulated by Hadlock 1984). We noted the maximum difference of ±0.7 mm in the IIrd and ±2 mm in IIIrd trimester (the maximum difference of ±2 mm was found in 36 week). Statistical analysis was performed by using descriptive and inferential statistics using Pearson’s correlation coefficient, sensitivity and specificity and software used in the analysis were SPSS 22.0 version (SPSS Inc., IL, Chicago) and GraphPad Prism 6.0 version (GraphPad Software, CA 92037 USA) and $P < 0.05$ is considered as the level of significance.

[Figure 2].

Figure 2: Ultrasonographic measurement of Femur Length



After noting the FL the complete information was recorded in the proforma. Each parameter recorded was compared with its respective standard and analyzed statistically.

Discussion

In the present study, we have recorded FL of the fetus for assessment of gestational age. In the present study, the specificity of FL value from known gestational age ranging 20–23 weeks was found 65%, and correlation coefficient was found to be 0.994 and $P = 0.006$, which was statistically significant. From 24 to 27 weeks accuracy was 52% and the correlation coefficient was 0.988 and $P = 0.012$, which was statistically significant. From 28 to 31 weeks, accuracy was again 52% and the correlation coefficient was 0.927 and $P = 0.074$, which was

statistically insignificant. From 32 to 36 weeks accuracy was 24%, and the correlation coefficient was 0.995 and $P = 0.0001$, which was statistically significant. This study shows the accuracy of the correctly diagnosed cases and P value decreases as pregnancy advance. In the present study, the mean FL in each week of gestation was compared with the western nomogram Jeanty *et al.*^[8] in Table 1. The maximum difference of ± 0.7 mm was found in the IIrd trimester and ± 2 mm was in the IIIrd trimester. Hoeler and Quetel^[9] analyzed over 300 fetuses, and they reported the variability during this period to be higher and that is $\pm 3-3.5$ weeks. O'Brien and Queenan^[10] proposed a new method for the prediction of gestational age in early IIrd trimester by ultrasound measurement of FL. A growth curve of the calcified section of the femur was constructed which indicated that gestational age could be predicted with 95% confidence limits to ± 6 days. Hadlock *et al.*^[11] studied the relationship between FL and gestational age by using cross-sectional analysis of 338 normal fetuses between 12 and 40 weeks. The prediction of gestational age from FL showed variability of ± 9.5 days between 12 and 23 weeks. Beyond 23 weeks variability increased up to ± 22 days. Yeh *et al.*^[12] studied 145 uncomplicated gravid patients with 16-42 weeks of gestation. The result of the analysis showed the variability in the estimation of gestational age by FL, between 25 and 35 weeks of gestation was < 5 days. Beyond 35 weeks measurement of FL was less precise with more variability. The correlation coefficient of gestational age versus fetal FL was statistically greater than that of the gestation age versus fetal biparietal diameter. In another study of 900 fetuses by Honarvar and Allahyari^[13] there is a variability of ± 5 days during 23-40 weeks of gestation. Gupta *et al.*^[14] conducted a study on 512 cases and they found the variability of ± 8 days in the estimation of gestational age by using FL. In this study, the results are similar to above mentioned studies, where the accuracy of the correctly diagnosed cases and P value decreases as pregnancy advance.

Conclusion

The sonographic examination is found to be effective to assess the fetal well-being and growth. The specificity and sensitivity of FL were found to be more appropriate in predicting gestational age in the IIrd trimester, and its reliability decreases in the IIIrd trimester. Mean value of FL parameter was found to have minimum discrepancy for the prediction of gestational age.

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