ORIGINAL RESEARCH PAPER

Volume-8 | Issue-10 | October - 2019 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr

INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

FETAL GESTATIONAL AGE ESTIMATION BY FETAL FOOT LENGTH MEASUREMENT AND FETAL FEMUR TO FOOT LENGTH RATIO IN SOUTH INDIAN POPULATION - A PROSPECTIVE STUDY.

Medical Science

Dr. Lakshmi MDRD Postgraduate. Pes Institute Of Medical Sciences And Research.

Dr. Adil Shah* MDRD Postgraduate. Pes Institute Of Medical Sciences And Research.* Corresponding Author

Dr. Mallikarjunappa Professor. PES Institute Of Medical Sciences And Research

Dr. Hameed Arafat Asst Professor. PES Institute Of Medical Sciences And Research

Dr. Revathi Rb Sr Resident, PES Institute Of Medical Sciences And Research

Dr. Parimala Magaluri Sr Resident PES Institute Of Medical Sciences And Research

ABSTRACT

INTRODUCTION: Ultrasonography is being a painless, non-invasive, non-ionizing, portable, redoable and relatively inexpensive modality used to evaluate fetal growth parameter many times during pregnancy.

AIM: To assess relationship between sonographic gestational age and fetal FL and FL/FOOT LENGTH between 16 and 39 weeks of gestation and to compare its accuracy with other biometric parameters.

MATERIALS AND METHODS: Prospective cross sectional study was performed on 500 normal singleton pregnancies at second and third trimesters between 16-39 weeks. The study was conducted on a gray scale real-time ultrasound scanner using linear and sector transducers to measure the standard fetal biometrics and fetal fetal FL and FL/FOOT LENGTH at our department of radiology , PES institute of medical sciences whic is a rural medical college adjoining three states (Andhra Pradesh , Karnataka and Tamilnadu).

RESULTS: Biparietal diameter (BPD), Head circumference (HC), Abdominal circumference (AC), and Femur length (FL) and Fetal FL and FL/FOOT LENGTH were compared with standard charts and scatter graphs were plotted. Coefficient of correlation were calculated which were 0.9620, 0.8632, , 0.9853, 0.8648 for BPD, HC, AC, FL and FL/FOOT LENGTH respectively, proving them reliable indicators . FL measured in the present study was compared with standard nomogram. A statistically significant curvilinear correlation was found between the FL and GA indicating it to be a reliable indicator of GA. Significant coefficient of correlation (0. 0.920 4) was observed between FL and GA indicating it to be a reliable parameter.

CONCLUSION: The HL was most accurate parameter next to FL in assessing GA. The study also indicates that combination of BPD, HC, AC, FL, FL is more accurate in predicting GA than any single parameter, particularly in the third trimester of pregnancy.

KEYWORDS

Gestational Age=ga. Kidney Length=kl, Ultrasonographic=usg, Bpd=biparietal Diameter. Hc=head Circumference.ac=abdominal Circumference.fl=femur Length ,fl/foot Length

INTRODUCTION:

Ultrasonography is being a painless, non-invasive, non-ionizing,portable, redoable and relatively inexpensive modality[1,2]. Foetal biometry with the help of US scanning provides the most reliable and important information about the fetal growth and wellbeing. Accurate knowledge of gestational age (GA) of the foetus is vital for timing of appropriate obstetric care, scheduling ,interpretation of certain antepartum tests, determining the appropriateness of foetal growth and designing interventions to prevent preterm births, post-term births, and related morbidities. EDD is calculated by adding 7 days to the first day of the LMP and adding 9 months (Nagele Rule)[12].

Mean sac diameter measurements are not recommended for estimating the due date.

CRL are more accurate in the first trimester. It should be obtained in a true midsagittal plane, with the genital tubercle and foetal spine longitudinally in view and the maximum length from cranium to caudal rump measured as a straight line[9].

Nontraditional sonographic parameters for estimating GA are being studied like transverse cerebellar diameter, foot length, clavicular length, epiphyseal ossification centers (Goldstein Ipubmed.DOI10.10.16./0002-9378(88)90793-4) , amniotic fluid volume(DOI: 10.1046/j.1469-0705.2001.00264.x · Source: PubMed). Placental grading, (DOI: http://dx.doi.org/10.18203/2349-3933.ijam20175181) colonic echogenicity, (DOI: http://dx.doi.org/10.18203/2320-1770.ijrcog20161328). Some authors have found a strong correlation of fetal sacral length (Divya J Tekani www.medplus.in), hard palate width (Ultrasound in Obstetrics and Gynecology 24(1):35-41), length, and area with gestational age in 2nd and 3rd trimesters[11].

Second trimmester Biparietal diameter and Head circumference (measured in transverse section of the head at the level of the thalami and cavum septi pellucidi; the cerebellar hemispheres should not be visible in this scanning plane). The femur length (measured with full length of the bone perpendicular to the ultrasound beam, excluding the distal femoral epiphysis). The abdominal circumference (measured in symmetrical, transverse round section at the skin line, with visualization of the vertebrae and in a plane with visualization of the stomach, umbilical vein, and portal sinus)[8]. FT was taken as the longest distance from the most posterior point of the foot to the tip of the first or the second toe, whichever was longer.

Gestational age assessment by ultrasonography in the third trimester (28 > weeks of gestation and beyond) is the least reliable method, with an accuracy of ± 21-30 days. . (**Methods for estimating the due date. Committee Opinion No. 700. American College of Obstetricians and Gynecologists. Obstet Gynecol. 2017;129:e150- 4).** FL, Humerus (HL), Tibia and Ulna were used in combination to allow of good estimation of GA that may be useful when the BPD measurement may be unreliable, unobtainable or abnormal however the femur and Humerus length are preferred over other long bones as a means of predicting menstrual age.(Methods for estimating the due date. Committee Opinion No. 700. American College of Obstetricians and Gynecologists. Obstet Gynecol. 2017;129:e150- 4).

Study of literature reveals that fetal foot has a characteristic pattern of normal growth and the fetal foot could be used to estimate gestational age[6]. The evaluation of the fetal femur/ foot length ratio can also be a useful parameter to differentiate fetuses that have dysplastic limb reduction, from those whose limbs are short because of constitutional factors/IUGR[3].

The present prospective study was designed to correlate the fetal gestational age by ultrasonic measurement of the fetal foot length in pregnant Indian women between 16-39 weeks of pregnancy and to evaluate the fetal femur to foot length ratio. to rule out the possibility of dysplastic anomalies.

The present study aims to study whether FL/FOOT LENGTH measurements can be used to reliably estimate the gestational age and to calculate the relationship between the fetal femur length and foot length.

MATERIALS AND METHODS:

Our prospective study has been done in the Department of Radio-Diagnosis, PES Institute of Medical Sciences and Research Kuppam. Andhra Pradesh. India, with voluson 730 , from jan 2019 to july 2019, no= 500 ANC's, using FL/FOOT LENGTH to estimate GA between 16 to 39 weeks of normal singleton pregnancies and to compare FL/FOOT LENGTH with routine parameters BPD, HC, AC and FL. The Femur diaphyseal length was calculated by measuring the ossified portions of diaphysis, and the femur length/ foot length ratios were calculated for each.

Inclusion criteria - Healthy women who were certain of their LMP and had prior regular menstrual cycles with uncomplicated pregnancy between 16 to 39 weeks of gestation were selected for the study.

Exclusion criteria- Unknown or inaccurate date of last menstrual period. Before 16 weeks of gestational age. Oligohydramnios. Polyhydramnios. Diabetic mother. Pregnancy induced hypertension. Pre-eclampsia.multiple gestations.

Each parameter was obtained as described in standard texts as descnibed below, compared with its respective standard chart. The graph was plotted between GA and individual parameters and the accuracy of each parameter evaluated and compared amongst each other. For a given gestational age, predicted values of Femur length was obtained for the 5 th, 10th, 25th, 50th, 75th and 90th percentiles to develop a nomogram. Correlation of foetal Femur length with BPD, HC, AC and foot length was also determined by using linear regression analysis. P value of less than 0.05 was considered as significant.

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.

RESULTS:

Age-wise details are <20 years n=92 (18.4%), 21-25 years n=91 (19.4%) 26-30 years n=97 (27.2%), 31-35 years n=136 (27.2%), and >36 years n=84 (16.8**%),** shows 27 % of our pts were between 31-35 weeks followed by 19.4% between 26-30 weeks of gestation.
Gravid wise details are GR 1 N=2059 (41%), Gr 2 n=176 (35.2%), Gr 3 n=86 (17.2%) and Gr n=33 (6.6%).

Table.1.The relationship between the fetal mean foot length and mean femur length and percentage.

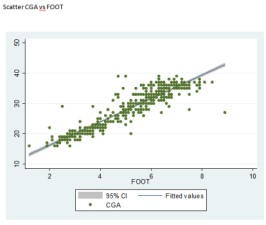
Menstrual age	PERCENTAGE %	No. of fetuses	Mean Femur length Mm	Mean Foot length mm	Ratio of femur length to foot length
16 weeks	0.6%	3	2.46	2.4	1.025
17 weeks	1.6%	8	2.1	2.48	0.86
18 weeks	2%	10	2.7	2.7	1.00
19 weeks	6.4%	32	3.7	2.85	1.32
20 weeks	7.2%	36	3.3	3.2	1.06
21 weeks	4.8%	24	3.5	3.4	1.02
22 weeks	4.6%	23	3.7	3.7	1.00
23 weeks	3%	15	4.2	4.1	1.02
24 weeks	3.4%	17	4.3	4.4	0.98
25weeks	2.4%	12	4.5	4.4	1.01
26weeks	2.4%	12	4.8	4.7	1.01
27 weeks	3%	15	5.0	5.3	0.94
28 weeks	5%	25	5.3	5.4	0.98
29 weeks	3%%	15	5.5	5.0	1.09
30 weeks	6%	30	5.7	5.6	1.02
31 weeks	4.4%	22	6.1	6.0	1.01
32weeks	4.6%	23	6.2	6.2	1.00
33weeks	7%	35	6.4	6.1	1.04
34WEEK	3.4%	17	6.6	6.5	1.00
35WEEK	7.8%	39	6.8	6.7	1.01
36WEEK	9.2%	46	7.1	6.9	1.02
37WEEK	5%%	25	7.2	7.0	1.02
38WEEK	1.8%	9	7.5	7.3	1.03
39WEEK	1.4%	7	7.5	6.7	1.11

The relationship between the fetal foot length, the gestational age and fetal femur length to fetal foot lemgth ratio was calculated and the ratio is found to be to or more than 0.94 throught the gestational age.

Table.2. Summary of relationship of foetal foot length and GA and Femur length.

Y axis	X axis	Regression formula	Correlation coefficient	P value
Foot length	GA	2.180xGestational age (weeks)-7.156	0.920	P<0.001
Foot length	Femur length	0.841xfemur length (mm) +9.972	0.864	P<0.001

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=0.9202and P<0.001) and 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).



DISCUSSION:

Gestational age has traditionally been estimated from the 1st day of the last menstrual period (LMP) using Naegle's rule. Doubilet who noted that the accuracy of these traditional predictors ie GS, CRL, BPD, HC, AC and FL, decreases as the pregnancy advances to third trimester. Benson CB, Doubilet PM. (Sonographic prediction of gestational age: accuracy of second- and third- trimester fetal measurement. Am J Roentgenol. 1991;157(6):1275–7). Therefore suggested that in addition to these traditional parameters, ancillary biometric and non biometric measurements can help to narrow the biological variability between fetuses.(Gottlieb AG, Galan HL. (Nontraditional sonographic pearls in estimating gestational age. Semin Perinatal. 2008; 32(2):154–6).

CRL, BPD, HC, AC and FL are commonly used to assess the GA. BPD is not a reliable indicator in macrocephaly/ hydrocephalus/ anencephaly similarly HC & AC in CDH. Similarly in short limb dwarfism, FL in dysplaseas and similarly AC in IUGR.

.Streeter,(Weight, sitting height, head size, foot length and menstrual age of the human embryo. Contrib embryo Cornegie Inst 1920; 11:143-170.) showed that the fetal foot has a characteristic pattern of normal growth. He proposed that the fetal foot could be used to estimate the gestational age.[1] Mercer et al, (Am J Obstet Gynecol 1987; 156 (2):350-5). found that the fetal foot length is a reliable parameter for use in assessment of gestational age and is particularly useful when other parameters do not accurately predict gestational age, like in hydrocephalus, anencephaly, short limb dysplasia. They reported a strong correlation between foot length and gestational age with an R^2 value of 0.981.[3] Other authors have also reported similar results.

The femur length to foot length ratio i.e. ratio of the ossified femur length to foot length on the plantar view has been studied by several authors.

The ossified femur length is almost equal to the foot length throughout the gestational age. Ratio >0.85, as the cut off valve [3].
Meirowitz et al[7] have reported foot length is approximately equal to

femur length throughout the gestation and the ratio can be used to detect most skeletal dysplasias.

Useful alternative is measuring foetal foot length.

Foetal foot length measurement is relatively simple and can be easily performed in daily practice with good reliability.

Shalev et al[4], , Campbell et al[3], Meirowitz et al[7], Mukta Mital[10] and **K S Joshi et al[5]** study findings correlates with our study.

CONCLUSION:

Our study 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.

We are grateful to our pts, management and Mr.Janakiraman-Biostatician and kum-Manasa and smt-Sunitha for the help in preparing the manuscript.

Funding: No funding sources, Conflict of interest: None, declared Ethical approval: The study was approved by the Institutional Ethics Committee.

REFERENCES:

1. Beazley JM, Underhill RA. Fallacy of the fundal height. Br Med J 1970;4:404-6.
2. Andersen HF, Johnson TR Jr, Barclay ML, Flora JD Jr. Gestational age assessment. I. analysis of individual clinical observations. Am J Obstet Gynecol 1981;139:173-7.
3. Campbell J, Henderson A, Campbell S. The foetal femur/ foot length ratio: A new parameter to assess dysplastic limb reduction. Obstetrics and Gynecology 1988; 72 (2): 181-4.
4. Shalev E, Wener E, Zuckerman H, Megory E. Reliability of sonographic measurement of the fetal foot. J Ultrasound Med 1989;8(5):259-262.
5. K S Joshi, B Marahatta,et al. Fetal Foot Length and Femur/ Foot Length Ratio: Significance in Nepalese Context. Nepalese journal of Radiolgy 2011;1(1): 15- 22.
6. Streeter GL. Weight, sitting height, head size, foot length and menstrual age of the human embryo. Contrib embryo Cornegie Inst 1920; 11(3):143-170.
7. Meirowitz NB, Ananth CV, Smulian JC et al. Foot length in fetuses with abnormal growth. J Ultrasound Med 2000;19(3):201-205
8. Verburg BO, Steegers EA, Ridder M, Snijders RJ, Smith E, Hofman A. New charts for ultrasound dating of pregnancy and assessment of fetal growth: longitudinal data from a population-based cohort study. Ultrasound Obstet Gynecol. 2008;31:388-96.
9 Tahmasebpour AR, Pirjani R, Rahimi-Foroushani A, et al Normal ranges for fetal femur and humerus diaphysis length during the second trimester in an Iranian population. J Ultrasound Medicine. 2012;31(7):991-5.
10. Mukta Mital, Prashant Gupta et al. Fetal gestational age estimation by fetal foot length measurement and fetal femur to foot length ratio in indian population - a prospective study. J of Evolution of Med and Dent Sci 2014; 3(10): 2621-2625
11. Paramila SVV, Shukla AK. Ultrasonographic estimation of foetal gestational age by humerus length and its comparison with femur length. J. Evid. Based Med. Healthc. 2016;3(74);4040-4.
12. Gaharwar A, Tiwari V. Correlation between Crown Rump Length of Fetus and Gestational Age in First Trimester of Pregnancy in North Indian Population. Int J Med Res Prof. 2019 May;5(3):102-4.