

Relationship between Ultrasound guided Fetal Foot length and Gestational age in the Ultrasound Department of Raja Rajeswari Medical College and Hospital- A Prospective study

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Abstract

Introduction: Appropriate assessment of Gestational age (GA) is crucial for evaluation of fetal growth. Ultrasound is the gold standard for estimation of gestational age. Multiple parameters are in use for the estimation of GA, but literature suggests that fetal foot length can be used to estimate gestational age, when other parameters are not available for measurement. This study is undertaken to assess the relationship between fetal foot length and gestational age.

Objective: To assess relationship between fetal foot length and gestational age.

Proposed Methodology: Study was conducted in Ultrasound Department of Raja Rajeswari Medical College and Hospital for a duration of 2 months (September 1st 2022 to October 31st 2022).

Inclusion criteria: Healthy pregnant women and fetuses verified by clinical and US scanning
GA verified clinically and by (LMP) of 18-36 weeks.

Singleton fetus.

Exclusion criteria: Those who were not willing to provide informed consent.

Study was conducted on 77 antenatal mothers. After Ethical committee approval informed consent was taken from the subjects prior to Ultra sound examination.

Keywords: Correlation, Fetal foot length, fetal growth, fetal parameters, Gestational age, Ultrasound.

Introduction

Estimation of gestational age (GA) is essential for the evaluation of fetal growth and to detect any anticipated problems like intra uterine growth retardation¹ and especially preterm births². GA can be estimated using the first day of the last menstrual period (LMP) and ultrasonography.³ Though LMP is a common method to assess GA, it cannot be used in case of irregular menstrual cycles³. In a country like India where female illiteracy is high, information on LMP may not be readily available with most of the women⁴. In such

cases, Ultrasound (US) examination is considered to be a gold standard for estimation of Gestational age³.

Ultrasound is a non-invasive procedure which can be done as a part of routine antenatal care. Various fetal biometric parameters that are measured routinely through US examination are gestational sac mean diameter, crown rump length, femur length (FL), biparietal diameter (BPD) and abdominal circumference (AC) and Fetal Foot length (FL)¹. BPD, AC, FL may underestimate or overestimate the Gestational age in case of any fetal anomalies⁵.

In 1920, Streeter had shown that fetal foot has a characteristic pattern of normal growth and proposed that the fetal foot could be used to estimate gestational age⁶. In 1988, Campbell et al⁷. differentiated fetuses having dysplastic limb from those whose limbs are short using FL/FFL ratio. In 1984, Warren M Hern et al.⁸ showed linear relationship between foot length and knee-to-heel length, biparietal diameter, fetal weight and placental weight. In 1987, Mercer et al.⁹ too in his study reported fetal foot length as a reliable parameter for the estimation of gestational age.

Objectives

To assess relationship between fetal foot length and gestational age.

Methods

This study was conducted in Ultrasound Department of Raja Rajeswari Medical College and Hospital for a duration of 2 months (September 1st 2022 to October 31st 2022).

Study Design and Subjects

A Prospective Study was conducted in the ultrasound department of Raja Rajeswari Medical College and Hospital after Ethical committee approval. Healthy pregnant women and fetuses verified by clinical and US

scanning, GA verified clinically and by (LMP) of 18-36 weeks and with singleton fetuses were included in the study. Total 77 subjects were included in the study based on the inclusion and exclusion criteria. Informed consent was obtained from all the subjects. Patients general condition was examined. Vitals were checked. Demographic details were collected by interview method and Obstetric ultrasound examination was done by a single radiologist. Along with routine fetal biometry of BPD, HC, FL, and AC, each fetal foot length was measured and the average of the two was considered.

Fetal foot length was measured from the skin edge overlying the calcaneus to the skin overlying the distal end of the longest toe (the first or second toe) on either the plantar or the sagittal view. (Fig. 1)

Healthy pregnant women clinically and Gestational age confirmation clinically were certified by the Obstetrician and healthy fetuses clinically were certified by the pediatricians.

Ethical statement

Ethical approval for the study was sought and obtained from the health research and ethics committee of Raja Rajeswari Medical College and Hospital. The data obtained was treated with utmost confidentiality.

Statistical Analysis

Data collected was entered in to Microsoft excel spread sheet and analyzed using statistical package for social science version 23.0. Continuous quantitative data like age, fetal foot length and gestational age was presented using mean and standard deviation. Categorical data was presented using frequency and percentages. Correlation between fetal foot length and gestational age was done using Pearson's Correlation test. The level of statistical significance was set at 5%, p value < 0.05.

Figure 1: Measurement of fetal foot length



Results

Total 77 subjects were included in the study. Age of the mothers ranged from 20-34 years and mean age in the study was 27.4±5.2 years. The gestational age ranged from 18-36 weeks and the mean gestational age in the study was 27.1±4.8.

Mean foot length in the study was 53.0±12.9 mm. Minimum and maximum foot length in the study was 33 and 74 mm respectively.

Table 1: Age distribution among mothers

Age in years	Frequency (%)
20-24	28 (36.4)
25-29	30 (39.0)
30-34	19 (24.6)
Mean age	27.4±5.2

Table 2: Correlation between Fetal Foot length and Gestational age

Correlation between Fetal Foot length and Gestational age	
R value	0.948926
P value	<0.00001*

Graph 1: Scatter plot showing correlation between Fetal Foot length and Gestational age

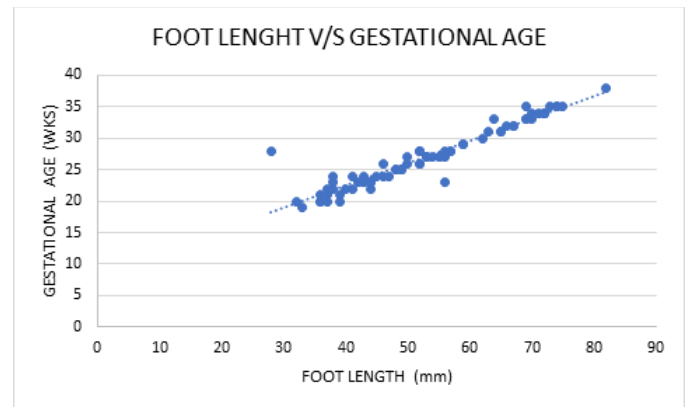


Table 3: Mean foot length according to Gestational age

GA in weeks	n (%)	Mean FFL (mm)
19	1 (1.3)	33.0
20	5 (6.5)	36.0
21	3 (3.9)	37.3
22	5 (6.5)	40.0
23	8 (10.4)	44.1
24	6 (7.8)	43.3
25	5 (6.5)	48.6
26	4 (5.0)	50.0
27	8 (10.4)	53.6
28	7 (9.0)	50.6
29	2 (2.6)	59.0
30	1 (1.3)	62.0
31	3 (3.9)	64.3
32	3 (3.9)	66.6
33	4 (5.0)	68.0
34	6 (7.5)	71.5
35	5 (6.5)	73.0
38	1 (1.3)	82.0

Among 77 subjects, majority i.e., 30 (39%) belonged to 25-29 years age group (Table-1). Strong positive correlation was found between fetal foot length and gestational age (R=0.948926, P<0.00001) as shown in

table-2 and Graph-1. There was an increasing trend in the foot length with increasing gestational age (Table-3).

Discussion

Knowledge on gestational age is essential to assess fetal growth. The traditional method is by applying Naegle's rule. But it has certain limitations like failure to recall and irregular menstrual cycles. Hence for accurate measurement of gestational age ultrasound examination is the preferred method. US examination is performed for routine antenatal care. Parameters like gestational sac diameter, CRL, BPD, HC, AC, FL are measured routinely to estimate gestational age. But all these parameters have limitations like cranial malformations affecting BPD, Abdominal pathologies affecting AC, limb dysplasia affecting FL^{10,11}. Hence in this study fetal foot length was measured along with routine parameters to find its relationship with gestational age. A strong positive correlation was observed between fetal foot length and gestational age ($R=0.948926$, $P<0.00001$).

Since Streeter's study in 1920, which proposed foot length for estimating gestational age, many studies^{12, 13, 14} since then have shown a positive correlation between foot length and gestational age. But the value of coefficient was different for different studies. In a study by Tenali et al.,¹² and Singh et al.,¹⁴ coefficient was 93% whereas in a study by Rakkappan et al.,¹³ it was 65%.

In a study conducted by Mittal et al.,¹⁵ among normal singleton pregnant women of 16-37 weeks gestation, linear relationship between foot length and gestational age was present with a R^2 value of 0.90 ($p < 0.001$). In a study conducted by Hemraj et al.,¹⁶ among pregnant women of 18-39 weeks gestation, strong positive correlation was found between foot length and gestational age was present with a R^2 value of 0.99 ($p < 0.00001$). Pandey et al.,¹⁷ in their study among pregnant

women of 15-36 weeks gestation revealed a strong positive correlation between foot length and gestational age with a R^2 value of 0.96 ($p < 0.0001$).

Several other studies like Joshi et al.,¹⁸, Majumdar et al.,¹⁹, Gavhane et al.,²⁰ showed positive correlation between fetal foot length and gestational age with R^2 value of >0.9 and $P<0.001$.

Limitations

In this study correlation of foot length with other fetal parameters was not considered.

Conclusion

A strong positive correlation was found between fetal foot length and gestational age. Fetal foot length can be used for the accurate estimation of gestational through routine antenatal ultrasound examination.

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