FETAL FOOT LENGTH - A NEW PARAMETER FOR ASSESSMENT OF GESTATIONAL AGE AND ITS COMPARISON WITH CONVENTIONAL PARAMETERS OF GESTATIONAL AGE BY ULTRASONOGRAPHY

SINGH V. K. ● ROHATGI P. ● NAWANI M. ● GUPTA U.

SUMMARY

Ultrasonographic measurement of fetal foot length was correlated with the gestational age. We evaluated one hundred patients with known L. M. P. and normal singleton pregnancy between 28 - 40 weeks gestation. All patients had ultrasonographic measurement of fetal foot length, biparietal diameter, head circumference, abdominal circumference and femur length. Comparison of curvilinear regression foot length versus gestational age demonstrated a strong correlation with one R^2 value of 92.5% which is higher than other parameters (R^2 value for BPD = 45.1%, HC = 80.1% AC = 82.5% Femur length - 84.1%). Ultrasonographic foot length correlated well with post partum measurements made within three days of delivery. Measurement of fetal foot length is of particular use when other parameters donot accurately predict gestational age e.g. hydrocephalus, anencephaly, short limb dysplasia. It can also be used in conjunction with biparietal diameter and femur length in the management of patients with premature labour in accurately predicting gestational age.

INTRODUCTION

With the development of obstetrical ultrasound as an adjunct to antenatal assessment many parameters have been studied in attempts to assess gestational age. However, no parameter to date has been found which would accurately predict gestational age.

This study was undertaken to correlate ultrasonographic foot length with gestational age and to compare the gestational age determined by foot length with that determined by other parameters that are commonly measured in an antepartum examination (BPD, HC, AC, FL).

Dept. of Obst. & Gyn. G. S. V. M. Medical College, Kanpur.

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MATERIAL AND METHODS

A total of hundred cases in the age group 18-35 years were studied between 28-40 weeks of gestation. All were very sure of their L M P and had H/o regular menstrual cycle prior to conception, general examination was done in order to exclude medical disorders of pregnancy.

On P/A examination - Fundal height (height of fundus above symphysis pubis) and abdominal girth at the level of umbilicus were noted. After doing routine investigation, Ultrasound examination was done on the same day in private clinics. On post partum examination foot length was measured within 3 days of delivery using a ruler in 40% cases. On Ultrasound examination - BPD, HC, AC and FL were measured using standard methodology. Foot was best assessed by identifying the tibia and moving the transducer approx. 40°, Caliper measurements were taken from heel to tip of great toe. age prediction was done from 'Normal Growth Curve' given by Mhasker et al (1989) on Indian population (in AIIMS). Both longitudinal and planter view measurements were taken where possible.

KNOWN (STANDARD) MENSTRUAL AGE

In all cases taken up for this study, patients were very sure of the date of their last menstrual period (LMP). The gestational age calculated from the L.M.P. on the day of examination with ultrasound was taken as known or standard menstrual age.

A Special Case History

This patient came to us at known menstrual age of 30 weeks 5 days (from L.M.P.). On clinical examination the fundal height was only 20 weeks. Ultrasound assessment demonstrated a biparietal diameter (72 mm) corresponding to gestational age of 29 weeks ± 2 weeks. However, the femur length of 27 mm was appropriate for only 17.5 weeks gestation. Foot length measurement of 48 mm corresponding to (29 weeks) confirmed the BPD age estimates and suggested a presumptive diagnosis of short limb dysplasia which was confirmed later at birth.

OBSERVATION

Table I

Distribution of cases according to known menstrual age (in weeks)

Sl. No.	Known menstrual age (in weeks)	No. of cases	Percentage
1.	28 - 30	8	8
2.	30 - 32	22	22
3.	32 - 34	23	23
4.	34 - 36	16	16
5.	36 - 40	15	15

The majority of patients (45%) were between 30 - 34 weeks of gestation. Only 15% cases had a gestation period of more than 38 weeks. The average gestation age from known L. M. P. was 34.4 weeks.

Table II

Showing distribution of 'FETAL FOOT LENGTH' measurement (in mm)

Sl. No.	Foot length (in mm)	Gestational age (in weeks) Corresponding to 'FOL' measurement (from 'FL' 'NOMOGRAM)	No. of cases	Percentage
1.	45 - 50	27.4 - 29.7	10	10
2.	50 - 55	29.7 - 32.2	18	18
3.	55 - 60	32.2 - 34.4	30	30
4.	60 - 65	34.4 - 36.7	22	22
5.	65 - 70	36.7 - 39.1	15	15
6.	70 - 75	39.1 - 41.5	5	5
	Total		100	100

In majority of cases (30%) the foot length values were between 55 - 60 mm, corresponding to period of gestation ranging from 32.2 weeeks to 34.4 weeks.

BEST FITTING REGRESSION MODEL FOR FOOT LENGTH (BASED ON POLYNOMINAL FITS) was calculated

$Y = 1.85 + 0.649X - 0.00159X^2$

Where Y = Gestational Age

X = Foot Length

Coefficient of determination (R^2) = 92.5% suggestion that foot length is a reliable indicator of gestation age.

Table III

Showing best fitting regresion model for various parameters

Sl. No.	Dependent variable	Independent variable	Regression Coefficient a	b	c	R^2
1.	BPD	Gestational age	58.5	- 1.06	0.00927	75.1%
2.	HC	- do -	- 18.9	0.223	- 0.000152	80.1%
3.	AC	- do -	- 11.2	0.0637	0.000061	85.5%
4.	Femur Length	- do -	37.1	- 0.519	0.00724	84.1%
5.	Foot Length	- do -	1.85	0.0649	- 0.00159	92.5%

The regression equation is $Y = a + bx + cx$

This suggests that the fetal foot length improves the accuracy of gestation age assessment.

Table IV

Showing distribution of error of period of gestation (in weeks) between 'FOOT LENGTH' (FOL) age and 'known' menstrual age (in week)

Sl. No.	Error of Gestational age (in weeks)	No. of cases		Percentage
1.	0 - 0.5	38	38	81%
2.	0.5 - 1.0	43	43	
3.	1.0 - 1.5	7	7	
4.	1.5 - 2.0	12	12	
	Total	100	100	

In majority of cases (81%). The error between 'foot length' age and 'known' menstrual age was within one week. The range of error was 0 - 2 weeks. Maximum error being of 2 weeks in 10% cases.

Table V

The error in predicting gestational age with various ultrasonographic measurement

Parameters	Max. Error	Mean Error	S. D.
BPD	4.4 week	1.0 week	1.81
HC	3.9 week	0.8 week	1.32
AC	3.7 week	0.9 week	1.15
FL	3.8 week	0.8 week	1.14
Foot Length	2.0 week	0.6 week	0.43

Table VI

Showing comparison of gestational age derived from 'FOOT LENGTH' in various studies

Range of foot Length Measurements (mm) in Present study	Corresponding Period of Gestation (POG) Streeter et al (1920)	Mercer et al (1987)	Mhasker et al (1989)
47 - 72 mm	24.6 - 35.3	25.0 - 35.3	28.2 - 40.0

This table shows that for same foot length measurements the corresponding period of gestation was higher in Indian population (Mhasker et al, 1989). Thus foot length measurements are smaller than that observed in Western population for corresponding period of gestation and this could be average lower birth weight of Indian babies.

- Scatter plot of foot length versus gestational age showed that curvilinear correlationship is most appropriate for these two variable in the present study.

CONCLUSIONS

1. Ultrasonographic measurement of foot length is a reliable indicator of gestational age.
2. Ultrasonographic foot length correlated well with post partum foot length measurements made within 3 days of delivery.
3. Measurement of fetal foot length is of particular use when other parameters do not accurately predict gestational age, e.g. hydrocephalus, anencephaly, short limb dysplasia.
4. It can also be used in conjunction with BPD and femur length in the management of patients with premature labour in order to accurately predict gestational age.

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