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SONOGRAPHIC FOOT LENGTH MEASUREMENT AS A PARAMETER FOR GESTATIONAL AGE ESTIMATION

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ABSTRACT:

INTRODUCTION: Fetal biometry is the measurement of the fetus and various segments of the fetal anatomy. In second and third trimesters, sonologist use four main anatomic parameters; biparietal diameter 13 - 40 weeks of gestational age, femur length 24 - 40 weeks of gestational age, head circumference and abdominal circumference, the traditional biometric parameters have some limitations; conditions affecting shape of skull like a cranial malformations will affect biparietal diameter (BPD) and head circumference (HC), abdominal conditions (hydrops, severe growth restriction) affect abdominal circumference (AC) and femur length (FL) measurements may be difficult to obtain in deeply engaged breech or may be abnormal in limb dysplasia. **AIM:** To evaluate the role of fetal foot length as a biometric parameter in estimation of gestational age along with conventional parameters biparietal diameter, femur length, abdominal circumference in normal singleton pregnancy and to establish the degree of correlation of fetal foot length with conventional parameter - femur length. **MATERIALS AND METHODS:** Data: Department of Radiodiagnosis in a tertiary care centre. Type of study: Observational prospective study. Study Duration: 18 months. (Dec-2022 to June2024). Sample size: 341. Statistical Analysis: Done by SPSS Package version 17. The continuous variable Footlength, GA by Foot length with respect to Age distribution is done by Analysis of Variance. **RESULTS:** Among the study population (341), We observed that there was a statistically significant strong positive correlation between gestational age and femur length, abdominal circumference, biparietal diameter which are considered conventional fetal biometry parameters. **CONCLUSION:** The results showed foot length has a strong correlation with conventional parameters like, AC (Abdominal Circumference) , BPD (Biparietal Diameter) and FL (Femur Length) Throughout the gestational ages of 15 to 40 weeks, the foot length: femur length ratio remained near constant during gestational ages (min 1.04 – max 1.25).

KEY WORDS: Correlation, Fetal biometry, gestational age, Obstetric ultrasound.

INTRODUCTION:

Fetal biometry is the measurement of the fetus and various segments of the fetal anatomy[1-3]. In second and third trimesters, sonologist use four main anatomic parameters; biparietal diameter 13 - 40 weeks of gestational age, femur length 24 - 40 weeks of gestational age, head circumference and abdominal circumference, the traditional biometric parameters have some limitations; conditions affecting shape of skull like a cranial malformations will affect biparietal diameter (BPD) and head circumference (HC), abdominal conditions (hydrops, severe growth restriction) affect abdominal circumference (AC) and femur length (FL) measurements may be difficult to obtain in deeply engaged breech or may be abnormal in limb dysplasia.[4-7]

In these situations, we need to use other parameters for more estimation of gestational age [8]. The fetal foot length can be useful parameter because it is easy to assess and measure. Hence, the present study was conducted to describe the role of ultrasound measurements of the foot in determining gestational age.

AIMS AND OBJECTIVES OF THE STUDY:

- To evaluate the role of fetal foot length as a biometric parameter in estimation of gestational age along with conventional parameters biparietal diameter, femur length, abdominal circumference in normal singleton pregnancy.
- To establish the degree of correlation of fetal foot length with conventional parameter - femur length.

MATERIALS AND METHODS:

- **Type of study:** Observational prospective study.
- **Institution**: Department of Radiodiagnosis in the tertiary care centre.
- **Duration of study:** 18 months. From Dec-2022 to June2024
- **Sample size**: 341
- **Data entry:** MS EXCEL.
- **Statistical Analysis:** Done by SPSS Package version 17. The continuous variable Footlength, GA by Foot length with respect to Age distribution is done by Analysis of Variance

Inclusion Criteria:

Pregnant women of gestational age 15-40 weeks attending antenatal outpatient department and inpatient department in normal live singleton pregnancy.

Exclusion Criteria:

1)Irregular menstrual cycle.

2) Uncertain date of last menstrual period.

3)Multiple pregnancies

4)Pregnant women with known complications of pregnancy like oligohydramnios, polyhydramnios, diabetes, hypertension, pre-eclampsia.

5) Recent use of contraceptives- within 3 months of time of conception.

6) Fetuses with foot anomalies were excluded from the study such as absence of foot, clubfeet, rocker-bottom foot: congenital vertical talus, polydactyly, syndactyly, and ectrodactyly.

7)Women with pregnancies complicated by any medical, surgical or obstetric disorders.

Ethical clearance:

- ✓ This study obtained ethical approval from the Institutional ethical committee.

Materials and Techniques:

Detailed menstrual history, h/o recent contraceptives use, previous obstetric, past medical & surgical history was taken. Patients general condition was examined. All routine investigations were done as a part of antenatal examination. Ultrasound examination was done strictly as per the PCPNDT protocol. Obstetric ultrasound examination using PHILIPS AFFINITI 70 G ULTRASOUND EQIUPMENT using Curvilinear probe of 3- 5 MHz using Obstetrics protocol was done in patients included in study and documented. The gestational age was calculated from the approximated values of conventional parameters (BPD, FL and AC).

OBSERVATION AND RESULTS:

Table 1: Mean calculation of parameters- Foot Length, femur length, biparietal diameter and abdominal circumference for each gestational age

Gestational Age	N	Mean Femur length	Mean abdominal circumference	Mean BPD	Mean Foot Length
15wk	2	18.5±0.70	97±2.82	32±1.41	18.5±2.12
16wk	9	19±1.87	97±4.69	32.77±1.98	23.77±1.98
17wk	12	22.66±1.23	112±6.96	37.08±1.42	27.41±1.97
18wk	12	25.5±1.38	120±5.96	39.58±2.15	30.75±2.30
19wk	5	28.6±1.81	131.8±5.84	42.8±1.30	32.2±2.04
20wk	21	31.19±1.50	142.86±3.36	45.95±1.28	35.23±2.44
21wk	10	35.22±2.38	157.22±6.47	49.1±2.18	37.2±1.54
22wk	28	36.85±1.70	165.14±6.42	52.28±2.69	39.21±2.68
23wk	23	39.4±1.39	173.34±6.19	55.17±1.58	43.08±3.52
24wk	18	41.94±1.92	184.38±4.87	58.72±2.39	44.77±2.71
25wk	9	43.55±2.92	185.55±3.24	62.44±0.88	47.88±1.61
26wk	9	46.77±1.09	201.88±6.09	64.11±1.69	49.66±2.78
27wk	16	50.6±1.24	214.81±5.99	67.25±1.65	53±2.12
28wk	14	51.64±1.97	225.14±6.35	70.14±0.86	55.5±2.10
29wk	5	54.6±1.14	235.2±4.97	73±0.70	58.4±1.94
30wk	12	56.45±1.03	241.90±9.87	75.18±0.98	61.5±1.31
31wk	11	56.18±4.33	240.72±2.19	77.90±1.04	63±1.61
32wk	17	59.70±1.40	261±5.96	79.58±1.32	65.52±1.62
33wk	19	62.26±0.87	270.63±3.12	82±0.63	68.15±1.92
34wk	19	64.36±2.21	279.36±9.56	83.47±1.07	69.57±1.34
35wk	15	66.26±1.27	291.13±10.65	85.73±1.22	72.8±2.27
36wk	15	67.93±3.47	295.6±18.49	86.73±1.57	75.06±1.90
37wk	16	69.34±0.94	304.26±7.81	88.56±1.31	77±2.33

38wk	8	69.87±3.64	305.5±18.07	90.12±2.74	80.12±2.47
39wk	11	73.45±2.46	321.5±19.02	91.27±1.67	83.36±1.43
40wk	5	72.25±2.21	326.8±11.88	91.5±0.57	85.25±0.95

Table 2: Corelation values of mean fetal biometry parameters with the estimated gestational age.

Fetal biometry parameters	Pearson corelation Value	P value
Mean femur length	0.9598	0.001
Mean Abdominal circumference	0.9045	0.001
Mean Biparietal diameter	0.9526	0.0001
Mean foot length	0.9502	0.001

We observed that there was a statistically significant strong positive correlation between gestational age and femur length, abdominal circumference, biparietal diameter which are considered conventional fetal biometry parameters.

Table 3: Gestational age and Foot Length /Femur length ratio.

Gestational Age	Femur Length	Foot Length	Ratio
15 wk	20.5	18.5	1.108
16 wk	23.77	19	1.251
17 wk	27.41	22.66	1.210
18 wk	30.75	25.5	1.206
19 wk	32.2	28.6	1.126

20 wk	35.23	31.19	1.130
21 wk	37.2	35.22	1.056
22 wk	39.21	36.85	1.064
23 wk	43.08	39.4	1.093
24 wk	44.77	41.94	1.067
25 wk	47.88	43.55	1.099
26 wk	49.66	46.77	1.062
27 wk	53	50.6	1.047
28 wk	55.5	51.64	1.075
29 wk	58.4	54.6	1.070
30 wk	61.5	56.45	1.089
31 wk	63	56.18	1.121
32 wk	65.52	59.7	1.097
33 wk	68.15	62.26	1.095
34 wk	69.57	64.36	1.081
35 wk	72.8	66.26	1.099
36 wk	75.06	67.93	1.105
37 wk	77	69.34	1.110
38 wk	80.12	69.87	1.147
39 wk	83.36	73.45	1.135
40 wk	85.25	72.25	1.180

- Significant correlation was found between gestational age and foot length as well.

Foot length ratio remained near constant during gestational ages (min 1.04 – max 1.25).

DISCUSSION:

Fetal foot length was found to be a reliable indicator in predicting gestational age, according to analysis of my data with a sample size [n=341].

In our study, Foetal foot length, FL BPD, and AC had correlation coefficients [R] of 0.9598, 0.9502,0.9526 and 0.9045 respectively. In all three of the aforementioned associations, there was a statistically significant correlation between the gestational age and traditional metric parameters (p values less than 0.001). Strong positive correlation with similar values was found for correlation between the gestational age and foot length also. Furthermore, the 95% confidence interval was within the 0.90–0.95 range, which is statistically significant. There were no fetuses with congenital anomalies of the foot, IUGR, hydrocephalus, macrosomia and microcephaly detected during the course of obstetric examination in my sample size.

Mercer et al in 1987- Comparison of curvilinear regression of foot length versus gestational age demonstrated a strong correlation with an R2 value of 0.981; 95% confidence intervals at each week compared favourably with both biparietal diameter and femur length data. Our study also showed similar strong correlation of foot length and gestational age (R2 value of 0.9598 at 95 % confidence interval) and hence can be used as a reliable parameter in similar circumstances. [8]

Campbell et al. 1988 had evaluated the fetal femur/foot length ratio and observed it to be a useful parameter to differentiate fetuses having dysplastic limb reduction from those whose limbs are short because of constitutional factors or intrauterine growth retardation. In the present study, the foot length: femur length ratio remained near constant during gestational ages (min 1.04 – max 1.25) indicating there were no cases of skeletal dysplasia. [9]

Pandey VD et al.2015 showed that the mean values of FTL, BPD, FL, AC against gestational age showed a linear increase in different parameters as pregnancy progresses from 15 to 36 weeks of gestation and positive correlation with gestational age where foetal foot length, FL, BPD, and AC had correlation coefficients [R] of 0.960, 0.993,0.949 and 0.995 respectively. In our study, had correlation coefficients showed similar strong positive correlation. [10].

CONCLUSION:

341 patients referred to Radiology Department, Sassoon Hospital, Pune fulfilling selection criteria were enrolled in the study and obstetric ultrasound examination was done in patients, data was documented and results analysed.

The results showed foot length has a strong correlation with conventional parameters like, AC (Abdominal Circumference) , BPD (Biparietal Diameter) and FL (Femur Length)

Throughout the gestational ages of 15 to 40 weeks, the foot length: femur length ratio remained near constant during gestational ages (min 1.04 – max 1.25).
Femur length: foot length ratio was calculated and found to be in the range of 1.08- 1.18. Our observation revealed a femur/foot length ratio of ≥ 0.9, hence ruling out skeletal dysplasia of fetuses in our sample size.
Thus the fetal/foot length ratio nomogram is a valuable measure which helps distinguish babies with dysplastic limb reduction from those whose limbs are short due to constitutional reasons or IUGR.
We hope that fetal foot length estimation gains widespread acceptance in the medical imaging community and is incorporated into the routine biometric parameters as part of the regular obstetric ultrasound examination.

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