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"Determination Of Gestational Age By Taking Diphyseal Length Of Long Bones -An Ultrasonographic Study"

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ABSTRACT
Determination of gestational age is crucial in predicting pregnancy outcomes, as it is linked directly with fetal maturity. Ultrasound is well known, time tested and safe modality in pregnancy. So using ultrasound, gestational age is determined in the present study using diaphyseal length of long bones like femur, humerus, radius and tibia along with other routine parameters like biparietal diameter, abdominal circumference etc. This study was conducted with the help of Department of Radiology, MGM Medical college Navi Mumbai in a sample size of 382 normal pregnant females in the second and third trimester. Estimated gestational age is found to be nearly accurate if calculated using diaphyseal length of long bones. Growth of diaphyseal length of long bones slows in late gestation. So it is concluded that diaphyseal length of femur, humerus, tibia and radius can be used as reliable parameters for estimation of Gestational age along with other parameters like biparietal diameter, abdominal circumference.

Key words: *Gestational age, Diphyseal length, Biparietal diameter Abdominal circumference Diaphyseal femoral length Diaphyseal humeral length Diaphyseal radial length Diaphyseal tibial length.*

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I. INTRODUCTION

Development of fetus in mother's womb has always been a subject of curiosity in the interest of better human progeny since the very begining. It is proven that well being of a human starts from initial development of fetus in mother's womb. Normal growth of the fetus in a way of fetal weight and maturation has long standing effect on human life and chronic diseases.

With routine use of high-resolution real-time ultrasonography, more information about the anatomy of the fetus can be obtained, including even subtle malformations. The prenatal diagnosis of abnormal fetal growth patterns such as growth retardation and growth acceleration is important, since in utero recognition of these patterns may reduce the high perinatal morbidity and mortality associated with their occurrence.

India is a vast country having a diverse ethnic and socioeconomic structure. It has been observed that the health standards of Indian adults vary widely from region to region. These differences have an impact on development and growth of the fetus. As it is observed in different studies conducted in various regions of the world. Unfortunately, none of these studies were considered in Indian fetuses.[1] Fewstudies have been concerned with the assessment of fetal maturity and have concentrated on fetus in utero near term. The practical value of such measurements is debatable since they vary over a wide range due to differences in fetal position. These measurements in vivo have also led to disagreement on the actual rates of growth of the ossification centers in the long bones.[1] In our study we have used ultrasound method to find out the relative reliability and authenticity in morphometry as far as diaphyseal lengths and gestational age is concerned.

So, in this study, gestational age has been studied with the help of different gestational parameters using ultrasonographic evaluation of fetal growth.

AIM

To correlate diaphyseal length of long bones with gestational age ultrasonographically.

OBJECTIVES

- To find out foetal parameters like biparietal diameter, abdominal circumference, diaphyseal femoral length, diaphyseal humeral length, diaphyseal radial length, diaphyseal tibial length in mothers of known gestational age.
- To compare findings with other studies.

II. MATERIALS AND METHOD

After ethical committee approval, data was collected from Department of Radiology, MGM Medical collage Navi Mumbai during the period of March 2010 till July 2011. After taking informed consent, 382 normal pregnant females in 2nd and 3rd trimesters were examined by ultrasonography for estimation of gestational age of the fetus, growth parameters and fetal weight was taken.Gestational age of the fetus in weeks was obtained by taking history about last menstrual period (LMP). Ultrasonographic parameters studied were

- Biparietal diameter (BPD)
- Abdominal circumference (AC)
- Diaphyseal Femoral length (FL)
- Diaphyseal Humeral length (HL)
- Diaphyseal Radial length (RL)
- Diaphyseal Tibial length (TL)

Statistical analysis of the collected data was done with the help of SPSS software.

- **Inclusion criteria :**

1. Known gestational age
2. Primi gravida females with 15 wks to full term gestation

- **Exclusion criteria :**

Maternal :

1. Unknown Gestational age
2. Pregnancy induced hypertension
3. Gestational diabetes
4. Severe anemia in early pregnancy
5. Chronic medical disorders which may hamper fetal growth
6. multiple pregnancies

Fetal :

1. Fetuses with congenital anomalies
2. intra-uterine growth restriction

III. OBSREVATIONS & RESULT

Table 1: Statistical analysis of Femur length

WKS	Average (mm)	SD	SEM	95% of coefficient
15-16	19.63	1.8	0.33	18.98 – 20.29
17-20	29.13	3.47	0.45	28.24 – 30.03
21-24	39.90	3.14	0.39	39.12 – 40.68
25-28	50.46	2.91	0.37	49.73 – 51.19
29-32	59.11	3.06	0.39	58.34 – 59.88
33-36	68.2	2.63	0.35	67.51 – 68.89
37-40	74.53	2.12	0.34	73.84 – 75.22

Table 2: Statistical analysis of Humeral length

Wks	Average (mm)	SD	SEM	95% of coefficient
15-16	19	1.89	0.34	18.31 - 19.69
17-20	27.62	3.62	0.47	26.68 - 28.56
21-24	36.88	2.89	0.36	36.16 – 37.59
25-28	45.13	2.74	0.34	44.44 – 45.81

29-32	53.54	2.45	0.31	51.93 – 53.16
33-36	59.36	3.01	0.39	58.57 – 60.15
37-40	64.62	1.91	0.32	64 – 65.24

Table 3: Statistical analysis of Tibial length

Wks	Avarage (mm)	S D	SEM	95% of coefficient
15-	16.46	2.	0.37	15.73 – 17.19
17-	25.03	3.	0.49	24.06 – 26
21-	34.49	3.	0.39	33.7 – 35.28
25-	43.80	2.	0.37	43.06 – 44.53
29-	51.76	2.	0.37	51.02 – 52.49
33-	59.4	3	0.39	58.61 – 60.19
37-	64.56	1.	0.32	63.92 – 65.19

Table 4Statistical analysis of Radial length.

Wks	Avarage (mm)	SD	SE M	95% of coefficient
15-16	**15.05**	**1.3**	**0.24**	14.57 – 15.52
17-20	**23.59**	**3.7**	**0.49**	22.62 – 24.56
21-24	**30.91**	**2.6**	**0.33**	30.25 – 31.57
25-28	39.09	**2.1**	0.27	38.56 – 39.62
29-32	44.6	**1.9**	**0.24**	44.11 – 45.09
33-36	49.89	**2.0**	**0.27**	49.34 – 50.43
37-40	54.36	**2.0**	**0.33**	53.71 – 55.02

Table 5: Statistical analysis of BPD

Wks	Avarage (mm)	SD	SEM	95% of coefficient
15-16	**32.91**	**2.51**	**0.46**	31.99 – 33.83
17-20	**43.2**	**3.98**	**0.51**	42.19 – 44.22
21-24	**55.49**	**3.43**	**0.43**	54.56 – 56.34
25-28	67.43	**3.50**	0.44	66.54 – 68.31
29-32	77.29	**3.21**	**0.40**	76.49 – 78.10
33-36	86.36	**2.92**	**0.38**	85.59 – 87.13
37-40	93.62	**3.09**	**0.50**	92.62 – 94.62

Table 6: Statistical analysis of AC

Wks	Avarage (mm)	SD	SEM	95% of coefficient
15-16	19.63	1.8	0.33	18.98-20.29
17-20	29.13	3.47	0.45	28.24-30.03
21-24	39.90	3.14	0.39	39.12-40.68
25-28	50.46	2.91	0.37	49.73-51.19
29-32	59.11	3.06	0.39	58.34-59.88
33-36	68.2	2.63	0.35	67.51-68.89
37-40	74.53	2.12	0.34	73.84-75.22

Growth of all sonological parameters like FL, HL, TL, RL, BPD and AC is linear to gestational age. FL, TL, BPD, AC shows faster growth in early gestational age till 36 weeks where as HL and RL also shows faster growth in early gestational age but only till 32and 28 weeks respectively. After above mentioned period, rate of growth slows down in later gestation.

IV. DISCUSSION

Measurement of fetal parameters by ultrasonography has an important role to play in the prognosis of the child after birth. With it one can get an idea about rate and pattern of growth whether normal or abnormal. 379 patients were assessed by ultrasonographic parameters. All the results were tabulated and analyzed statistically. Some parameters were used to derive ratios. All the results were compared with study results of other investigators.The rate of fetal growth was correlated with increase in gestational age.
With help of these ultrasonographic findings fetal gestational age could be estimated.

In 1981 Hadlock[2] described femur length as a predictor of gestational age for first time. He compared its growth with BPD. Later Jeanty[3,4] found that femur length has linear growth pattern with gestational age and fetal weight. FL is a good indicator of gestational age in late pregnancy. BPD and AC change due to reduced liquor either due to oligohydramnios or premature rupture of membranes and in abnormal presentation of fetus such as a breech presentation. BPD and HC may also change, if patient is in late stage of labor, as head descends in pelvis causing molding of head which reduces BPD and HC.

Table 7: Comparison of GA derived by FL with the other workers

wks	Actual GA	GA by our derived equation	GA by hadlock	GA by Jeanty	GA by Ott [5]
15	15.6	14.6	15.3	15.2	14.2
16	16.9	15.8	16.2	16.2	14.9
17	17.6	17.4	17.5	17.6	15.9
18	18.7	18.6	18.5	18.6	16.7
19	19.7	19.5	19.3	19.4	17.3
20	20.7	21.1	20.6	20.8	18.4
21	21.9	22.1	21.5	21.7	19.2
22	22.7	23.0	22.4	22.6	20.0
23	23.7	24.1	23.4	23.6	20.9
24	24.9	25.4	24.6	24.8	22.0
25	25.7	26.4	25.6	25.8	23.0
26	27.1	27.4	26.6	26.7	23.9
27	28.7	28.3	27.5	27.6	24.9
28	29.1	29.3	28.5	28.6	25.9
29	29.9	29.9	29.2	29.3	26.6
30	30.7	31.0	30.4	30.4	27.9
31	31.6	31.9	31.4	31.3	29.0
32	32.9	33.0	32.5	32.4	30.3
33	33.9	33.9	33.6	33.4	31.5
34	34.9	34.8	34.7	34.4	32.8
35	35.9	35.5	35.4	35.0	33.7
36	37.0	36.3	36.4	36.0	35.0
37	38.4	37.3	37.6	37.0	36.5
38	38.9	37.8	38.3	37.6	37.4
39	39.4	38.7	39.3	38.6	38.8

GA by using BPD

It is the first parameter used by Ian Donald[6] in 1962 by A-mode scan. Only indirect measurement of BPD was possible. With use of B-mode scan by S. Campbell[7] in 1969 said it was possible to visualize BPD at level of thalami. Same technique is still in use.
BPD grows with gestational age linearly, but rate of growth reduces in late pregnancy. We can use BPD for estimation of gestational age.

Table 8 : Comparison of GA derived by BPD with the other workers

wks	Actual GA	GA by our derived equation	GA by Hadlock	GA by kurtz[8]	GA by Ott
15	15.6	14.4	15.6	14.9	14.9
16	16.9	15.9	16.7	16.2	16.0
17	17.6	17.1	17.6	17.1	16.8
18	18.7	18.5	18.6	18.3	17.8
19	19.7	19.7	19.6	19.2	18.7
20	20.7	20.8	20.5	20.1	19.6
21	21.9	22.0	21.6	21.1	20.6
22	22.7	23.3	22.6	22.1	21.7
23	23.7	24.0	23.3	22.8	22.4
24	24.9	25.3	24.6	24.0	23.6
25	25.7	26.4	25.6	24.9	24.6
26	27.1	27.5	26.7	26.0	25.7
27	28.7	28.5	27.7	27.1	26.8
28	29.1	29.4	28.6	27.9	27.7
29	29.9	30.2	29.4	28.8	28.6
30	30.7	31.2	30.6	30.0	29.8
31	31.6	32.2	31.7	31.2	31.0
32	32.9	33.1	32.6	32.3	32.0
33	33.9	33.6	33.3	32.9	32.7
34	34.9	34.7	34.5	34.4	34.1
35	35.9	35.3	35.3	35.3	35.0
36	37.0	36.2	36.3	36.6	36.2
37	38.4	36.9	37.2	37.7	37.2
38	38.9	38.0	38.6	39.5	38.9
39	39.4	38.7	39.5	40.7	40.0

GA by using AC

Tamura[9] came to conclusion that abdominal circumference is a more reliable parameter for fetal weight estimation. Same conclusion can be drawn in the present study. Fetal weight increases in second trimester due to fetal fat increase around abdomen and thigh. Fetus also stores more glycogen in liver which can be good source of energy after birth when fetus is adjusting to the external environment. Both these factors lead to an increase in abdominal circumference with gestational age.

Table 9: Comparison of GA derived by AC with the other workers

wks	Actual GA	GA by our derived equation	GA by Hadlock
15	15.6	15.4	15.2
16	16.9	16.4	16.1
17	17.6	17.4	17.0
18	18.7	18.6	18.1
19	19.7	19.6	19.0
20	20.7	20.9	20.2
21	21.9	21.7	21.0
22	22.7	23.0	22.2
23	23.7	23.9	23.1
24	24.9	24.7	23.8
25	25.7	25.8	24.9
26	27.1	27.1	26.2
27	28.7	27.8	26.9
28	29.1	29.2	28.3
29	29.9	30.2	29.3
30	30.7	30.7	29.9
31	31.6	32.0	31.1

32	32.9	32.8	32.0
33	33.9	33.5	32.7
34	34.9	34.7	34.0
35	35.9	36.0	35.4
36	37.0	36.8	36.2
37	38.4	37.2	36.6
38	38.9	38.5	38.0
39	39.4	38.7	38.3

V. CONCLUSION

Accurate determination of Gestational age is fundamental in obstetric care. Ultrasound is a reliable method for evaluation of Gestational age and in this way can improve obstetric care. It is an easy, accurate, safe, non-teratogenic, cheap and non-invasive method of measuring fetal parameters. In this study 382 patients with gestational age varying from 15-40 weeks were examined ultrasonographically. Gestational age calculated from last menstrual period (LMP) and converted into days. Six fetal parameters were measured. While studying growth pattern it has been observed that all the parameters show positive linear growth with Gestational age at a given time. Only difference found is that the rate of growth slows in late gestation.

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