



Fetal tibial length as a tool for assessment of gestational age - A comparative study in North India

Vishnu Datt Pandey¹, Vishram Singh², G L Nigam³, Yasmeen Usmani⁴, Yogesh Yadav^{5*}

¹Lecturer, Department of Anatomy, LLRM Medical College, Meerut, Uttar Pradesh, India

²Professor and Head, Department of Anatomy, Santosh Medical College, Ghaziabad, Uttar Pradesh, India

³Assistant Professor and Head, Department of Anatomy, LLRM Medical College, Meerut, Uttar Pradesh, India

⁴Assistant Professor, Department of Radio diagnosis, SVBP Hospital, LLRM Medical College, Meerut, Uttar Pradesh, India

⁵Associate Professor, Department of Anatomy, Rama Medical College, Hapur, Uttar Pradesh, India

*Corresponding author email: dryogeshyadav@gmail.com

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Abstract

Making appropriate management decisions requires accurate appraisal of gestational age. Accurate pregnancy dating may assist obstetricians in appropriately counselling women who are at risk of a preterm delivery about likely neonatal outcomes and is also essential in the evaluation of fetal growth and the detection of intrauterine growth restriction. The purpose of this study was to find out the other parameters such as tibial length which can be used to determine the gestational age either more accurately or can be used in other conditions where the previous parameters are unreliable. We found that in normally developing fetus the fetal tibial length increases with advancing gestational age and regression analysis showed a strongly significant relationship between fetal tibial length and gestational age. Fetal tibial length is a good marker for gestational age and can also be used in cases, which are not sure about their last menstrual period (LMP).

Key words

Fetal tibial length, Gestational age, Ultrasonography, Fetal age determination.



Introduction

Appropriate assessment of gestational age is paramount in obstetric care. Making appropriate management decisions requires accurate appraisal of gestational age. Accurate pregnancy dating may assist obstetricians in appropriately counseling women who are at risk of a preterm delivery about likely neonatal outcomes and is also essential in the evaluation of fetal growth and the detection of intrauterine growth restriction. Accurate gestational age is also important in the interpretation of biochemical serum screening test or for counselling patients regarding the option of pregnancy termination early in the pregnancy. Since clinical data such as the menstrual cycle or uterine size often are not reliable, the most precise parameter for pregnancy dating should be determined by the obstetrician by ultrasound. Ultrasound is an accurate and useful modality for the assessment of gestational age in the first and second trimester of pregnancy and, as a routine part of prenatal care, can greatly impact obstetric management and improve antepartum care. When choosing the optimal parameter for estimating gestational age, it is essential that the structure has little biologic variation, and can be measured with a high degree of reproducibility. In the past, the biparietal diameter (BPD) had been described as a reliable method of determining gestational age. While the BPD was the first fetal parameter to be clinically utilized in the determination of fetal age in the second trimester, more recent studies have evaluated the use several other biometric parameters including head circumference (HC), abdominal circumference (AC), femur length (FL), foot length, ear size, orbital diameters, cerebellum diameter and others [1]. The measurement of the long bones of the extremities is being increasingly incorporated into the ultrasonic evaluation for fetal development and diagnosis of fetal anomalies [2]. All of the limb bone lengths

correlate with gestational age and may serve as indicators of skeletal dysplasia. Extensive study has been done in Indian population for the assessment of gestational age by femur length, biparietal diameter and abdominal circumference. But the data regarding the tibial length in Indian population is meagre. Fetal tibial length measurement in ultrasound can be utilised as an accurate parameter to determine gestational age.

Aim of the present study was to determine the fetal tibial length which corresponds to gestational age. A comparative evolution of fetal tibial length verses BPD (Bi Parietal Diameter), AC (Abdominal Circumference) and FL (Femur Length) was also done and fetal tibial length was determined in estimating gestational age in 2nd and 3rd trimester.

Material and methods

The present study was conducted in the Department of Anatomy, Santosh Medical College and Hospital in coordination with the Department of Anatomy and Radio diagnosis, LLRM Medical College, Meerut in pregnant women a during 2nd and 3rd trimester.

The present study was done in 100 pregnant women who were not sure about their menstrual period and having singleton apparently normal fetuses between 15 to 36 weeks of gestation and subjects having any medical pathology were excluded from study. We measured the femur length, BPD, AC and determined gestational age individually on each parameter, then mean gestational age was calculated, then tibial length was measured on that particular gestational age. All measurements were made by scanning the patients using a new Medison SA 8000 SE ultrasonographic machine by a single skilled and experienced sinologist.



Results

The present study was conducted in 100 pregnant women, between the age range of 18 to 40 years, during 2nd and 3rd trimester.

Gestational age was calculated individually on BPD (Bi Parietal Diameter), AC (Abdominal Circumference) and FL (Femur Length), and then mean gestational age was determined by the above mentioned parameters. Sonographically we measured fetal tibial length from 15th week of gestation to 38th week of gestation. Other parameters measured were BPD, AC, and FL as per **Table-1**.

Graphical representation of linear correlation between tibial length and gestational age was as per **Graph - 1**. The graph represented a linear correlation between the two parameters. Comparative plot of TL, FL, BPD, AC against gestational age was as per **Graph - 2**.

From regression analysis a strongly significant relationship has been observed between fetal tibial length and gestational age.

$$Y = 9.117 + 0.371X$$

Where y=gestational age in weeks, X=tibial length in mm.

Discussion

Ultrasound assessment of gestational age has become an integral part of obstetric practice in recent times. In the past, the biparietal diameter (BPD) had been described as a reliable method of determining gestational age. While the BPD was the first fetal parameter to be clinically utilized in the determination of fetal age in the second trimester, more recent studies have evaluated the use several other biometric parameters including head circumference (HC), abdominal circumference (AC), femur length

(FL), foot length, ear size, orbital diameters, cerebellum diameter and others [1].

The present study was done in 100 pregnant women who were not sure about their menstrual period and having singleton apparently normal fetuses between 15 to 36 weeks of gestation and subjects having any medical pathology were excluded from study. Other parameters measured were BPD, FL, and AC. Statistical analysis of the observations showed R² and standard deviation of study significant. In the present study R value is 0.991 and Standard deviation is 0.874.

Queenan JT, O'Brien GD, Campbell S (1980) made a study on 41 patients with known menstrual dates and found the growth of the fetal limb bones was linear from 12 through 22 weeks' gestation, but the various bones appeared to grow at different rates [3].

C. Exacoustos, et al. studied linear growth of all limb bones between 13 and 40 weeks of gestation in total of 2317 normal pregnant women by ultrasonographic scan. They found R value 0.994 and standard deviation 1.619 for tibial length in their study. The standard deviation is much less as compared between two studies and R values are very near to each other [4].

Lyn S. Chitty and Douglas G. Altman ultrasonographically scanned 663 fetuses between gestational age of 12 to 42 weeks and measured all long bones, they found Standard deviation 0.049 [5].

Juozas Kurmanavicius, et al. did a prospective cross sectional study on 6557 pregnant women between 12 to 42 weeks of gestational age. They obtained R value 0.999 for limb length [6].



Taner Ziylan, et al. in their study concluded the R value for limb length in foetuses between 20 to 30 weeks 0.905 [7].

Zeba Khan, Nafis Ahmad Faruqi, et al. (2006) showed maximum growth rates between 4th to 6th months in most of the long bones. The rate of growth for femur during aforementioned period was relatively higher i.e. >12 mm per month. Growth rate of tibia was maximum (30.50 mm per month) during 5th Month [8].

The values in our study were lower or higher because there was a significant racial and socioeconomic difference between individuals of the present study and those of studies done by E.P. Issel, C. Exacoustos and Lyn S. Chitty as per **Table-2**. The differences in the readings may also be attributed to number of operators, type of study (cross-sectional verses longitudinal study), estimate of gestational age (rounded off verses exact) and quality of ultrasound machine (older or newer).

Conclusion

In normally developing fetus the fetal tibial length increases with advancing gestational age. Fetal tibial length is a good marker for gestational age and can be used in cases, which are not sure about their LMP.

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Note: This study is a part of PhD work of first author under guidance of the second author.

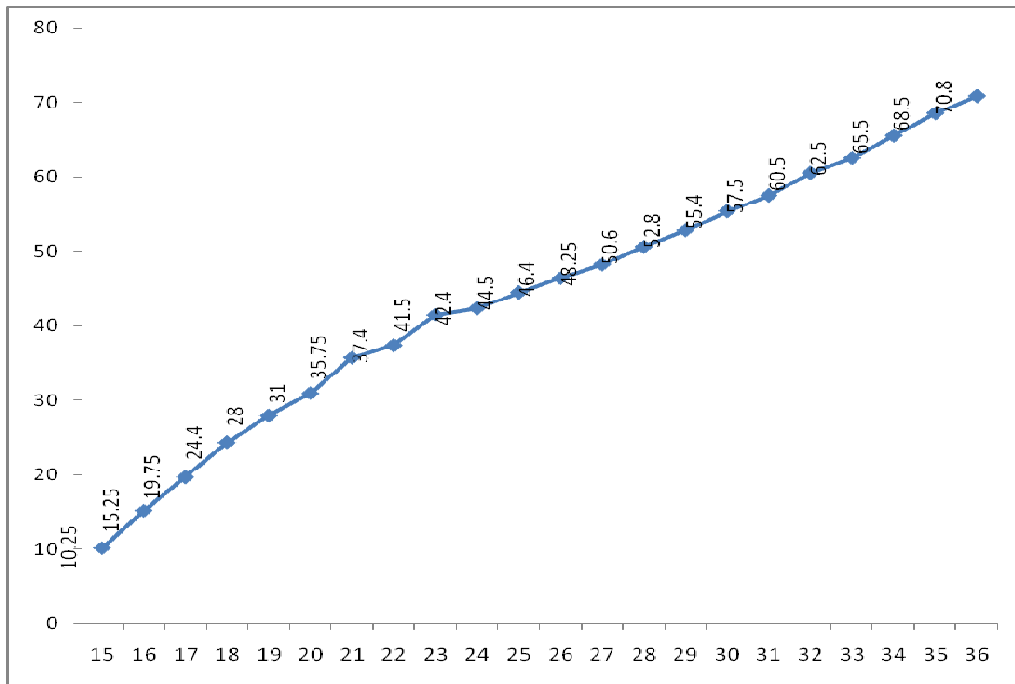
Table - 1: Association between gestational age and TL, BPD, AC and FL.

Sr. No.	Gestational age (weeks)	Number of cases	Mean tibial length (mm±SD)	Mean BPD (mm±SD)	Mean AC (mm±SD)	Mean FL (mm±SD)
1	15	4	10.25±0.50	15.50±1.41	95.00±3.82	15.75±1.70
2	16	4	15.25±0.50	32.75±1.89	104.0±2.82	20.50±0.57
3	17	4	19.75±0.50	37.25±0.95	111.2±6.99	23.25±0.95
4	18	5	24.40±0.55	40.60±0.89	116.4±4.09	27.80±0.44
5	19	4	28.00±0.82	45.25±0.95	124.5±2.51	30.50±1.00
6	20	6	31.00±0.90	47.66±0.81	144.0±4.19	33.33±1.21
7	21	4	35.75±0.50	55.00±0.81	155.0±2.58	34.00±0.81
8	22	5	37.40±0.90	56.80±0.83	173.2±2.77	37.20±1.30
9	23	4	41.50±0.58	58.00±0.81	181.0±2.58	40.66±1.00
10	24	5	42.40±0.55	61.00±1.41	196.2±3.63	42.60±0.89
11	25	4	44.50±0.58	62.00±1.41	200.8±4.85	45.50±1.00
12	26	5	46.40±0.55	65.20±1.64	216.4±5.77	49.20±1.30
13	27	4	48.25±0.50	65.00±1.15	225.5±5.00	51.50±1.00
14	28	6	50.60±0.82	71.66±3.07	231.2±11.5	54.00±2.52
15	29	5	52.80±0.55	74.80±0.83	255.4±5.45	54.40±1.14
16	30	5	55.40±0.55	75.00±1.00	272.8±3.34	57.40±0.89
17	31	4	57.50±0.58	78.75±0.95	271.5±5.97	58.75±0.95
18	32	5	60.50±0.52	79.20±0.83	288.2±9.70	62.40±2.07
19	33	4	62.50±0.58	83.50±2.51	294.0±3.74	63.00±2.58
20	34	4	65.50±0.58	85.00±0.81	304.0±4.32	66.20±50.5
21	35	4	68.50±0.58	87.25±1.50	312.7±3.40	69.25±1.70
22	36	5	70.80±0.84	89.80±1.48	325.6±6.22	72.60±1.34

Table - 2: Comparison of mean tibial length of present study with previous studies.

Gestational age (weeks)	Mean tibial length in mm			
	Present study	E.P. Issel	C. Exacoustos	Lyn S. Chitty
15	10.25	-	16.00	14.10
16	15.25	-	20.00	16.90
17	19.75	22.00	22.00	19,90
18	24.40	23.00	23.00	22.80
19	28.00	26.00	26.00	25.70
20	31.00	29.00	29.00	28.50
21	35.75	32.00	32.00	31.20
22	37.40	33.00	33.00	33.80
23	41.50	37.00	37.00	36.40
24	42.40	39.00	39.00	38.80
25	44.50	41.00	40.50	41.00
26	46.40	43.00	43.00	43.20
27	48.25	45.00	45.00	45.30
28	50.60	46.00	46.00	47.30
29	52.80	49.00	48.00	49.20
30	55.40	50.00	49.50	51.00
31	57.50	52.00	52.00	52.70
32	60.50	55.00	55.00	54.40
33	62.50	56.00	55.00	55.90
34	65.50	57.00	57.00	57.50
35	68.50	59.00	59.00	58.90
36	70.80	61.00	60.00	60.30

Graph - 1: Mean tibial length verses gestational age - Linear increase of tibial length as pregnancy progresses from 15 weeks to 36 weeks.



Graph - 2: Comparative plot between mean TL, FL, BPD, AC - Linear increase of BPD, AC, FL as compared to tibial length as pregnancy progresses from 15 weeks to 36 weeks.

