

## Estimation of Gestational Age of Fetus with the Help of Fetal Tibial Length: By Real Time Ultrasonography

Ranjana Barjatiya<sup>1</sup>, Geeta<sup>2\*</sup>, Savita<sup>2</sup>, Prakrati<sup>3</sup>

<sup>1</sup>Associate professor, Department of Anatomy, JLN Medical College, Ajmer, Rajasthan.

<sup>2</sup>Senior Demonstrator, Department of Anatomy, SP Medical College, Bikaner, Rajasthan.

<sup>3</sup>Senior Demonstrator, Department of Anatomy, RUHS, Jaipur, Rajasthan, INDIA.

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### \*Correspondence to:

Dr. Geeta

Sr. Demonstrator,

Anatomy

S.P. Medical College,

Bikaner

Rajasthan (India)

g79geeta@gmail.com

### ABSTRACT

**INTRODUCTION:** The ultrasound is a sound wave beyond the audible range of frequency. Clinical application of ultrasound in obstetrics was introduced and popularized by Donald & Glasgow in 1958, the advantage being that the ultrasound is a noninvasive technique causing minimum discomfort to the patient and practically no side effect on the fetus.

**MATERIALS AND METHODS:** In present study an analysis will also be made of the variation in the gestational period, associated with the tibial length and socioeconomic, physical and medical factors recorded from obstetric and gynecological records. The patients included in this study were of 13 weeks to 40 weeks of fetal gestational age as diagnosed during the antenatal examination by gynecologist.

**RESULTS:** At the 14 weeks of the gestation the mean calculated tibia length was 15.7mm and at 20 weeks was 29.33 mm. The mean fetal tibial length of 51.92 mm was recorded at the age of 30 weeks of gestation whereas the same was 74.51mm at 40 weeks of gestation.

**CONCLUSIONS:** Dating of fetus by fetal tibial length is more accurate than the other fetal parameters and it was found more predictive than other fetal parameters.

**KEYWORDS:** Fetal tibial length, Gestational age, Obstetrics, Ultrasonography.

### INTRODUCTION

The ultrasound is a sound wave beyond the audible range of frequency. In medical field the use of ultrasound started for detection and visualization of cerebral ventricles by Dussik in 1930s. A quick easy and accurate method for estimating fetal age, fetal weight and fetal wall being in utero would be of obvious benefit to the clinicians participating in modern obstetrics. Long bone such as femur, tibia, fibula, humerus, radius and ulna are developed during 7th weeks to 12th weeks.<sup>1,2</sup> With the advancement in technology of three-dimensional ultrasonography, abnormality in face, relative proportion of limbs, hands and feet are observed with more accuracy.<sup>3</sup> The ability to examine the fetus and to detect fetal growth, fetal gestational age and any other fetal anomalies has dramatically changed the diagnosis and practice of obstetrics.<sup>4</sup> In general, prognosis for delayed diagnosis and mild abnormality in ultrasonography results are not as ugly as those that accompany other abnormalities in different organ or chromosome.<sup>5,6</sup> The knowledge of fetal growth and development is important for an understanding of

variation from the normal intrauterine growth retardation and intrauterine growth acceleration both of which contribute significantly to perinatal mortality and morbidity.<sup>7,8</sup>

### MATERIALS AND METHODS

The present study was conducted in the Department of Anatomy in collaboration with the Department of Radiodiagnosis, Sardar Patel Medical College and Associated Group of Hospitals, Bikaner, Rajasthan, India. This study incorporated 500 normal pregnant women were from the Obstetrics and Gynaecology department who came for antenatal examination. The patients included in this study were of 13 weeks to 40 weeks of fetal gestational age as diagnosed during the antenatal examination by gynecologist. The ultrasonographic measurement of fetal tibial length was made in millimeter (mm).

- Percentage of Hb% were noted in all 500 cases and correlated with any effect of Hb% on the tibial length and other measurements.

- Make a relation of fetal tibial length with fetal gestational age.
- The correction of socioeconomic status with the gestational age and the different measurements.
- The prediction error of the estimated fetal gestational age by different formulae are tabulated under the following headings shows: Frequency percentage, Linear regression.

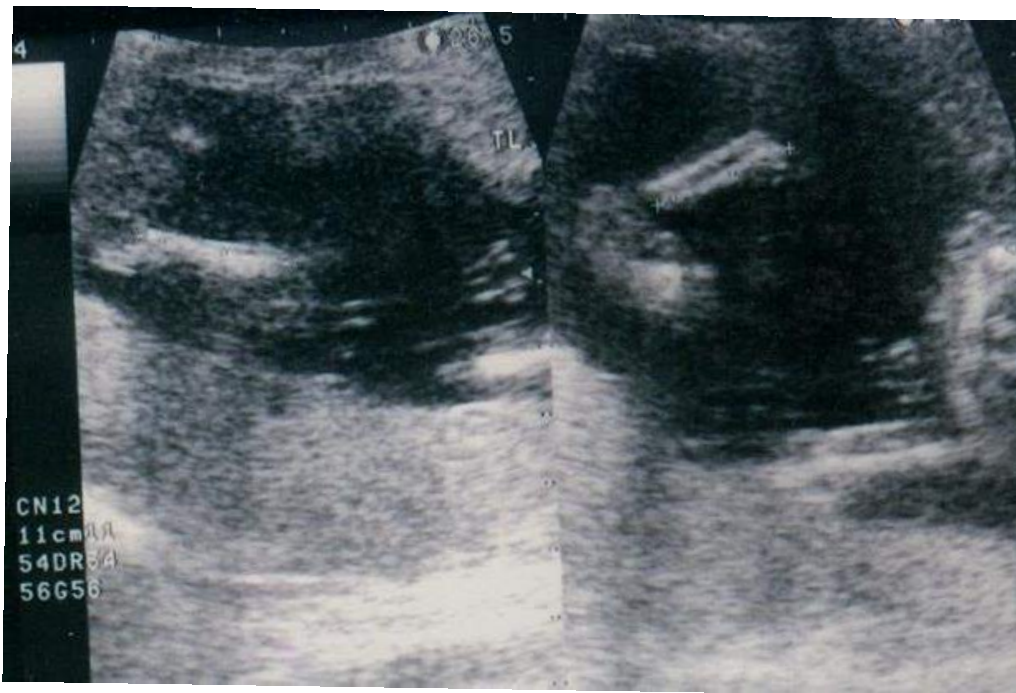


Figure 1: The length of the diaphysis measured as fetal tibial length, 22.5 mm/ 23.1 mm, LMP GA. 28± 1 Day

Table No 1: Distribution of %frequency of the cases according to the socioeconomic status of patients

| S.N.  | Socioeconomic status | No. of cases | % Frequency |
|-------|----------------------|--------------|-------------|
| 1.    | Poor                 | 205          | 41%         |
| 2.    | Lower middle         | 191          | 38.2%       |
| 3.    | Upper middle         | 84           | 16.8%       |
| 4.    | Higher               | 20           | 4%          |
| Total |                      | 500          | 100%        |

Table No.2: Distribution of %frequency of the cases according to Anemia profile of patients

| S.N. | Anemia profile (gm %) | No. of cases | % Frequency |
|------|-----------------------|--------------|-------------|
| 1.   | 1-2                   | -            | -           |
| 2.   | 3-4                   | -            | -           |
| 3.   | 5-6                   | 1            | 0.2         |
| 4.   | 7-8                   | 19           | 3.8         |
| 5.   | 9-10                  | 420          | 84.0        |
| 6.   | 11-12                 | 60           | 12.0        |
| 7.   | 13-14                 | -            | -           |
| 8.   | >14                   | -            | -           |

### OBSERVATION AND RESULTS

Observations indicate that in govt. hospital, more of the patients came for the treatment were from lower socioeconomic status.

On accessing the anemia profile by the percentage of Hb/dl, it was found that 84% of cases having the average hemoglobin.

On viewing mean of fetal tibial length measured by ultrasonographically, it showed that from 13-19 weeks the difference in th standard deviation of the mean of fetal tibial length was  $\pm 1.40$ , from 32 to 40 weeks the

difference in the standard deviation of the mean of fetal tibial length was  $\pm 0.04$ . The maximum variability was observed from 20 weeks to 31 weeks of gestational age.

In present study the fetal tibial length calculated by -  $15.85+2.259 \times GA(X)$  this equation is also tally the result, which is obtained by ultrasonographically. At the 14 weeks of the gestation the calculated tibia length is 15.7mm, at the age of 20 weeks 29.33mm. The fetal tibial length is 51.92 mm at the age of 30 weeks of gestation and at the 40 weeks of gestation the calculated tibial length is 74.51mm.

**Table No. 3: Distribution of mean with standard deviation of fetal tibial length.**

| Fetal gestational age (weeks) | No. of cases | Mean (mm) | SD   |
|-------------------------------|--------------|-----------|------|
| 13                            | 1            | 11.00     | -    |
| 14                            | 7            | 12.71     | 1.24 |
| 15                            | 4            | 15.0      | 1.22 |
| 17                            | 8            | 19.62     | 1.24 |
| 19                            | 11           | 24.18     | 3.11 |
| 20                            | 12           | 29.0      | 2.16 |
| 22                            | 12           | 31.75     | 1.81 |
| 23                            | 11           | 37.63     | 1.31 |
| 25                            | 34           | 41.61     | 2.18 |
| 26                            | 25           | 41.32     | 3.61 |
| 28                            | 34           | 41.61     | 2.18 |
| 29                            | 25           | 50.92     | 3.16 |
| 30                            | 31           | 53.29     | 3.18 |
| 31                            | 42           | 54.66     | 3.34 |
| 32                            | 22           | 58.54     | 3.36 |
| 34                            | 32           | 61.09     | 1.53 |
| 35                            | 18           | 62.33     | 1.64 |
| 36                            | 16           | 63.0      | 1.94 |
| 37                            | 05           | 65.40     | 0.34 |
| 38                            | 04           | 68.40     | 0.40 |
| 39                            | 7            | 70.71     | 1.33 |
| 40                            | 2            | 72.00     | -    |

**Table No. 4: Calculated gestational age by using equation-  
 $Y = 8.95 + 0.401 \times X$  (Y=Y- Fetal gestational age( calculated),  
X- Fetal tibial length (estimated))**

| Serial No. | Weeks | Tibial length (mm) |
|------------|-------|--------------------|
| 1          | 11.88 | 11.00              |
| 2          | 12.60 | 12.71              |
| 3          | 13.58 | 15.00              |
| 4          | 14.96 | 18.25              |
| 5          | 17.04 | 23.13              |
| 6          | 17.49 | 24.18              |
| 7          | 19.54 | 29.00              |
| 8          | 20.72 | 31.75              |
| 19         | 23.22 | 37.63              |
| 10         | 23.84 | 39.08              |
| 11         | 24.92 | 41.61              |
| 12         | 24.79 | 41.32              |
| 13         | 26.81 | 44.55              |
| 14         | 28.88 | 50.92              |
| 15         | 30.48 | 54.66              |
| 16         | 32.13 | 58.54              |
| 17         | 33.21 | 61.09              |
| 18         | 33.74 | 62.33              |
| 19         | 35.05 | 65.40              |
| 20         | 36.33 | 68.40              |
| 21         | 37.86 | 72.00              |

The equation also generated by the data of the present study to calculate the gestation age with the help of the known tibial length.  $Y = 8.95 + 0.401 \times X$ . Y= fetal gestational age and the X is the measured fetal tibial length by ultrasonographically. For the mean of fetal tibial length obtained by the ultrasonographically, the

calculate gestational age is 12.60 weeks for 12.7 mm fetal tibial length, at 30.14 mm tibial length the calculated gestation age is 20.03 weeks, for 54.66 mm of tibial length the calculated gestation age is 30.48 weeks and on 72.00 mm the calculated gestation age is 37.86 weeks.

**Table No.5: Calculated fetal tibial length by using equation-  
 $Y = -15.85 + 2.259 \times GA(X)$  Y- Fetal Tibial Length( calculated),  
 X- Fetal Gestational age (estimated)**

| Serial No. | Tibial Length (mm) | Weeks |
|------------|--------------------|-------|
| 1          | 17.84              | 13    |
| 2          | 15.77              | 14    |
| 3          | 18.03              | 15    |
| 4          | 20.29              | 16    |
| 5          | 27.07              | 19    |
| 6          | 29.33              | 20    |
| 7          | 31.58              | 21    |
| 8          | 33.84              | 22    |
| 9          | 38.36              | 24    |
| 10         | 40.62              | 25    |
| 12         | 45.14              | 27    |
| 13         | 47.40              | 28    |
| 15         | 49.66              | 29    |
| 16         | 51.92              | 30    |
| 17         | 54.17              | 31    |
| 18         | 58.69              | 33    |
| 19         | 60.95              | 34    |
| 21         | 65.47              | 36    |
| 22         | 67.73              | 37    |
| 24         | 69.99              | 38    |
| 25         | 72.25              | 39    |
| 26         | 74.51              | 40    |

## DISCUSSION

In present study as per mentioned earlier the main emphasis given on fetal tibial length, though the literature related with this were available apparent less for comparison. After analyzing the data the distribution of mean of fetal tibial length give the linear growth of tibial length from 13 weeks of gestational age to 40 weeks of gestational age.

On comparison of result of present study with result of the study done by the Queenan JT<sup>5</sup>, it observed that result of the present study and this previous study had almost equal. The length of the fetal tibial at the 15 weeks of gestation in the present study 15 mm and same 15 mm was observed by the Queenan.

In present study the mean value of fetal tibial length was 12.7mm at the 14 weeks of gestational age, at 20 weeks of gestational age it was 29mm, at 30 weeks the fetal tibial length was 53.29mm and at 40 weeks of gestational age it was 72.00mm.

On the comparison with study done by Jeanty<sup>6</sup>, the fetal tibial length at the 14 weeks of gestational age was 12mm, at the 20 weeks of gestational age 27mm, at 30 weeks of gestational age it was 50mm and at 40 weeks of gestational age the fetal tibial length was 66mm in length.

The fetal tibial length at the 15 weeks of gestational age was 10.25mm, at the 20 weeks of gestational age 31 mm, at 30 weeks of gestational age it was 55.40 mm observed

by Vishnu Datt Pandey<sup>7</sup> et al. According to this study the fetal tibial length is a good marker for gestational age and can be used in cases, which are not sure about their LMP. Lyn S. Chitty and Douglas G. Altman<sup>8</sup> ultrasonographically scanned 663 fetuses between gestational age of 12 to 42 weeks and measured all long bones, they found Standard deviation 0.049.

## CONCLUSION

Tibia has very minimum mal development for congenital anomalies hence the prediction of the gestation age with the help of fetal tibial length is more confirmatory and more corrective than the fetal biparital diameter, femur length and other parameters. So the dating of fetus by the fetal tibial length is more accurate than the other fetal parameters and it is more predictive than the other fetal parameters.

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