



CODEN [USA]: IAJPBB

ISSN: 2349-7750

**INDO AMERICAN JOURNAL OF
PHARMACEUTICAL SCIENCES**<http://doi.org/10.5281/zenodo.3689509>Available online at: <http://www.iajps.com>

Research Article

**CORRELATION BETWEEN TRANSVERSE CEREBELLAR
DIAMETER AND FEMUR LENGTH IN THIRD TRIMESTER
OF PREGNANCY****¹Dr. Hira Bushra, ²Dr. Faiza Waseem, ³Dr. Rafia Irum ,
⁴Dr. Muhammad Usman Bashir**¹Assistant Professor of Radiology, Chaudry Pervaiz Elahi Institute of Cardiology Multan²Women Medical Officer, Jinnah Hospital Lahore³Assistant Professor of Radiology, Sharif Medical and Dental College Lahore⁴Associate Professor of Physiology, CMH Multan Institute of Medical Sciences**Article Received:** December 2019 **Accepted:** January 2020 **Published:** February 2020**Abstract:**

Objective: The objective of this study was to determine the correlation between transverse cerebellar diameter (TCD) and femur length (FL) in third trimester of pregnancy.

Material and methods: This cross-sectional study was conducted at Department of Diagnostic and Interventional Radiology, Chaudry Pervaiz Elahi Institute of Cardiology Multan from May 2018 to November, 2018 over the period of 6 months. Total 100 pregnant women between 26-38 weeks of pregnancy, who sure of dates calculated by first day of last normal menstrual period coming for obstetrical USG to the radiology department of SGRH were selected for this study. The patient was placed in supine position. The transducer was placed on the skin surface after applying the coupling agent. In each patient, femur length (FL) and transverse cerebellar diameter (TCD) were measured and correlation between FL and TCD was assessed.

Results: A strong positive correlation (r value = 0.966, p value = 0.000) was found between TCD and FL in the third trimester of pregnancy. Similarly, a strong correlation was also observed between TCD and gestational age (GA) ($r=0.982$, p value: 0.000) and between FL and GA ($r=0.970$, p value: 0.000). Out of 100 patients, TCD was found to give correct assessment corresponding to the gestational age by LMP in 91% patients, while in 84% patients FL was found to give correct assessment corresponding to the gestational age by LMP.

Conclusions: There is strong correlation between transcerebellar diameter (TCD) and femur length (FL) in normal pregnancies in the third trimester of pregnancy between 26-38 weeks of gestation and correlation of transcerebellar diameter with gestational age is stronger than correlation of femur length with gestational age in the third trimester of pregnancy.

Key words: Transcerebellar diameter, Gestational age, Femur length, Third trimester of pregnancy.

Corresponding author:**Dr. Hira Bushra,**

Assistant Professor of Radiology,

Chaudry Pervaiz Elahi Institute of Cardiology Multan

QR code



Please cite this article in press Hira Bushra et al, *Correlation Between Transverse Cerebellar Diameter And Femur Length In Third Trimester Of Pregnancy.*, Indo Am. J. P. Sci, 2020; 07(02).

INTRODUCTION:

Ultrasound assessment for fetal age is becoming increasingly important. Several sonographically derived fetal parameters used to date pregnancy include femur length (FL), abdominal circumference (AC), biparietal diameter (BPD), and head circumference (HC). However the variability in assessing gestational age with these parameters goes on increasing as the pregnancy advances. Recently, the measurement of the fetal transverse cerebellar diameter (TCD) has been accepted as part of routine obstetric ultrasonographic examination¹. Fetal cerebellum grows progressively along with gestational age and, therefore, can predict gestational age at any trimester^{2,3}. Parameters such as Biparietal diameter (BPD) etc. are thought to compute gestational age more correctly when performed at an earlier gestation³.

In our country, many pregnant ladies come for their first antenatal check-up in the third trimester and are unsure of their LMP and do not possess early dating ultrasound report. Management decisions become particularly difficult in conditions where there is growth restriction or growth acceleration. Since the last decade, transverse cerebellar diameter (TCD) is taken as a reliable predictor of fetal age assessment in third trimester⁴. Malik G et al have reported positive correlation between transcerebellar diameter and gestational age ($r=0.98$, p value less than 0.0001)³. In another study, conducted in India, correlation between TCD and FL was found to be strongly positive (r values= 0.987)⁵. In another study Naseem et. al reported that TCD was found to be accurate in correct diagnosis of gestational age in about 91.7% patients¹.

Transverse cerebellar diameter (TCD) can be easily used in those cases where biparietal diameter (BPD) is difficult or impossible to be applied e.g cases with expressed moulding of head. Fetal femur length (FL) is routinely measured during the 2nd and 3rd trimester to assess fetal age. Since the long bones of the fetus are usually involved in the skeletal dysplasias, measurement of femur length (FL) provides the first indication that bone formation or growth is not normal.⁶ Transverse cerebellar diameter can be used to establish the gestational age in normal fetuses and in restricted growth fetuses (IUGR). This is because cerebellum does not change its form and also its size correlates well with gestational age and biparietal diameter^{7,8}. TCD may be altered in abnormal fetuses and could be used for diagnosing congenitally abnormal fetuses. TCD is also valuable in identifying babies with asymmetrical intrauterine growth restriction⁹⁻¹².

The correct knowledge of gestational age is very important in an obstetrician's ability to conveniently manage the ante-partum care of a pregnant lady and

is of utmost importance in ante-natal tests and successful planning of delivery. Failure in the correct assessment of gestational age can result in iatrogenic prematurity which has its own atrocious consequences. In skeletal dysplasias, there is early and severe shortening of the long bones making it difficult for correct assessment of fetal age by femur length measurement. The fetal cerebellum is visualized on ultrasonography unit as early as 10-20 weeks, and it grows in a linear pattern in second trimester and third trimester. Cerebellum does not change in form and size because of impenetrable surrounding petrous ridges and occipital bone. Due to this, transverse cerebellar diameter can be easily used where it is difficult to measure femur length or in cases where there are fluctuations in the form or size of femur and other long bones.

The present study was undertaken to evaluate the correlation between transverse cerebellar diameter and femur length in normal pregnancies. Such study will have considerable potential for establishment of an alternative pregnancy dating system in late pregnancy and use transverse cerebellar diameter (TCD) as an independent parameter for gestational age measurement in third trimester of pregnancy in cases where LMP is uncertain.

MATERIAL AND METHODS:

This cross-sectional study was conducted at Department of Diagnostic and Interventional Radiology, Chaudry Pervaiz Elahi Institute of Cardiology Multan from May 2018 to November, 2018 over the period of 6 months. Total 100 pregnant women between 26-38 weeks of pregnancy, who sure of dates calculated by first day of last normal menstrual period coming for obstetrical USG to the radiology department of SGRH were selected for this study.

Pregnant ladies with anomalous fetus on ultrasonography, pregnancy with Intra uterine death (IUD), multiple gestation on ultrasonography, medical disorders like diabetes, hypertension after taking history and antenatal follow up by obstetrician were excluded from the study. *Toshiba* Aplio 80 (model number SSA-770A) sonography unit was used to measure fetal transverse cerebellar diameter (TCD) and femur length (FL). The transducer used was a 3.75 MHz convex array transducer. The study was approved by the ethical committee and written informed consent was taken from every patient. History was taken from every patient. Demographic profile of all the patients was also noted on pre-designed proforma.

The patient was placed in supine position. The transducer was placed on the skin surface after applying the coupling agent. In each patient, femur length (FL) and transverse cerebellar diameter

(TCD) were measured and values were noted on proforma.

The collected data was converted into variables and was entered and analyzed accordingly by the statistical software namely SPSS version 17. Mean \pm standard deviation were computed for transcerebellar diameter (TCD), femur length (FL) and gestational age (GA). Frequency and percentages were calculated for parity. Pearson correlation was applied to determine the significant correlation between TCD, FL and GA. A p-value of ≤ 0.05 was considered as significant.

RESULTS:

A total of one hundred (100) pregnant patients with singleton and nonanomalous fetuses, who were sure of dates, were included in this study conducted at the Department of Diagnostic and Interventional Radiology, Sir Ganga Ram Hospital (SGRH) Lahore to determine the correlation between transverse cerebellar diameter (TCD) and femur length (FL) in third trimester of pregnancy. All the subjects were in their third trimester of pregnancy from 26-38 weeks, calculated by first day of last menstrual period. Ultrasound measurements were done with commercially available real time ultrasound equipment *Toshiba Aplio 80* (model number SSA-770A).

Majority of the patients belonged to age group 26-30 years (46%) followed by age group 20-25 years (34%) and >30 years (12%). Patients <20 were only 08% (Table 1). Regarding the parity status, as shown in table no. 2, among the 100 normal pregnancies, 08 were primigravida; 34 were gravida

2; 46 were gravida 3 and 12 were gravida 4. The transverse cerebellar diameter (TCD) and femur length (FL) were measured ultrasonographically in millimeters. The mean \pm SD transverse cerebellar diameter (TCD) was found to be 29.71 \pm 1.44 mm during 26-29 weeks of gestation; 37.00 \pm 2.27 mm during 30-34 weeks and 41.87 \pm 1.04 mm during 35-38 weeks of gestation. At 26-29 weeks of gestation, the minimum TCD was 27 mm and maximum TCD was 32 mm; at 30-34 weeks, the minimum TCD was 34 mm and maximum TCD was 40 mm; and at 35-38 weeks of gestation, the minimum TCD was 39 mm and maximum TCD was 44 mm (Table 3).

The mean \pm SD femur length (FL) was found to be 51.43 \pm 3.03 mm during 26-29 weeks of gestation; 61.10 \pm 3.99 mm during 30-34 weeks and 70.23 \pm 2.52 mm during 35-38 weeks of gestation. At 26-29 weeks of gestation, the minimum FL was 47 mm and maximum FL was 57 mm; at 30-34 weeks, the minimum FL was 53 mm and maximum FL was 67 mm; and at 35-38 weeks of gestation, the minimum FL was 65 mm and maximum FL was 74 mm (Table 4).

Table 5 shows that the correlation coefficient between TCD and gestational age (GA) was strongly positive ($r = 0.982$) and it was statistically highly significant (p value: 0.000). Similarly, correlation coefficient between FL and GA was also positive ($r = 0.970$) and statistically highly significant (p value: 0.000). A strong and positive correlation (r value = 0.966, p value = 0.000) was found between TCD and FL. The analysis showed that TCD had a stronger correlation with gestational age than FL (p value = 0.000).

Table 1: Distribution of cases according to maternal age (n = 100).

Age (Years)	Number of cases	Percentage (%)
<20	8	8
20-25	34	34
26-30	46	46
>30	12	12

Table 2: Distribution of cases according to parity (n = 100)

Parity	Number of cases	Percentage (%)
Primigravida	8	8
Gravida 2	34	34
Gravida 3	46	46
Gravida 4	12	12

Table 3: Fetal Mean±SD transverse cerebellar diameter (TCD) during different gestational ages

S. No.	Gestation (weeks)	N	Mean±SD TCD (mm)	Minimum TCD (mm)	Maximum TCD (mm)
1	26-29	14	29.71±1.44	27	32
2	30-34	39	37.00±2.27	34	40
3	35-38	47	41.87±1.04	39	44

Table 4: Fetal Mean±SD femur length (FL) during different gestational ages

S. No.	Gestation (weeks)	N	Mean±SD FL (mm)	Minimum FL (mm)	Maximum FL (mm)
1	26-29	14	51.43±3.03	47	57
2	30-34	39	61.10±3.99	53	67
3	35-38	47	70.23±2.52	65	74

Table 5: Pearson Correlation between transverse cerebellar diameter (TCD), femur length (FL) and gestational age (GA), in the third trimester of pregnancy

Parameters	R value	p value
TCD & FL	0.966	0.000
GA & TCD	0.982	0.000
GA & FL	0.970	0.000

DISCUSSION:

The precise dating of pregnancy is very crucial for pregnancy management from the first trimester to delivery. This is especially important for the determination of viability in premature and post-dates deliveries.¹³ Before the use of ultrasound on a large scale, obstetricians and gynecologists were dependent on a combination of history and physical examination to clinically assess gestational age. Ultrasound provided the obstetricians with a method to measure the fetus and thus estimate gestational age. When ultrasound is performed accurately by expert radiologist for assessment of gestational age it becomes clinically superior to using menstrual history dating system.¹⁴⁻¹⁵

The biometric parameters used for gestational age assessment such as biparietal diameter (BPD), femur length (FL), abdominal circumference (AC) and head circumference (HC) have their own limitations and the variability in predicting gestational age with these parameters goes on increasing as the pregnancy advances.¹⁶⁻¹⁷ Compared to the second trimester, the fetal parameters in the third trimester are liable to much greater size variations. Their accuracy for gestational age (GA) assessment is decreased markedly and estimates may have

confidence intervals of ± 3 weeks.¹⁸ Transcerebellar diameter (TCD) is emerging as a new and reliable parameter. It represents an independent biometric parameter as is evident from our study. The fetal cerebellum is identifiable as early as 10-20 post menstrual weeks. It grows in a linear fashion in 2nd trimester but then its curve flattens in 3rd trimester. Measurements of the transverse diameter of the cerebellum (TCD) is independent of the gestational age and shape of the fetal head, thus TCD remains an accurate method of estimating fetal age even in cases of uncertain dates, dolicocephaly or brachycephaly.¹⁹⁻²⁰

In our study, transverse cerebellar diameter (TCD) was measured in millimeters with commercially available real time ultrasound equipment Toshiba Aplio 80 (model number SSA-770A) in one hundred (100) pregnant ladies in third trimester of pregnancy. The mean±SD transverse cerebellar diameter (TCD) was found to be 29.71±1.44 mm during 26-29 weeks of gestation; 37.00±2.27 mm during 30-34 weeks and 41.87±1.04 mm during 35-38 weeks of gestation. At 26-29 weeks of gestation, the minimum TCD was 27 mm and maximum TCD was 32 mm; at 30-34 weeks, the minimum TCD was 34 mm and maximum TCD was 40 mm; and at 35-

38 weeks of gestation, the minimum TCD was 39 mm and maximum TCD was 44 mm.

Goel et al²¹ also studied TCD in pregnant ladies during different trimesters. They reported that the mean transverse cerebellar diameter (TCD) was 17.32 mm during 14-20 weeks of gestation; 26.63 mm during 21-30 weeks and 40.73 mm during 31-40 weeks of gestation. At 14-20 weeks of gestation, the minimum TCD was 13.0 mm and maximum TCD was 21.4 mm; at 21-30 weeks, the minimum TCD was 18.4 mm and maximum TCD was 35 mm; and at 31-40 weeks of gestation, the minimum TCD was 36 mm and maximum TCD was 48.4 mm. It can be seen that the mean TCD in third trimester is close to that of our study. The femur length (FL) can be measured as early as 10th week gestational age because of its size and echogenicity. Correlation with true gestational age is within one week prior to 20 weeks gestational age, but falls to within 2.1 to 3.5 weeks in the third trimester.¹⁸ The FL is most commonly used ultrasound parameter and one of the standard methods against which other parameters of gestational age assessment are compared. In our study, femur length (FL) was also measured in millimeters with commercially available real time ultrasound equipment Toshiba Aplio 80 (model number SSA-770A) in one hundred (100) pregnant ladies in third trimester of pregnancy. The mean±SD femur length (FL) was found to be 51.43±3.03 mm during 26-29 weeks of gestation; 61.10±3.99 mm during 30-34 weeks and 70.23±2.52 mm during 35-38 weeks of gestation. At 26-29 weeks of gestation, the minimum FL was 47 mm and maximum FL was 57 mm; at 30-34 weeks, the minimum FL was 53 mm and maximum FL was 67 mm; and at 35-38 weeks of gestation, the minimum FL was 65 mm and maximum FL was 74 mm. Rashid et al²² also studied FL in pregnant Bangladeshi ladies from 13-40 weeks of gestation. Femur length was found to increase gradually with gestational age. In their study, the mean femur length (FL) was 22.8 mm during 13-20 weeks of gestation; 41.86 mm during 21-30 weeks and 52.17 mm during 31-40 weeks of gestation. In an Indian study²³, at 13th week of gestational age, the mean femur length was 11 mm and at 40th week, it was 76 mm. Regression analysis was used to find out the correlation between transverse cerebellar diameter (TCD), femur length (FL) & gestational age (GA). Pearson correlation coefficient ("r" value) and p values were determined. In our study, there was strong and positive correlation (r = 0.982) between TCD and gestational age (GA) and it was statistically highly significant (p value = 0.000). Guan B found curvilinear relationship between TCD and gestational age (R² = 0.99, p value < 0.05). We also noticed curvilinear relationship between TCD and gestational age (R = 0.982, p value = 0.000).

In the study of Goel et al²¹, the "r" value for correlation between TCD and gestational age (GA)

was 0.991 (p = 0.001). Another prospective study in 371 normal pregnant women, with gestational ages ranging from 13 weeks to 40 weeks also revealed curvilinear relationships between TCD and the gestational age.²⁴ In another study, the fetal transverse cerebellar diameter was measured in 116 women with regular menstrual cycles, at 17-40 weeks of gestation. It was found that TCD correlated well with gestational age. The 95% confidence interval of the linear regression was also given. It was concluded that TCD may be a more useful indicator of the accurate gestational age in case of dolichocephaly or brachycephaly, and it facilitates antenatal detection of congenital disorders.²⁵ Other studies demonstrated that transverse cerebellar diameter measurement is an accurate predictor of gestational age, even in the third trimester of pregnancy. It was found that concordance between the actual and predicted gestational age was high (r = 0.92; P < .0001).²⁶⁻²⁷

The correlation coefficient between FL and GA was strong (r=0.970) in our study, and also statistically highly significant (p value: 0.000). A strongly positive and highly significant correlation (r value = 0.966, p value = 0.000) was found between TCD and FL. The analysis showed that TCD had a stronger correlation with gestational age than FL (p value = 0.000). One of the earliest relationships between femur length and gestational age was established by Hadlock et al who determined the relation between femur length and menstrual age in 338 fetuses using real time sonography. Predicted femur length values at various points were found to be comparable to the results of other investigations. He concluded that FL can be used as an adjunct in estimating menstrual age and as a screening device for certain diseases that affect limb growth.²⁸⁻²⁹ In an Iranian study, researchers measured FL in fetuses older than 24 weeks of gestation. The relation between femur length and menstrual age was determined by cross sectional survey in 900 normal fetuses. A regression equation was derived from the data acquired according to which the error in the estimation of gestational age for a given femur length was less than 6 days.³⁰ Another study tried focused on the effectiveness of ultrasonic femur length measurement from 12 to 40 week's gestation, as a means of assessing fetal age. The femur length and biparietal diameter (BPD) were obtained from 471 pregnant women with confirmed dates, using real-time scanning. Linear regression analysis with the correlation coefficient of the femur growth-curve (r = 0.989, p less than 0.001) and that of the BPD (r = 0.985, p less than 0.001) showed that the former was as good as the latter.³¹

CONCLUSIONS:

There is strong correlation between transcerebellar diameter (TCD) and femur length (FL) in normal

pregnancies in the third trimester of pregnancy between 26-38 weeks of gestation and correlation of transcerebellar diameter with gestational age is stronger than correlation of femur length with gestational age in the third trimester of pregnancy.

REFERENCES:

- Naseem F, Fatima N, Yasmeen S, Saleem S. Comparison between transcerebellar diameter with biparietal diameter of ultrasound for gestational age measurement in third trimester of pregnancy. *J Coll Physicians Surg Pak* 2013; 23:322-5.
- Shaikh MS, Lombay B. Fetal MRI: reviewing the history, indications, technique, safety and drawbacks. *J Coll Physicians Surg Pak* 2004; 14: 576-9.
- Malik G, Waqar F, Abdul Ghaffar, Zahidi H. Determination of gestational age by transverse cerebellar diameter in third trimester of pregnancy. *J Coll Physicians Surg Pak* 2006; 16:249-52.
- Gupta AD, Banerjee A, Rammurthy N, Revati P, Jose J, Karak P et al. Gestational age estimation using transcerebellar diameter with grading of fetal cerebellar growth. *NJCA* 2012; 1: 115-20.
- Jindal M. Accuracy of Transcerebellar diameter measurement by ultrasonography in the evaluation of fetal age. Bangalore: Rajiv Gandhi university of Health Sciences Karnatka; 2013.
- Chaddha V, Kapoor N. Fetal Skeletal System. *Journal of Ultrasound in Obstetrics* 2010; 4:388-400.
- Chavez MR, Ananth CV, Smulian JC, Vintzileos AM. Fetal transcerebellar diameter measured for prediction of gestational age at the extremes of fetal growth. *J Ultrasound Med* 2007; 26:1167-71.
- Araujo EJ, Pires CR, Nardoza LM. Correlation of the fetal cerebellar volume with other fetal growth indices by three dimensional ultrasound. *J Matern Fetal Neonat Med* 2007; 20:581-7.
- Julia AS, Hamzeiou KS, Rajagopalan V, Kim K, Barkovich AJ, Habas PA et al. 3D morphometric analysis of human fetal cerebellar development. In: Julia AS, Hamzeiou KS, Rajagopalan V, editors. *The cerebellum*. Philadelphia: Mosby; 2012: 761-70.
- Kuklisova M, Aljabar P, Srinivasan L, Counsell SJ, Doria V, Serag A, et al. A dynamic 4D probabilistic atlas of the developing brain. *Neuroimage* 2011; 54:2750-63.
- Holanda-Filho JA, Souza AI, Souza AS, Figueroa JN, Ferreira AL, Cabral-Filho JE. Fetal transverse cerebellar diameter measured by ultrasound does not differ between genders. *Arch Gynecol Obstet* 2011; 284:299-302.
- Gottlieb AG, Galan HL. Nontraditional sonographic pearls in estimating gestational age. *Semin Perinatol* 2008; 32:154-60.
- Kalish RB, Chervenak FA. Sonographic determination of gestational age. *Ultrasound Rev Obstet Gynecol* 2005; 5:254-8.
- Hughes R, Aitken E, Anderson J, Barry C, Benton M, Elliot J. National Institute for Health and Clinical Excellence. Antenatal care. Routine care for the healthy pregnant woman. NICE clinical guideline 62. London: RCOG Press; 2008.
- Bottomley C, Bourne T. Dating and growth in the first trimester. *Best Pract Res Clin Obstet Gynaecol* 2009; 23:439-52.
- Hadlock FP, Harrist RB, Martinez-Poyer J. How accurate is second trimester fetal dating. *J Ultrasound Med* 1991; 10:557-61.
- Kurtz AB, Wapner RJ, Kurtz RJ, Dershaw DD, Rubin CS, Cole-Beuglet C et al. Analysis of biparietal diameter as an accurate indicator of gestational age. *J Clin Ultrasound* 1980; 8:319-26.
- Naseem F, Ali S, Basit U, Fatima N. Assessment of gestational age; comparison between transcerebellar diameter versus femur length on ultrasound in third trimester of pregnancy. *Professional Med J* 2014; 21: 412-7.
- BR Joshi. Fetal transcerebellar diameter nomogram in Nepalese population. *J Institute Med* 2010; 32:19-3.
- Baschat AA. Fetal growth disorders. In: *High risk pregnancy*. St.Louis: Saunder; 2011: 173-9.
- Goel P, Singla M, Ghai R, Jain S, Budhiraja V, Babu CSR. Transverse cerebellar diameter- A marker for estimation of gestational age. *J Anat Soc India* 2014; 59:158-61.
- Rashid SQ. Gestational age predicted by femur length in Bangladesh. *J Bangladesh Coll Physicians Surg* 2010; 3:163-6.
- Rajan R, Girija B, Vasantha R. Ultrasound determination of fetal growth parameters and gestational age. In: Malhotra N, Kumar P, Dasgupta S, Rajan R (eds.) *Ultrasound in Obstetrics and Gynecology*, 3rd Ed. New Delhi, Jaypee Brothers 2001; 394-98.
- Reece EA, Goldstein I, Pilu G, Hobbins JC. Cerebellar measurements with ultrasonography in the evaluation of fetal growth and development. *AM J Obstet Gynecol* 1987; 156:1065-9.
- Hata K, Hata T, Senoh D, Makihara K, Aoki S, Takamiya O et al. Ultrasonographic measurement of the fetal transverse cerebellum in utero. *Gynecol Obstet Invest* 1989; 28:111-2.
- Hashimoto K, Shimizu T, Shimoya K, Kanzaki T, Clapp JF, Murata Y. Fetal Cerebellum: US appearance with advancing gestational age. *Radiology* 2001; 22:70-4.

27. Chavez MR, Ananth CV, Smulian JC, Yeo L, Oyelese Y, Vintzileos AM. Fetal transcerebellar diameter measurement with particular emphasis in the third trimester: a reliable predictor of gestational age. *Am J Obstet Gynecol* 2004; 191:979-84.
28. Hadlock FP, Harrist RB, Deter RL, Park SK. Fetal femur length as a predictor of menstrual age: sonographically measured. *Am J Roentgenol* 1982;138:875-8.
29. Hadlock FP, Harrist RB, Deter RL, Park SK. A prospective evaluation of fetal femur length as a predictor of gestational age. *J Ultrasound Med* 1983; 2:111-2.
30. Honarvar M, Allahyari M. Assessment of gestational age based on ultrasonic femur length in fetus. *Acts Medica Iranica* 1999; 37:134-8.
31. Shalev E, Feldman E, Weiner E, Zuckerman H. Assessment of gestational age by ultrasonic measurement of the femur length. *Acta Obstet Gynecol Scand* 1985; 64:71-4.