

Accuracy of Transcerebellar Diameter in Detection of Gestational Age in Third Trimester in Cases of Intra Uterine Growth Restriction

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Abstract--- **Background:** *The transverse cerebellar diameter (TCD) serves as a valid indicator of GA in the fetus and is a standard against which aberrations in other fetal parameters may be compared. The main goal of this research was to evaluate accuracy of transcerebellar diameter (TCD) in detection of gestational age in pregnancies with intrauterine growth restriction IUGR. Methods:* A case-Control study was carried out in department of Obstetrics and Gynecology at Zagazig University Hospital from June 2019 to Mars 2020. Included 52 women with normally progressing pregnancies during the third trimesters, 26 patients of them were normal pregnancies and 26 patients complains from IUGR in 3rd trimester at gestational age (27week to 37 week). Trans-abdominal ultrasound was performed on all patients, Fetal TCD was measured using the widest diameter of the cerebellum, measurement of fetal Bi-Parietal Diameter (BPD), Abdominal Circumference (AC), and Femur Length (FL). **Results:** *There were positive correlation between GA by Last Menstrual Period (LMP) and sonar parameters at normal group in all parameters but highest was TCD with P value 0.000, but at IUGR group only TCD, AC and FL were significantly positive correlated with GA; and TCD were highly significant, both HC and BPD were irrelevant. Conclusions:* *The TCD measurement appears to be an accurate predictor of gestational age, even in the third trimester of pregnancy.*

Keywords--- *Transcerebellar Diameter, Intrauterine Growth Restriction, Gestational Age.*

I. INTRODUCTION

Confirmation of gestational age obtained by LMP is made by ultrasound especially when there is discrepancy between fetal measurements. This avoids fallacies caused by different times of ovulation and aids in proper decision making in obstetrics. Second trimester fetal biometry is not accurate as LMP or first trimester CRL for proper estimation of gestational age even more some authors consider CRL measurement is more reliable than LMP which raises the clinical value [1]. First trimester screening is also essential to detect fetal anomalies and is more accurate significantly in estimation of fetal gestational age than second trimester fetal biometry. In pregnancies that are not complicated by any medical disorders with physiologically normal uniform fetal pattern of growth, evaluation and clinically essential estimation of fetal growth in relation to estimated fetal gestational age can be

calculated using BPD, HC, AC, FL and TCD [2].

Intra Uterine Growth Restriction (IUGR) is defined as decreased fetal birth weight less than 10th percentile as regard to gestational age. It is diagnosed when the fetal gestational age measured by transabdominal ultrasound less than estimated gestational age measured using first day of last menstrual period by more than 2 weeks. It is also diagnosed when there is a delay more than 2 weeks in a serial ultrasound monitoring of fetal gestational age [3].

The cerebellum, the largest part of hind brain, it consists of a midline part called the vermis and two lateral hemispheres. It is roughly spherical but somewhat constricted in its median region and flattened, the greatest diameter being transverse [4].

The transverse cerebellar diameter (TCD) has been one of the most reliable ultrasound parameters for growth, especially early gestation. The fetal cerebellum shows progressive growth throughout the gestation period 5,7; thus, it is an organ capable of providing information on the prediction of GA during the pregnancy. The TCD is well established in the ultrasound literature as a reliable parameter for estimating GA. This parameter may be particularly useful for accurate dating of pregnancies in the third trimester [5].

The TCD serves as a valid indicator of GA in the fetus and is a standard against which aberrations in other fetal parameters may be compared, especially when the GA cannot be determined by the routine methods of an early pregnancy scan or the date of the last menstrual period [6]. Normograms have been established for TCD and gestational age through pregnancy and many studies reported the better correlation of TCD with gestational age in second and third trimester and even in patients with IUGR, its usefulness as growth assessing parameter in comparison with other routine ultrasound parameters [4,7]. This study aimed to evaluate accuracy of transcerebellar diameter (TCD) in detection of gestational age in pregnancies with intrauterine growth restriction IUGR.

II. METHODS

After written informed consent was obtained from all participants and approval of the ethics committee, Case-Control study was carried out on 52 women with normally progressing pregnancies during the third trimesters, with gestational ages between 27 and 37 weeks of gestation come to outpatient clinic of department of Obstetrics and Gynecology at Zagazig General Hospital and Zagazig University Hospital from June 2019 to Mars 2020, 26 patients of them were normal pregnancies and 26 patients complains from IUGR in 3rd trimester at gestational age (27week to 37 week).

Inclusion criteria: Age (19-40) years old, Pregnant women with singleton pregnancy. Pregnant women at gestational age from 27 week of gestation to 37 week of gestation according to first day of last menstrual period in regular cycle patients or first trimestric visit ultrasound. Pregnant women with IUGR as diagnosed with ultrasound and fetal Doppler (in 1st group), and normal pregnancy in (2nd group). **Exclusion criteria:** Pregnant women <19 or > 40 years old. Pregnant women with multiple pregnancies, congenital fetal malformations, premature rupture of membranes. Pregnant women were using any vasodilator drugs in treatment of medical diseases preconceptional.

Fetal hydrops. Post-term pregnancy. Intrauterine fetal death. Maternal vascular diseases that affect fetal Doppler as autoimmune diseases that can cause IUGR. Pregnant women who were smokers or alcohol abusers.

All patients were subjected to a thorough assessment of history, with a focus on the date of the last menstrual period to ensure its reliability; general and abdominal examination; and ultrasound examination to assess fetal viability, Biparietal diameter (BPD), Transcerebellar diameter (TCD), Abdominal Circumference (AC), and Femur length (FL).

Trans-abdominal ultrasound examination was performed on all patients while women are in a slightly tilted position with the head of the bed raised 30 degrees and with a small pillow under the right loin, by GE Voluson 730 Pro- and GE Logic P7 ultrasound machines with a 3.5MHz abdominal probes.

Fetal Transcerebellar diameter (TCD) was measured using the method described by (AIUM 2013) to Obtain the trans thalamic view of fetal Bi-Parietal Diameter (BPD) by means of rotation of the probe slightly downwards, towards the fetal neck, the posterior horns of the lateral ventricles was disappear from view to be replaced by the cerebellum. The T.C.D. is measured at 90 degree to the long axis of the cerebellum across its widest point, using the outer to outer method. Figure (1).

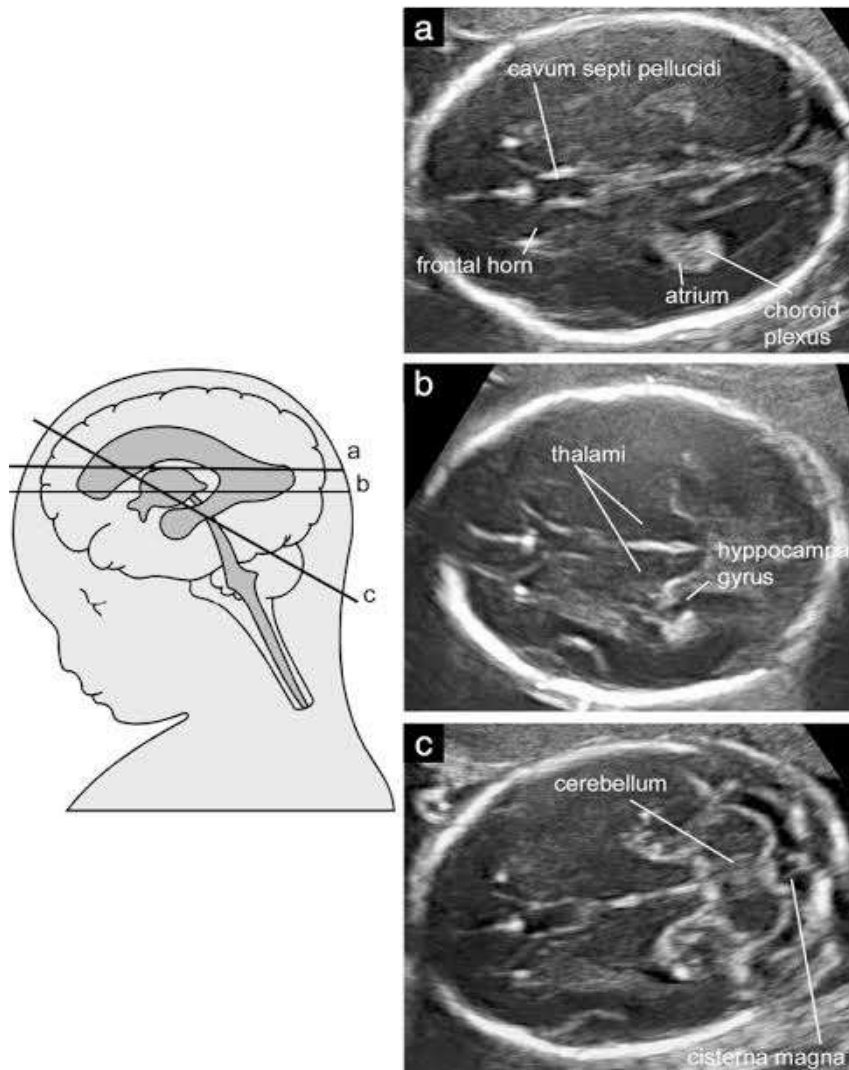


Fig. 1: Method of Measure of TCD.

III. STATISTICAL ANALYSIS

Data collected throughout history, basic clinical examination, laboratory investigations and outcome measures coded, entered and analyzed using Microsoft Excel software. Data were then imported into Statistical Package for the Social Sciences (SPSS version 20.0) (Statistical Package for the Social Sciences) software for analysis. P value was set at <0.05 for significant results &<0.001 for high significant result.

IV. RESULTS

Table 1, showed that maternal age was distributed as 31.84 ± 6.96 and 31.33 ± 6.09 respectively between Normal and IUGR with no significant difference. BMI was 26 ± 2.6 and 28 ± 2.9 respectively between Normal and

IUGR with no significant difference. There was no significant difference between groups regard gestational age.

Table 2, showed that there was no significant difference regard parity and fetal sex.

Table 3, showed that at 27-30 w of GA there was no significant difference between groups except in FL. At GA 31-33 w, normal was significantly higher than IUGR except in TCD and HC as there was no significant difference between groups regard them. At GA 34-37 w IUGR group was significantly lower than Normal group regard all parameters except TCD.

Table 4, showed that at normal group all parameters were highly significantly positive correlated with GA but highest was TCD. At IUGR only TCD, AC and FL were significantly positive correlated with GA but TCD were highly significant but AC and FL were only significant and much weaker than TCD.

Table 5, showed that no significant difference between actual GA and estimated GA by all sonar parameters at normal group. At IUGR group all GA estimated by sonar were significantly underestimated except GA estimated by TCD.

Table 1: Demographic Data.

	Normal	IUGR	t	P
Maternal age by years	31.84±6.96	31.33±6.09	0.294	0.770
BMI	26±5.5	28±6.5	1.198	0.233
GA LMP	31.23±3.56	32.0±3.36	-0.829	0.411

Table 2: Parity and Fetus Sex Distribution between Groups

			Group		Total	X ²	P
			Normal	IUGR			
Parity	PG	N	10	11	21		
		%	38.5%	42.3%	40.4%		
	Multi	N	16	15	31	0.08	0.77
		%	61.5%	57.7%	59.6%		
Fetal sex	Female	N	11	11	22		

		%	42.3%	42.3%	42.3%		
	Male	N	15	15	30	0.00	1.0
		%	57.7%	57.7%	57.7%		
Total		N	26	26	52		
		%	100.0%	100.0%	100.0%		

Table 3: Sonar Parameters Distribution between Studied Groups at each Gestational age GA Stage

GA by weeks (w)		Normal	IUGR	t	P
27-30 w	BPD(mm))	72.58±2.31	69.93±5.41	1.78	0.085
	TCD(mm))	33.06±0.98	32.46±2.51	0.83 8	0.414
	HC(mm)	273.35±8.73	267.0±18.23	1.24 2	0.225
	AC(mm)	250.65±20.7 1	235.78±20.7 9	1.95 8	0.060
	FL(mm)	56.23±1.81	51.26±6.89	2.77 9	0.010*
31-33 w	BPD(mm))	77.60±1.38	63.16±1.32	15.1 7	0.00**
	TCD(mm))	35.66±0.57	34.0±2.09	1.31	0.231
	HC(mm)	290.06±4.91	256.81±32.7 1	2.43	0.055

	AC(mm)	261.66±7.91	231.71±19.5 1	2.58	0.042*
	FL(mm)	59.86±1.27	48.0±3.79	5.14	0.001* *
34-37 w	BPD(mm))	85.0±3.65	69.63±7.85	4.64	0.001* *
	TCD(mm))	40.28±2.81	39.83±2.31	0.31 8	0.761
	HC(mm)	323.85±8.80	266.75±28.8 9	4.99 1	0.00**
	AC(mm)	304.42±16.2 1	245.51±29.7 5	4.53 4	0.001* *
	FL(mm)	68.64±3.63	56.85±6.41	4.16 4	0.002*

Table 4: Correlation between Gestational Age by LMP and Sonar Parameters at each Group

Group			GA_LMP
Normal	BPD	r	.894**
		P	.000
	TCD	r	.978**
		P	.000
	HC	r	.916**
		P	.000
	AC	r	.818**
		P	.000

	FL	r	.944**
		P	.000
IUGR	BPD	r	.161
		P	.395
	TCD	r	.828**
		P	.000
	HC	r	.323
		P	.081
	AC	r	.445*
		P	.024
	FL	r	.447*
		P	.021

Normal P-P Plot of Regression Standardized Residual

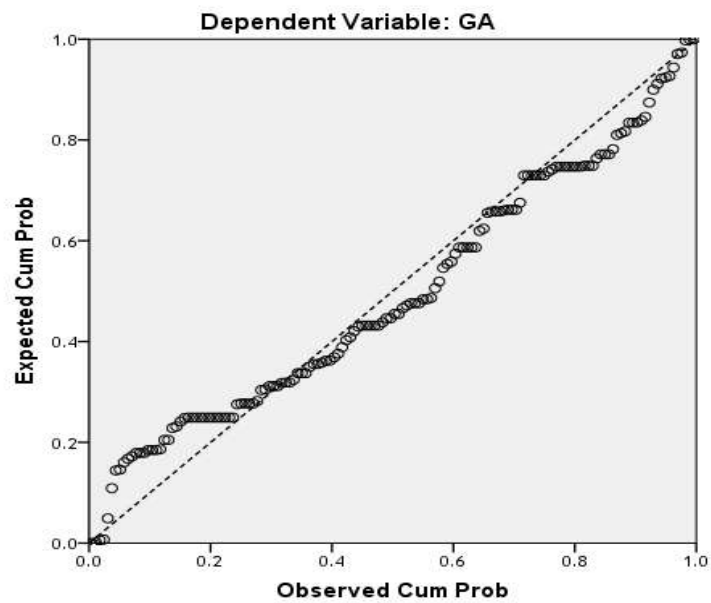


Figure 2: Regression between Actual Gestational Age and Sonar Parameters

Table 5: Paired Analysis for difference between Gestational Age (GA) by First Day of Last Menstrual Period and Estimated GA by Ultrasound Parameters in Normal and IUGR Groups

Group		Mean	SD	Paired t	P
Normal	GA_LMP	31.2308	3.56716	0.256	0.800
	Estimated GA BPD	31.1486	2.84865		
	GA_LMP	31.2308	3.56716	-0.487	0.630
	Estimated GA TCD	31.3015	3.48989		
	GA_LMP	31.2308	3.56716	1.479	0.082
	Estimated GA HC	29.7200	3.72132		
	GA LMP	31.2308	3.56716	0.598	0.555
	Estimated GA AC	30.9900	2.98619		
	GA_LMP	31.2308	3.56716	0.939	0.357
	Estimated GA FL	31.0061	3.02996		
IUGR	GA_LMP	32.0000	3.36821	5.511	0.00**
	Estimated GA BPD	27.8181	3.09669		
	GA_LMP	32.0000	3.36821	1.708	0.091
	Estimated GA TCD	31.1843	3.94404		
	GA_LMP	32.0000	3.36821	3.556	0.001**
	Estimated GA HC	29.4037	3.00269		
	GA LMP	32.0000	3.36821	5.128	0.00**
	Estimated GA AC	28.8477	3.12934		
	GA_LMP	32.0000	3.36821	6.084	0.00**

	Estimated GA FL	27.8854	4.24469		
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V. DISCUSSION

Many studies reported the better correlation of TCD with gestational age in second and third trimester and even in patients with IUGR, its usefulness as growth assessing parameter in comparison with other routine ultrasound parameters [4, 8].

There was no statistically significant difference in demographic criteria between the two groups (age, parity and fetal gender) with **P** value 0.77, 0.77, 0.1 respectively. Also study there was **no** significance difference between gestational age between two groups.

There were statistically significant difference between 2 groups in BPD, HC, AC and FL of fetuses with **p** value 0.00, 0.034, 0.012, 0.012, and 0.003 respectively but there were **no** statistically difference between 2 groups in TCD in normal group and in IUGR group with **P** value 0.719; in another word there were highly positive correlation between GA by LMP and sonar parameters at normal group in all parameters but highest was TCD with **P** value 0.000 but at IUGR group only TCD, AC and FL were significantly positive correlated with GA; and TCD were highly significant with **P** value 0.000 but AC and FL were lower significant and much weaker than TCD with **P** value 0.024 and 0.021 respectively. Both HC and BPD were irrelevant with **P** value 0.081 and 0.395 respectively. So TCD is good predictor which not changes as other ultrasonic parameters.

This was similar to **Satish, & Likhitha** [9] as they obtained data from Ultrasonic examinations of normal pregnancies and they found high correlation between TCD with BPD, FL, AC, HC and GA which showed good correlation with **P** value 0.0001.

Vinkesteijn et al. [10] had a retrospective, cross-sectional analysis of 360 normally developing fetuses in the period of 17 and 34 weeks and 73 growth-restricted fetuses between 24 and 34 weeks gestation was done, they found that the TCD measurement is typically spared in cases of IUGR. Even in severe growth restriction, the TCD was only mildly affected.

Chavez MR et al. [11] said that TCD measurement was both reliable and accurate in predicting gestational age even in extremes of fetal growth and suggests that the TCD is extremely valuable when the gestational age is unknown or IUGR is suspected.

Naseem et al. [8] made them study on 327 patients pregnant in their third trimester for detected an accurate method for assessment of gestational age in third trimester of pregnancy by comparing the transcerebellar diameter, biparietal diameter and femur length and they concluded that TCD is the most accurate method for assessment of gestational age in third trimester followed by FL, and the least accurate is the BPD. Also, by combining accuracy of TCD (89%) and that of FL (81%), they could be near certain of gestational age in most of their patients even if they were unsure of their dates.

Afshan et al. [12] conducted their study to determine the accuracy of fetal transverse cerebellar diameter measurement for the prediction of gestational age in growth restricted fetuses. The study sample was 100 pregnant women in the third trimester of pregnancy satisfying the eligibility criteria, 50 were fetuses with normal fetal growth and 50 growth restricted fetuses. The results showed that mean transverse cerebellar diameter in the fetuses showing normal growth was not statistically different from the mean transverse cerebellar diameter of that in the growth restricted fetus. They concluded that fetal TCD measurements seem to correlate well with the gestational age in both normal and growth restricted fetuses as there was no significant difference in TCD measurements in normal and growth restricted fetuses. Transverse cerebellar diameter measurement could be used reliably for accurate estimation of gestational age in growth restricted fetuses.

Prssad and Likhitha [9] detected a good correlation between the GA and TCD throughout the third trimester and even in the case of intra uterine growth retardation (IUGR).

Akl et al. [13] performed a study in Egypt on 150 pregnant women in their third trimester to determine the accuracy of the TCD in assessment of gestational age and he concluded that the TCD is a reliable method for assessment of gestational age in third trimester of pregnancy.

Ananthareddy et al. [14] study was done on the 20 pregnant women between 15 to 40 weeks, and reported that In IUGR pregnancies the gestational age was correlated to TCD and various ultrasonic parameters including BPD, FL, AC and HC. There was a very good correlation between gestational age and TCD, but the correlation was not that strong between gestational age and other parameters including BPD, FL, AC and HC. It showed that in 17 out of 20 patients the TCD measurements were within the 5th percentile and only in 3 patients it was less than 5th percentile. BPD & FL were less than 5th percentile in 18 out of 20 patients and AC, HC measurements were less than 5th percentile in all the 20 patients. This difference was statistically significant ($P = 0.0001$), that is TCD measurements were within the normal range in significantly higher number of patients than other ultrasonic measurements. They found that femur measurement as accurate as BPD in the estimation of gestational age of the fetus. So it was being used routinely along with BPD to predict the fetal age particularly when the head is in a difficult position and compared with other parameters.

Reddy et al. [15] evaluated accuracy of predicting GA using Fetal Transcerebellar Diameter (TCD) and to compare between TCD and other existing parameters in evaluating GA in 15 to 40 weeks of gestation. They showed that TCD is an accurate parameter in estimation of gestational age in second and third trimesters as its values are in close relation with that of GA by LMP. It is also better predictor of the gestational age when compared to other parameters especially in third trimester.

Ali et al. [16] The study included 500 pregnant women with sure and reliable dates at the Department of Obstetrics and Gynecology, Al-Azhar (Bab Alsheria) university Hospital. The entire subjects were in the third trimester of pregnancy seen at 31 – 36 weeks, the transcerebellar diameter, the biparietal diameter and femur length were measured for determination of gestational age. There was no statistically significant difference between LMP and TCD according to gestational age (wks), the average difference was weak 0.56 and C.I. 95% (0.14-0.98) with p-value >0.05 NS, and there was no statistically significant difference between LMP and FL according to gestational

age (wks.), the average difference was weak 0.72 and C.I. 95% (0.18-0.97) with p-value >0.05 NS. And there was no statistically significant difference between LMP and AC according to gestational age (wks), the average difference was weak 0.172 and C.I. 95% (0.43-2.15) with p-value >0.05 NS. But there was highly statistically significant difference between LMP and BPD according to gestational age (wks), the average difference was high 2.21 and C.I. 95% (0.56-0.3.22) with p-value <0.001 HS.

Lyndon et al.[17] obtained transverse cerebellar diameter in 44 small for gestational age fetuses between 27-42 weeks. The cerebellar diameter was normal in 12(27.3) between 1-2 SDs, below the mean for gestational age in six (13.6%) and greater than 2 SDs, below the mean in 26(59.1/5%). Hence they concluded that transverse cerebellar diameter **couldn't** be used to assess gestational age in those fetuses suspected of being small for gestational age. This may be due to difficulties in visualization, due to occipitoposterior presentation, ossification of the fetal skull and engagement of the fetal head.

VI. CONCLUSIONS

The TCD measurement appears to be an accurate predictor of gestational age, even in the third trimester of pregnancy. It is recommended to use TCD as an important ultrasound biometric parameter in normal singleton for the prediction of gestational age.

REFERENCES

1. Gottlieb AG, Galan HL. Nontraditional sonographic pearls in estimating gestational age. *Semin. Perinatol.* 154-160 (2008).
2. Whitworth M, Bricker L, Neilson JP et al. Ultrasound for fetal assessment in early pregnancy. *Cochrane. Database. Syst. Rev.* 4 (2010).
3. Mohammed EE, Alashkar OS, Abdeldayem TM, Mohammed SA. The use of low dose sildenafil citrate in cases of intrauterine growth restriction. *Clin Obstet Gynecol Reprod Med*, 2017; 3(4), 1-5.
4. Goel P, Singla M, Ghai R, Jain S, Budhiraga V, Babu R. Transverse cerebellar diameter-a marker for estimation of gestational age. *J Anat Soc. India.* 2010; 59(2): 158-161.
5. Kalish RB, Chervenak F. Sonographic determination of gestational age. *TMJ* 2009; 59: 202–208.
6. Araujo Júnior E, Pires CR, Nardoza LM, Filho HA, Moron AF. Correlation of the fetal cerebellar volume with other fetal growth indices by three-dimensional ultrasound. *J Matern Fetal Neonatal Med.* 2007; 20: 581–587.

7. 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(2): 412-417.
8. 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 (5): 322-5.
9. Satish-Prasad BS, Likhitha S. Cerebellar measurements with ultrasonography in evaluation of fetal age. *IOSR. J Dental and Med Sci. (IOSR- JDMS).* 2014; 13(9): 49-56.
10. Vinkesteyn AS, Mulder PG, Wladimiroff JW. Fetal transverse cerebellar diameter measurements in normal and reduced fetal growth. *Ultrasound Obstet Gynecol;* 2000; 15: 47-51.
11. 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.
12. Afshan A, Nadeem S, Shamim AS. Fetal transverse cerebellar diameter measurement, a useful predictor of gestational age in growth restricted fetuses. *Professional Medical Journal,* 2014; 21: 888-91.
13. Akl S, Mohammed M, Bahaa EA, Mohammed A. Accuracy of Transcerebellar Diameter at the Third Trimester in Estimating the Gestational Age in Singleton Pregnancy. *Med. J. Cairo Univ.* 2014; 82(1): 879-84.
14. Ananthareddy SM, Bahaddur A. Biometric parameter in estimation of the gestational age among IUGR: A ultrasound based study. *Am J Oral Med Radiol.* 2016; 3(2): 73-76.
15. Reddy RH, Prashanth K, Ajit M. Significance of foetal transcerebellar diameter in foetal biometry: A pilot study. *J Clin Diagn Res.* 2017; 11(6): 01-04.
16. Ali OE, Elsayy IR, Elbedewy AM. Comparative Study between Fetal Biometry and Transverse Cerebellar Diameter in Estimating Gestational Age in Third Trimester. *Egypt J Hospital Medicine,* 2019; 75(4), 2673-2678.
17. Lyndon MH, David Guzik, Joanne Fries, Hixson J, Rivello D. The transverse cerebellar diameter in estimating gestational age in the large for gestational age fetus. *Obstet Gynecol.* 1990; 75: 981.