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# Placental thickness and Transcerebellar diameter for accurate estimation of gestational age in the second trimester (A cross sectional study)

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## Abstract

**Objective:** To assess the accuracy of combined measurement of placental thickness and transcerebellar diameter in estimation of fetal gestational age in second trimester.

**Patients and Methods:** A cross sectional study was conducted at ultrasound unit, department of obstetrics and gynecology, Ain shams University Maternity Hospital in the period between January 2020 and March 2020. The population studied included 161 pregnant ladies at 14 to 26 weeks. Trans-abdominal ultrasound (Samsung H60, Convex Pro = CV1 = 8MHz - probe 4.9 MHz) was used to assess placental thickness and transcerebellar diameter.

**Results:** Our results showed that there is positive correlation between Placental thickness and gestational age  $r= 0.44$  which is highly significant (P value < 0.001). Also highly statistically significant positive correlation between TCD and G.A (P value < 0.001)  $r= 0.92$ . Statistical analysis of our results showed that trans-cerebellar diameter was more accurate than placental thickness for accurate estimation of gestational age with almost perfect agreement (0.91) between gestational age by last menstrual period and gestational age by trans-cerebellar diameter.

**Conclusion:** Client's aged  $32.8 \pm 3.4$ . More than half had primary infertility with mean duration of  $4.6 \pm 2.4$ . Female factor infertility was the commonest cause of infertility. The pregnancy rate per embryo transfer was 36.4%, miscarriage rate was 9.1%, while the live rate was 27.3%. The mean VAS scores at 1 hour, 6 hours, 24 hours and at embryo transfer were  $7.1 \pm 2.8$ ,  $4.6 \pm 1.4$ ,  $2.8 \pm 1.2$  and  $1.0 \pm 0.9$  respectively. The mean Likert score was  $2.4 \pm 0.9$ .

**Conclusion:** Both placental thickness and TCD are useful fetal biometric parameters that can be used for assessment of gestational age. Although placental thickness is positively correlated to G.A, it is not as accurate as TCD. Unfortunately, combined use of placental thickness and TCD is not superior to TCD alone in accurate estimation of gestational age.

**Keywords:** Ultrasound, placental thickness, transcerebellar diameter, gestational age.

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## **INTRODUCTION**

Determination of gestational age depends on accurate recall of the last menstrual period with regular rhythm and ultrasound assessment of fetal biometry. Over or under estimation of gestational age may result from inaccurate recalling of the last menstrual period and the affection of the fetal biometry by multiple factors.<sup>(1)</sup>

Worldwide the most common used fetal parameters for detection of the gestational age are biparietal diameter, head circumference, abdominal circumference and femur length. In the first trimester, the ultrasound assessment of gestational age is the most accurate. By the second trimester, ultrasound accuracy is reduced. By the third trimester, ultrasound accuracy becomes markedly reduced. Recently, studies have shown that fetal trans-cerebellar diameter is the most precise ultrasound parameter for estimation of the gestational age.<sup>(2)</sup>

The most accurate ultrasound single tool for estimation of gestational age in third trimester is trans-cerebellar diameter then FL, and then BPD. By combination of a TCD and FL we can know the gestational age in many women with unsure dates.<sup>(3)</sup>

The efficacy of the placenta to transfer the amount of nutrients, oxygen, and carbon dioxide that passes from the mother to fetus is in direct relation to the surface area of the placenta. By the third trimester, the placental growth is ended while the placental thickness continues to grow until the late third trimester.<sup>(4)</sup>

Placental thickness is a reliable biometry in the assessment of gestational age in singleton pregnancies is the placental thickness. This is due to the linear association between placental thickness and gestational age. It is measured at the site of cord insertion.<sup>(5)</sup> The placental thickness measurement is very easy and useful.<sup>(6)</sup>

The aim of the present study is to detect accuracy of combined measurement of placental thickness and trans-cerebellar diameter in estimation of fetal gestational age in second trimester of pregnancy.

## **PATIENTS AND METHODS**

This cross sectional study conducted at ultrasound unit, department of obstetrics and gynecology, Ain shams University Maternity Hospital in the period between January 2020 and March 2020.

The population of the study was pregnant ladies aged 18 to 41 years old with confirmed last menstrual period, regular cycles and not used hormonal pills 3 months prior to conception attended outpatient clinics in the second trimester for antenatal care with singleton and low risk pregnancy.

Women who had any disorder affecting the size of the placenta or fetal growth, fetal anomalies, liquor abnormalities and/or abnormal placentation were excluded from our study.

The study included 161 pregnant female who fulfilled inclusion criteria. They were subjected to full detailed history taking. Accurate last menstrual period date was obtained and gestational age was calculated using Neagle's rule or first trimester ultrasound (CRL). General and abdominal examinations were done including fundal level and Leopold's maneuvers. Placental thickness, trans-cerebellar diameter and estimated fetal weight were measured using trans-abdominal ultrasound.

Study procedure:

Detailed history was taken to exclude the previous exclusion criteria in selected cases: Personal history including name, age, occupation and special habits, Present, past history, family history, obstetric history including gravidity, parity, gestational age and menstrual history by Naegele's rule.



**Examination:**

**General examination**

Abdominal examination: fundal level and Leopold’s maneuvers.

**Investigation:**

Trans-abdominal ultrasound (Samsung H60, Convex Pro = CV1 = 8MHz - probe 4.9 MHz) was used to asses:

The placental thickness: was measured by placing the ultrasound probe perpendicularly to the placental plane, at the site of the cord insertion. The maximum thickness was measured in the cross section. The placenta was measured to 1 mm precision, at its greatest thickness, which was perpendicular to the uterine wall. Both the uterine wall and retro placental vein were excluded.

Trans-cerebellar diameter: This plane of TCD was at lower level than that of the trans-ventricular plane with posterior tilting. It included the visualization of the frontal horns of the lateral ventricles, CSP, thalami, cere-

bellum and cisterna magna.

**Ethical Considerations:** Approval of the ethical committee of the department of obstetrics and gynecology, Faculty of medicine, Ain shams university was obtained. The study was conducted in accordance with the current approved clinical protocol and relevant policies, requirements and regulations of the Ain Shams University Maternity Hospital.

**Data analysis:**

Analysis of data was done using SPSS program version 23. To describe the studied sample, quantitative data were presented as minimum, maximum, mean and standard deviation. Qualitative data were presented as count and percentage. Pearson correlation test was used to compare correlation between different continuous variables. Linear regression analysis was done to measure predictive ability of TCD and PT for prediction of GA. Intra-class correlation was used to measure agreement between GA by LMP and GA by TCD. P value < 0.05 was considered statistically significant.

**RESULTS**

Determination of gestational age depends on accurate recall of the last menstrual period with reg

**Table (1):** Demographic characteristics among the studied groups

Items			
Age	Mean ± SD	28.66± 5.49	
	Range	19 – 41	
		N	%
Gravidity	PG	48	29.8%
	G2	30	18.6%
	G3	32	19.9%
	G4 or more	51	31.7%

Parity	PG	48	29.8%
	P1	43	26.7%
	P2	34	21.1%
	P3	23	14.3%
	P4 or more	13	8.1%
Mode of previous delivery	NVD	37	32.2%
	CS	78	67.8%
	Total	115	100.0%
Fetal sex	Female	56	46.7%
	Male	64	53.3%
GA in weeks	Mean $\pm$ SD	22.09 $\pm$ 3.13	
	Range	14 – 28	

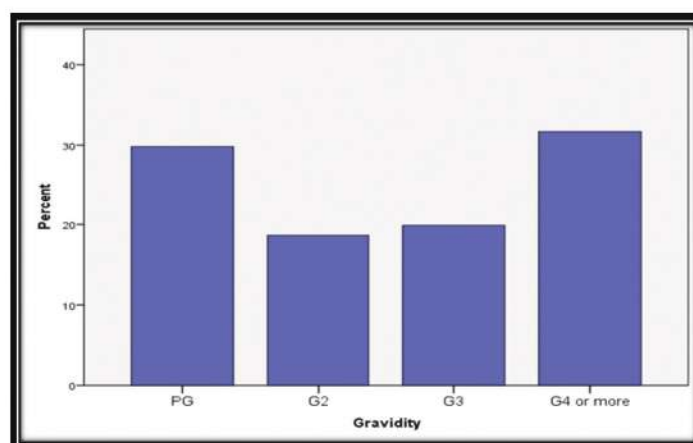


Figure (1): Gravidity

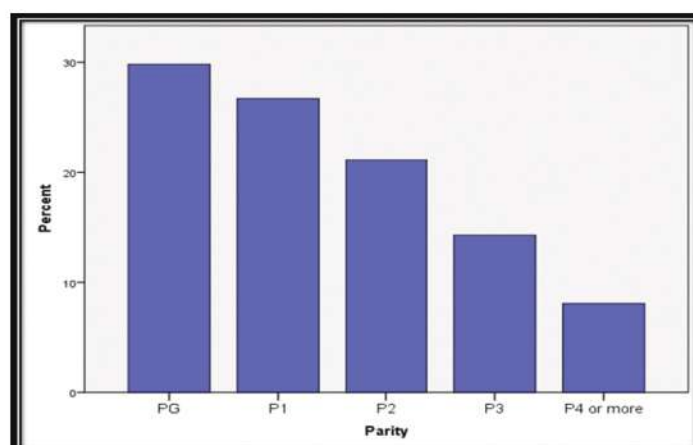


Figure (2): Parity

**Table (2):** Mean values of PT in relation to gestational age

Items		Placental thickness in mm	
		N	Mean $\pm$ SD
GA in weeks	14.00	1	21.00 $\pm$
	15.00	2	22.00 $\pm$ 5.66
	16.00	7	21.43 $\pm$ 4.76
	17.00	6	22.67 $\pm$ 5.79
	18.00	8	27.88 $\pm$ 3.60
	19.00	13	23.54 $\pm$ 5.90
	20.00	10	29.60 $\pm$ 5.50
	21.00	13	28.85 $\pm$ 5.26
	22.00	19	29.58 $\pm$ 5.77
	23.00	25	30.72 $\pm$ 4.80
	24.00	16	37.06 $\pm$ 11.12
	25.00	20	31.15 $\pm$ 7.98
	26.00	12	31.25 $\pm$ 6.06
	27.00	7	32.00 $\pm$ 8.83
	28.00	2	41.50 $\pm$ 2.12

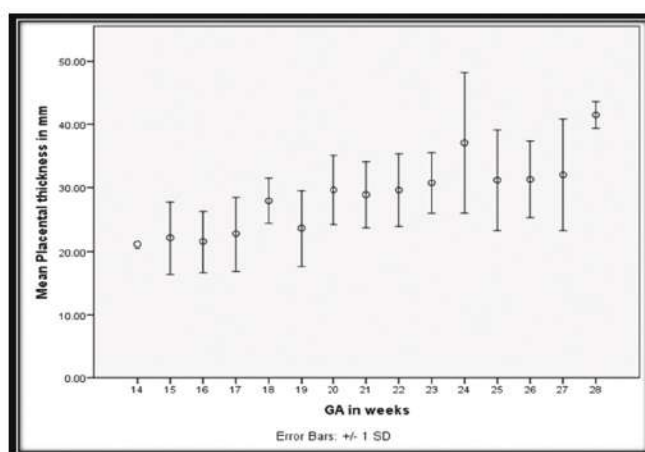


Figure (3): Mean values of PT in relation to gestational age

**Table (3):** Mean values of TCD in relation to gestational age:

Items		N	Mean $\pm$ SD
GA in weeks	14.00	1	13.00 $\pm$
	15.00	2	15.00 $\pm$ 1.41
	16.00	7	15.43 $\pm$ 1.13
	17.00	6	16.00 $\pm$ 0.89
	18.00	8	17.88 $\pm$ 1.13
	19.00	13	18.69 $\pm$ 1.55
	20.00	10	21.20 $\pm$ 1.32
	21.00	13	21.62 $\pm$ 1.61
	22.00	19	23.37 $\pm$ 2.41
	23.00	25	24.16 $\pm$ 1.91
	24.00	16	26.00 $\pm$ 1.83
	25.00	20	27.00 $\pm$ 1.69
	26.00	12	27.67 $\pm$ 1.97
	27.00	7	30.71 $\pm$ 1.98
	28.00	2	32.50 $\pm$ 2.12

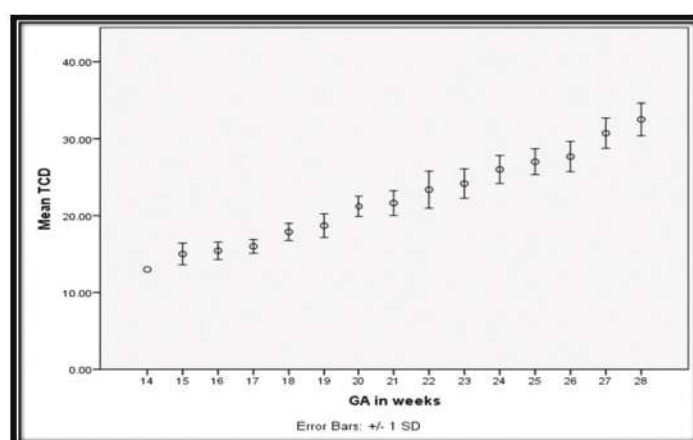


Figure (4): Mean values of TCD in relation to gestational age

**Table (4):** Correlation between GA and PT:

Items		Placental thickness in mm
GA in weeks	Pearson Correlation	0.44
	P value	<0.001 HS

Table 4 shows there is highly statistically significant positive correlation between Placental thickness and gestational age (P value < 0.001)  $r = 0.44$

Person Correlation Coefficient (r) between (-1 to + 1) correlation coefficient (r) more close to +1 indicates more strength of association.

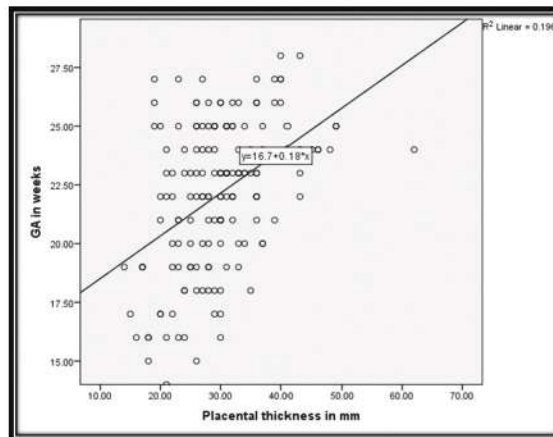


Figure (5): Correlation between GA and PT

**Table (5):** Correlation between GA and TCD:

Items		TCD
GA in weeks	Pearson Correlation	0.92
	P value	<0.001 HS

Table 5 shows there is highly statistically significant positive correlation between TCD and G.A (P value < 0.001)  $r = 0.92$ .

P-value > 0.05: Non significant, P value < 0.05: Significant, P value < 0.001: Highly significant.

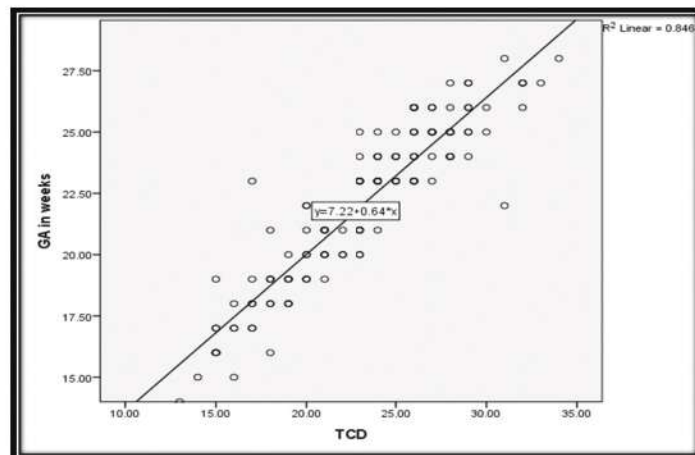


Figure (6): Correlation between GA and TCD

**Table (6):** Intra-class correlation for agreement between GA by LMP and GA by TCD:

Cronbach's Alpha		N of Items		
0.96		2		
Items		Mean $\pm$ SD		
GA by LMP		22.09 $\pm$ 3.13		
GA by TCD		21.71 $\pm$ 3.16		
Intra-class Correlation	95% Confidence Interval		F Test with True Value 0	
	Lower Bound	Upper Bound	Value	Sig
0.91	0.88	0.93	21.506	<0.001

F-test is a test will null hypothesis that the true value of ICC=0.

Cronbach's alpha tells you how reliably the two methods agree.

ICC tells you how reliable is for you to use GA by TCD to inquire for GA (0-0.2 indicates poor agreement, 0.3-0.4 indicates fair agreement, 0.5-0.6 indicates moderate agreement, 0.7-0.8 indicates strong agreement, and >0.8 indicates almost perfect agreement).

**Table (7):** Linear regression analysis for predictive ability of PT for prediction of GA:

	Unstandardized Coefficients		Standardized Coefficients	T	Sig.	95.0% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
(Constant)	16.697	.894		18.677	<0.001	14.932	18.463
Placental thickness in mm	.182	.029	.443	6.224	<0.001	.124	.239

We can predict G.A from PT by The following equation

**Equation:**  $GA = 16.697 + (0.182 * PT)$ , Model  $R^2 = 0.19$

**Table (8):** Linear regression analysis for predictive ability of TCD for prediction of GA:

	Unstandardized Coefficients		Standardized Coefficients	T	Sig.	95.0% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
(Constant)	7.223	.512	Model $R^2 = 0.85$	14.108	<0.001	6.212	8.234
TCD	.640	.022	.920	29.570	<0.001	.597	.682

We can predict G.A from TCD by the following equation.

**Equation:**  $GA = 7.223 + (0.64 * TCD)$ , Model  $R^2 = 0.85$



**Table (9):** Linear regression analysis for predictive ability of combined TCD and PT for prediction of GA:

	Unstandardized Coefficients		Standardized Coefficients	Significance	95.0% Confidence Interval for B	
	B	Std. Error	Beta		Lower Bound	Upper Bound
(Constant)	7.169	.538		<0.001	6.106	8.232
Placental thickness in mm	.005	.015	.012	0.738	-.024	.034
TCD	.636	.025	.914	<0.001	.587	.684

$$GA = 7.169 + 0.005*PT + 0.636*TCD$$

$$\text{Model } R^2 = 0.85$$

## **DISCUSSION**

A crucial step in proper antenatal care is accurate pregnancy dating. Accurate gestational age is vital in managing pregnancy. In many cases it is the key for determination of timing of certain intervention.<sup>(6)</sup>

Inaccurate pregnancy dating is associated with increased incidence of iatrogenic preterm and postterm deliveries. It is associated with high perinatal morbidity and mortality. In case of uncertain gestational age the clinician is in dilemma searching for best way for accurate dating. The best way for accurate pregnancy dating in absence of sure and reliable last menstrual period is ultrasound<sup>(7)</sup>

Among the most commonly used parameters in ultrasound for estimation of the gestational age in the second trimester are the Bi Parietal Diameter, Head Circumference, Abdominal Circumference and Femoral Length. A recently added ultrasound parameter is Transverse cerebellar diameter (TCD).<sup>(8)</sup>

Anatomically the cerebellum lies in the posterior cranial fossa and it is surrounded by the occipital bone. This is a natural protection from any external pressure. This is very important fact that makes TCD the least ultrasound parameter to be affected by external factors.<sup>(9)</sup>

Another promising ultrasound parameter used for assessment of fetal gestational age is Placental thickness. This is due to the pres-

ence of linear relationship between placental thickness and the gestational age.<sup>(10)</sup>

This is cross sectional study assessed the accuracy of combined measurement of placental thickness and trans-cerebellar diameter in estimation of fetal gestational age in second trimester of pregnancy and the use of these two ultrasound measurements as another method for accurate estimation of gestational age in absence of accurate pregnancy dating.

According to our knowledge, there are no previous studies that evaluate the use of combined measurement of placental thickness and trans-cerebellar diameter for estimation of fetal gestational age (GA) during second trimester.

Our findings have shown that, there is a positive correlation between TCD and GA which is highly statistically significant (P value < 0.001)  $r = 0.92$ . Linear regression analysis for predictive ability of TCD for detection of GA, We can predict G.A from TCD by The following equation: Equation:  $GA = 7.223 + (0.64 * TCD)$ , Model  $R^2 = 0.85$ .

In the current study, we evaluated the role of placental thickness in assessment of gestational age and we found a positive correlation between PT and GA which is highly significant ( $r = 0.44$ , P value < 0.001). Linear regression analysis for predictive ability of PT for detection of GA, We can predict G.A from PT by The following equation:



Equation:  $GA = 16.697 + (0.182 * PT)$ , Model  $R^2 = 0.19$ .

According to regression analysis, linear regression analysis for predictive ability of combined TCD and PT for prediction of GA

$GA = 7.169 + 0.005*PT + 0.636*TC$ , Model  $R^2 = 0.85$

Statistical analysis of our results showed that trans-cerebellar diameter was more accurate than placental thickness for accurate estimation of gestational age with almost perfect agreement (0.91) between gestational age calculated from last menstrual period and gestational age by trans-cerebellar diameter. Unfortunately, combined use of placental thickness and TCD measurement is not superior to TCD alone in accurate estimation of gestational age.

A prospective case control study by Alalfy et al. assessed the accuracy of the transcerebellar diameter in comparison to other ultrasound parameters in detection of the gestational age with normal and complicated pregnancies. This study concluded that trans-cerebellar diameter, in comparison to other biometric measurements, is the most accurate ultrasound parameter. This is because the growth of cerebellum is not affected by any disorder. <sup>(11)</sup>

Another prospective pilot study by Reddy et al. evaluated the accuracy of fetal transcerebellar Diameter (TCD) in prediction of the gestational age in pregnant ladies between 15 to 40 weeks. The study compared between TCD and the other ultrasound parameters. They showed that TCD is the best gestational age predictor. <sup>(9)</sup>

A prospective cohort study, by Uikayet al. aimed to assess the degree of accuracy of trans-cerebellar diameter in detection of gestational age. The study included 500 women. Their gestational age ranged from 7 and 11 weeks of gestation. The follow up continued to 40 weeks of gestation. Ultrasound performed once in each trimester. They concluded that, TCD is the most reliable ultrasound parameter in estimation of gestational age. <sup>(7)</sup>

A prospective cross sectional study, by Nageshet al. included 100 women with normal singleton pregnancies from 15 to 40 weeks. They evaluated the development of fetal cerebellum using ultrasound and its role in assessment of the fetal gestational age. They showed that TCD was well correlated with gestational age. <sup>(8)</sup>

An observational cross-sectional study, by Njeze et al. supports our findings as regard the correlation between placental thickness and gestational age. They examined the relation between placental diameter and thickness with gestational age in 400 women during the third trimester. They concluded that placental thickness is correlated to the gestational age. <sup>(12)</sup>

Another study by Pant and Dashottar evaluated the use of placental thickness for detection of the gestational age and the pattern of growth of the placenta. The study included 110 pregnant women from 14 weeks to 40 weeks. They agreed with us and stated that placental thickness corresponds with the gestational age in second trimester and is useful as an additional parameter for gestational age estimation. <sup>(13)</sup>

Mahaleet al. evaluated the relationship between placental thickness and gestational age. The study included 225 women from 12 to 40 weeks with sure and reliable LMP. Pregnancy dating was confirmed by first trimester ultrasound. When comparing the placental thickness with the gestational age, a coefficient of correlation ( $r$ ) = 0.972 was obtained which was statistically significant [ $p < 0.001$ ]. <sup>(14)</sup>

## **CONCLUSION**

Both placental thickness and TCD are useful fetal biometric parameters that can be used for assessment of gestational age. Although placental thickness is positively correlated to G.A, it is not as accurate as TCD. Unfortunately, combined use of placental thickness and TCD is not superior to TCD alone in accurate estimation of gestational age.



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