

## Comparison of Fetal Kidney Length with Biparietal Diameter in Second Trimester and Femur Length in Third Trimester for Prediction of Gestational Age – A Case Study

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**Abstract:** Obstetric sonography plays an important role in the accurate determination of intrauterine gestational age. The exemplary safety record of diagnostic ultrasound is probably an important reason that it has become so widely used.<sup>1</sup> Ultrasonic measurement of fetal biometry (CRL, BPD, FL) are considered to be reliable when they are performed in first & early 2nd trimester (<24 weeks). Currently there is no single fetal measurement used for accurate estimation of gestational age in the 3rd trimester especially in women who booked late & unsure about their LMPs.<sup>2</sup> Several longitudinal studies have been performed in the western countries concerning sonographic measurement of foetal kidney length. Initially these were done for diagnosis of renal malformation in utero & later on they were to find out the correlation between the fetal kidney length and the gestational age. So we also planned to measure the fetal kidney length sonographically & to consider it as a new parameter to determine the gestational age. Hence this study is to establish this linear correlation.

**Keywords:** ultrasonography, crown rump length(CRL), biparietal diameter(BPD), femur length(FL), kidney length(KL)

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### I. Introduction

Knowledge of gestational age is important in following ways<sup>3</sup>: i) To anticipate normal spontaneous delivery or to plan elective delivery within the time frame of a term pregnancy. In some cases early termination is necessary as soon as fetus becomes mature eg. preeclampsia, IUGR, diabetes, central placenta previa & sensitized Rh negative mother. ii) To consider invasive procedures such as chorionic villus sampling, genetic amniocentesis and in interpretation of biochemical tests such as maternal serum alpha-fetoprotein screening. iii) To evaluate the foetal growth. iv) Gestational age influence the management decision if the foetus is diagnosed with anomaly. So all important clinical decisions are influenced by the gestational age. Ultrasound is safe for the patient, the foetus and the sonologist. There is no reported risk of ionizing radiation as in radiography,<sup>4</sup> or any other known biological or embryotoxic effect. It does not require any injections as sometimes needed in imaging studies.<sup>5</sup>

### II. Materials And Methods

A prospective study was done in 200 healthy women between the 20th week of gestation and 38th week of gestation in out patient and in-patient sections of Obstetrics and Gynaecology department of Sree Balaji Medical College and Hospital, Chennai. This study was undertaken to determine comparison of fetal kidney length with biparietal diameter ( BPD ) in second trimester and femur length ( FL ) in third trimester for prediction of gestational age. **INCLUSION CRITERIA** :Reliable LMP, Dating confirmed by first trimester USG, Singleton pregnancy, Age of 20-35 years, Women of GA 20-38 weeks, Women of any gravidity. **EXCLUSION CRITERIA** :Multiple pregnancies, Dilated renal pelvis, Women who are diagnosed with hypertension, renal diseases, diabetes. Oligohydramnios, polyhydramnios, Fetal anomaly, Fetal growth restriction. **EXAMINATION METHOD**: All the statutory requirements under PNDT act were followed. All women who meet the inclusion & exclusion criteria were included into the study after signing an informed written consent. Routine USG was done in all cases enrolled in the study. Transabdominal ultrasonography was performed with patient in supine position, measurement were performed by USG machine-Siemens Acuson-2000 model were used, and to minimize interobserver error, obtaining the measurements was restricted to one independent investigator. Time period(20-22 weeks) along with anomaly scan in second trimester. Along with

growth scan in third trimester > 28 weeks of gestation measurements were taken. The kidney length was measured from one outer pole to another, as described by Bertagnoli et al. for any measurements to be included in the study, the adrenal glands had to have been clearly identified & excluded from the measurements. All the measurements were performed during fetalapnea. Where there were difficulties measuring both kidneys (due to the position of the fetus), the mother was allowed to wander outside the investigation room for 30–45 min and then return for repeat scanning. At the outset, failure to obtain measurements of both kidneys at any stage led to automatic exclusion from the study. Fetal biometric indices were measured . Linear mixed regression models were used to examine the evidence of a linear relationship between estimated gestational age and the various anthropometric measurements. Statistical analysis was done with the statistical package for social science (SPSS). Standard deviation was taken as measure of variation & the frequencies of the data were expressed as mean ( $\pm$  SD). Level of significance was expressed as 'P' value <0.05 was taken as significant.

### III. Results

**TABLE 1:** Association between gestational age and BPD & KL in the study group in 2nd trimester.

<b>GestationalAge (weeks)</b>	<b>BPD(in weeks) X <math>\pm</math> SD</b>	<b>KL(in weeks) X <math>\pm</math> SD</b>
20	21.080 $\pm$ 0.18	21.700 $\pm$ 0.035
21	21.150 $\pm$ 0.12	22.560 $\pm$ 0.047
22	22.210 $\pm$ 0.13	23.405 $\pm$ 0.048
23	22.340 $\pm$ 0.18	24.260 $\pm$ 0.050
24	23.760 $\pm$ 0.17	25.105 $\pm$ 0.051
25	23.970 $\pm$ 0.19	25.920 $\pm$ 0.053

This table shows the mean BPD & KL in the antenatal women of each gestational age of the 2nd trimester.

**Table2 :** Association between gestational age and KL & FL in the study group in 3rd trimester.

<b>GestationalAge (weeks)</b>	<b>FL (in weeks) X <math>\pm</math> SD</b>	<b>KL (in weeks) X <math>\pm</math> SD</b>
30	30.11 $\pm$ 0.17	31.375 $\pm$ 0.055
31	31.91 $\pm$ 0.12	32.155 $\pm$ 0.050
32	32.54 $\pm$ 0.16	32.960 $\pm$ 0.062
33	33.45 $\pm$ 0.27	33.795 $\pm$ 0.062
34	34.27 $\pm$ 0.04	34.650 $\pm$ 0.063
35	35.08 $\pm$ 0.28	35.460 $\pm$ 0.063
36	35.98 $\pm$ 0.14	36.285 $\pm$ 0.063
37	36.89 $\pm$ 0.18	37.420 $\pm$ 0.063
38	37.51 $\pm$ 0.26	38.015 $\pm$ 0.063

This table shows that mean KL correlates well with FL in the estimation of gestational age.

**TABLE 3:** Linear regression equation of various indices comparison of 2nd trimester and 3rd trimester - KL/FL/BPD in relation to gestational age.

#### 2nd TRIMESTER :

<b>Parameter</b>	<b>Intercept Estimate</b>	<b>SE</b>	<b>Slope Estimate</b>	<b>SE</b>	<b>P Value</b>	<b>r<sup>2</sup></b>	<b>SE<sub>P</sub></b>
KL	1.203	0.353	0.832	0.105	0.015	99.5	8.17
BPD	1.782	0.330	0.411	0.902	0.000	99.0	9.23

#### 3rd TRIMESTER :

<b>Parameter</b>	<b>Intercept Estimate</b>	<b>SE</b>	<b>Slope Estimate</b>	<b>SE</b>	<b>P Value</b>	<b>r<sup>2</sup></b>	<b>SE<sub>P</sub></b>
KL	2.458	0.233	0.849	0.233	0.000	98.9	8.34
FL	2.710	0.496	0.432	0.496	0.289	97.9	9.58

The above tables show the equations derived from linear regression analysis when the individual variables were considered separately. In the 2nd trimester, KL recorded with standard error of 8.17 days, compared to the BPD which recorded standard error of 9.23 days. There was no significant difference between KL & BPD measurement's importance because the corrected BPD measurement were used. In the 3rd trimester, the most accurate was KL with standard error of 8.34 days, compared to the FL which had standard error of 9.58 days. Hence, it can be concluded that kidney length is the most appropriate method to estimate the gestational age mainly in the 3rd trimester.

#### **IV. Discussion**

Accurate gestational dating is of paramount importance and the cornerstone for management of pregnancies. Accurate and easily reproducible sonographic foetal biometric parameters for gestational dating are clinically important for the optimal obstetric management of pregnancies. This is especially true in determining timing of a variety of gestational tests, assessing adequacy of growth and timing of delivery for the optimal obstetric outcome. In this study, we have analyzed 200 patients not at risk for fetal kidney disease and whose pregnancies resulted in a normal fetal outcome, to determine how renal length varies with gestational age. The study group included women in the second and third trimester from 20 weeks to 38 weeks. The results were analyzed, It dates pregnancy as shown in ( Table : 3 ) with the accuracy of  $\pm 8.17$  days when correlated with 2nd trimester &  $\pm 8.34$  days when correlated with 3rdtrimester.KL was compared with other biometric indices like BPD & FL. BPD dates pregnancy with the accuracy of  $\pm 9.23$  days when correlated with 2nd trimester, FL by  $\pm 9.58$  days, suggesting that KL is the best predictor in the estimation of gestational age especially during the 3rd trimester when compared to the 2nd trimester. Hence, this study has concluded that kidney length can be combined with other biometric indices to increase the accuracy in estimation of gestational age. There are several studies which were done earlier in other countries like UK, USA,GERMANY. There are only a few Indian studies to show the relation between Gestational Age and Renal length. So this study is done to find out whether there exists any differences among different women of different ethnic groups. Sato et al<sup>5</sup> in his study , showed that kidney growth correlates well with abdominal circumference and could be an additional parameter for the detection of intrauterine growth retardation, but since we have excluded antenatal women with risk factors, this study was not able to show whether, it can be used as a predictor of intrauterine growth retardation. Likewise, since we did not include diabetic mothers, our study cannot say whether renal length correlates with gestational age in macrosomic foetus. The study demonstrated that by measuring kidney length, pregnancies could be dated within  $\pm 8.17$  days when correlated to 2nd trimester and  $\pm 8.34$  days when correlated with 3rd trimester which is in correlation with the study by JJ Kansaria et al 2009<sup>6</sup>, which was predicted by  $\pm 9.17$  days, Kidney length predicted gestational age with better precision than the model with biometric indices of abdominal circumference and femur length, this provides an obvious advantages where biparietal diameter and/or head circumference cannot be accurately measured because foetal head is too low or correct plane for measurement cannot be obtained. In these circumstances, therefore kidney length can be used on its own to estimate gestational age. In a study on 58 pregnant women, Konje et al<sup>7</sup> showed that there was a significant correlation between gestational age and kidney length. They concluded that fetal kidney length could be used reliably for estimation of gestational age. Results of the present study are in good agreement with that study. Lawson et al<sup>8</sup> showed that measurement of fetal kidney length in mm is approximately the same as gestational age in weeks which supports the result of this study Although fetal kidney size, as for all fetal organ is affected by growth variations these appear to predominately affect only the AP and transverse diameter but not the kidney length. Rule of thumb is that "renal length in mm almost approximates GA in weeks". In our study we also found that the mean length of fetal kidney linearly increased with gestational age and a strong correlation exists between fetal kidney length and GA determined by BPD & FL and an average of these which is similar to the study by konje et al 2002. A previous study regarding the fetal kidney lengths carried out in Bangladesh by Ansari et al<sup>9</sup>, They found an excellent correlation between gestational age and fetal kidney. In that study he showed that the average kidney length of 29 mm at 29 weeks and 39.5 mm at 40 weeks, which is also in good agreement with the present study. Results of the present study are also in agreement with the study done by S.Afroz et al<sup>10</sup> However it should always be remembered that a single USG examination for determining gestational age is unreliable after 30 weeks, so taken in conjunction with BPD, FL, renal length based on 3rd trimester could well be used as an additional parameter for determination of gestational age and also an early means of detection of abnormal renal development.

#### **V. Conclusion**

KindegLength positively correlated with BiparietalDiameter, and Femur Length and clinical gestational age and the correlation was found to be significant ,there is a linear relationship between the kidney growth and the gestational age. So KindegLength can be used as a reliable parameter for determination of gestational age.

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