Original Research Article

ESTIMATION OF FOETAL GESTATIONAL AGE BY MEASURING THE HUMERUS LENGTH

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Abstract
Introduction: The estimates of age based on measurements of humerus length (HL) can be used as an alternative in pregnancy dating. These additional measurements taken provide a more 'universal view' of the foetal development than can be afforded by any single measurement. In the present study humerus length was measured to study the correlation and significance of this parameter with last normal menstrual period (LNMP) in estimating the foetal gestational age [FGA].
Material and Methods: In the present study, a total of 100 antenatal women attending Out-Patient Department of Obstetrics and Gynaecology at Government Maternity Hospital, Sultan Bazaar, during the period of
January 2016 to August 2016 i.e. for eight months were included in the study, undergone ultrasonography of parameters of humerus bone.
Result: HL and LNMP value in Total estimating the FGA with correlation coefficient r value of 0.951, correlation was significant at < 0.01 level (p value 0.000). In second Trimester r value of 0.885, and correlation was significant at the 0.01 levels (p value 0.000) and < 0.01 level (p value 0.000). In 3rd Trimester r value of 0.621 and correlation is significant at < 0.01 level (p value 0.000). Coefficient r-value, of humerus HL was 0.961, in the study population trimester wise.
Conclusion: We concluded that ultrasonographically measured HL of the foetus is reliable predictor in estimating the foetal GA.
Key words: Humerus length, Foetal Gestational Age and Ultrasonography

Introduction:
Previously, estimation of gestational age was based on the history and physical examination like the menstrual history, maternal sensations of foetal movements, and assessment of

uterine size by bimanual examination in 1st trimester, initial detection of foetal heart tones by doppler and uterine fundal height measurement. (1, 2) The estimation of FGA from menstrual history is done using Naegele's rule and it is the method that is universally used. By this rule, FGA is estimated by taking the first day of the LNMP and adds seven days to it, then subtracting three months and adds a year. This is assuming that the average length of the menstrual cycle is 28 days. In the fundal height method, depending upon the height of the fundus from the symphysis pubis, FGA will be determined. However, it has been reported that even in the best known cases, these techniques were filled with error (3).

In most of the cases, the date of the last normal menstrual period is not known or there may be history of irregular menstrual cycles or may be on contraceptives and in such a case, estimation of FGA becomes difficult, hence the estimation of FGA by various parameters measured on ultrasonography will be very much useful. Ultrasonographic foetal biometry is the widest spread method used to establish gestation age, estimate foetal size and monitor its growth.

FGA is proper assessment of the foetal well-being requires an accurate knowledge of gestational age of the foetus. HL is an accurate predictor of gestational age. At 13 weeks of gestation the mean humerus length 13.12± 0.50, while at 40 weeks of gestation 69.00±00 respectively.
 In the present study HL was measured to study the correlation and significance of this parameter with LNMP in estimating the FGA.

Material and Methods
In the Present study, a total of 100 antenatal women attending Out-Patient Department of Obstetrics and Gynaecology at Government Maternity Hospital, Sultan Bazaar, during the period of January 2018to August 2018 i.e. for eight months were included in the study.

The included patients were undergone the ultrasound scanning in the Hospital and the visibility on ultrasonography of humerus bone parameter were obtained and tabulated. Multiple gestation, uncertain first day of last normal menstrual period, irregular menstrual cycle or <26 or >30 days, IUGR, major fetal abnormalities, and those who are having maternal complications were excluded from the study.

Results:

Table 1: Mean Gestational Age of the Foetus in Total participants, Foetus in second trimester, and Foetus in third trimester according to LNMP and HL

	Total			Second trimester			Third trimester		
	Bony parameter measurements in mm (Mean±SD)	GA in weeks Mean± SD	Range (weeks)	Bony parameter measurements in mm (Mean±SD)	GA in weeks Mean± SD	Range (weeks)	Bony parameter measurements in mm (Mean±SD)	GA in weeks Mean± SD	Range (weeks)
GA by HL	44.28±15.94	27.18±8.14	13-40	31.00±9.16	20.25±3.55	13-27	58.67±6.13	34.68±3.93	28-40

Correlation of Foetal Gestational Age by Humerus Length (HL) :

In the present study, when analysis using Pearson correlation coefficient was done, it indicated a significant positive linear relationship between HL and LNMP value in estimating the foetal gestational age, with r value of 0.951 and correlation was significant at <0.01 level (p value 0.000). The correlation between LNMP and HL was given in Graph 1.
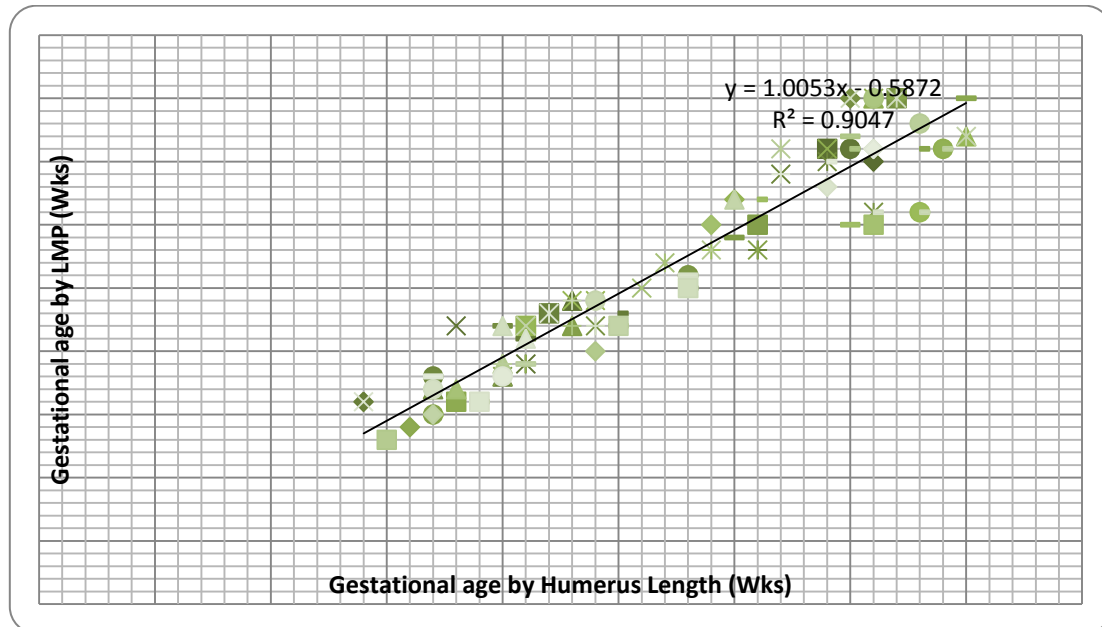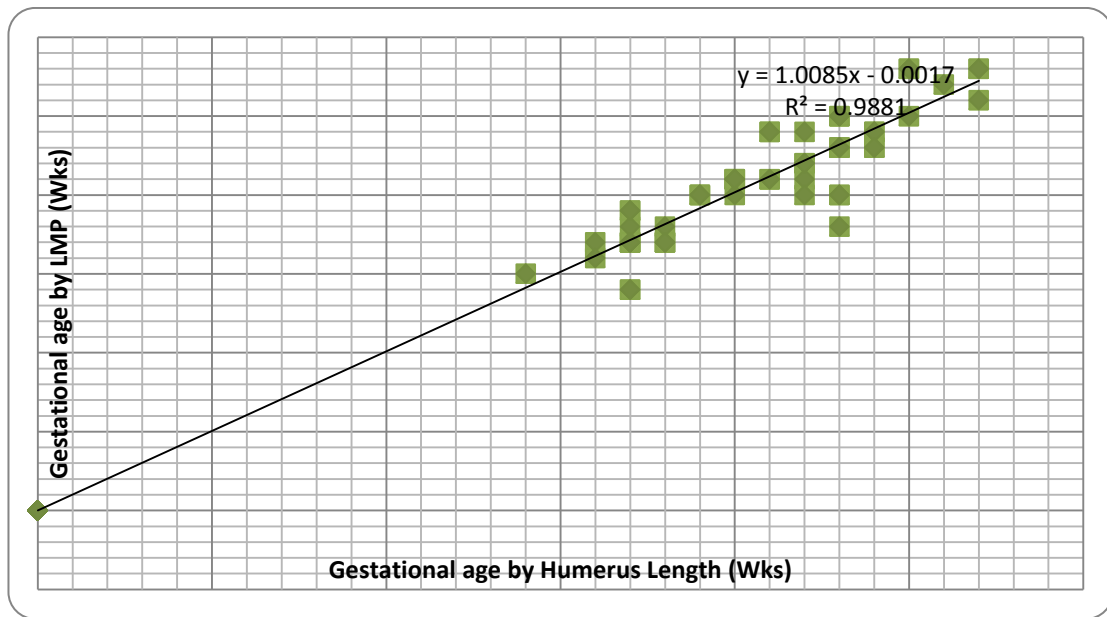

Graph 1: Correlation between HL and LNMP in estimation of foetal GA

When the correlation coefficient 'r' value HL (0.951/) with LNMP was compared, there is not much difference between them, but r value of HL is slightly higher indicating the more linear relationship HC with LNMP.

In the present study, correlation of the various HLparameter and LNMP was also done according to the pregnancy trimester.

**Correlation of Foetal Gestational Age by Humerus Length (HL) :**

In this study, it was observed on analysis using Pearson correlation coefficient indicated a significant positive linear relationship between HL and LNMP value in estimating foetal Gestational Age with r value 0.885 and correlation is significant at <0.01 level (p value 0.000). The correlation between HL and LNMP was given in Graph 1.

Graph 2 : Correlation between HL and LNMP in estimation of foetal GA in second trimester

Correlation of Foetal Gestational Age by Humerus Length (HL) with LNMP :

In this study, we observed that on analysis using Pearson correlation coefficient indicated a significant positive linear relationship between HL and LNMP value for estimating the foetal gestational age with r value of 0.621 and correlation was significant at <0.01 level (p value 0.000). The correlation between HL and LNMP was given in Graph 19.
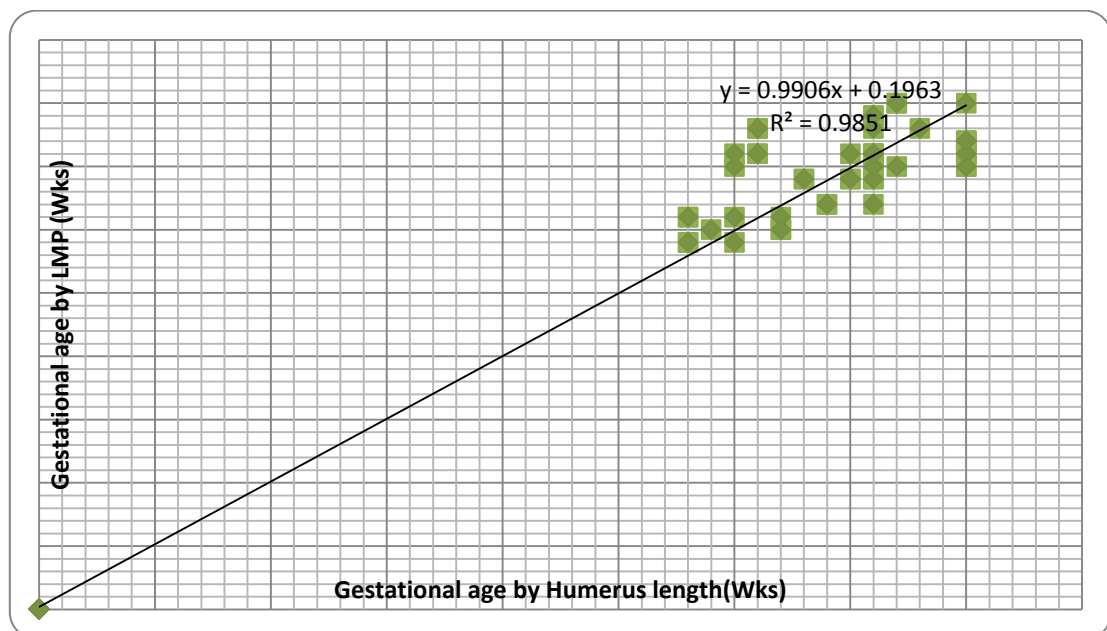
Graph 3 : Correlation between HL and LNMP in estimation of foetal GA in third trimester

Table 2: Correlation coefficient values of various bony parameters in estimating the fetal GA

Bony Parameter	2nd trimester r-value (n=46)	3rd Trimester r-value (n=54)	Total study population r-value (N=100)
HL	0.885	0.621	0.951

Discussion

The most important aspect of pregnancy management is the assessment of gestational age. Gestational age is the estimation of age of an unborn baby. It is generally accepted that safe obstetric practice depends on the valid prediction of gestational age as it is the key for successful ante partum care and critical interpretation of antenatal diagnostic tests and successful planning of intervention. Uncertain gestational age is associated with adverse pregnancy outcomes including low birth weight, spontaneous preterm delivery and post dated pregnancy. Thus by knowing the appropriate gestational age, the follow up in obstetric practice becomes easy and improves the foetal and maternal outcome.

The humeral length (HL) is of great interest in obstetric practice, as it is helpful in the estimation of fetal age especially in women who do not remember their date of last menstrual period or whose fundal height on abdominal examination is not corresponding with their LNMP gestational age[R1,R2]. Humerus length is measured from upper to lower end of diaphysis.. The fetal humerus was identified by the region of the chest in which the pumping heart is a gross marker.

In this study, the estimated mean gestational age in weeks from the mean of bony parameters was calculated i.e., with mean ± SD of Humerus length (44.28±15.94mm) was 27.10±8.14 with range of 14-40 weeks. The study findings were comparable with the study done by Nagesh R et al (2016).[R5]

Table 3:

	Humerus length in mm (mean ± SD)	Humerus length Range in mm
Present study	44.28±15.94	12-73
Study by Nagesh R et a (2016)	45.49 ± 14.36	13.1-69

The correlation between the various bone parameters and LNMP for estimating the foetal gestational age, had shown significant linear relationship with positive correlation.

In the present study, the correlation coefficient values in estimating the foetal GA using Humerus length was 0.951. The findings are similar to the studies done by Moawia Gameraddin et al (2015) and Nagesh R et al(2016).

In the study done by Moawia Gameraddin et al (2015) there was a strong positive correlation between gestational age (last menstrual period) and humeral length (r=0.80). They concluded that the estimation of gestational age is possible by measuring humeral length

Table 4 : showing the comparison of r value of present study with other studies.

	Present Study Findings (r-value)	**Study done by Moawia Gameraddin eta al (2015) (r-value)**	**Study done by Nagesh R et al (2016) (r-value)**
Humerus length	0.951	0.8	0.993

In this study, the antenatal women were grouped according to the age into two groups. It was observed that most of them (97%) belonged to the age group of 18- 27 years and only 3% of them were between the age group of 28 – 37 years. The Mean±SD of age of the patients was 22.1±2.58 years. The antenatal women when categorized according to the parity, it was observed nearly half of them (43%) belong to first gravida (Primi), 36% were in second gravida, 20% in third gravida and only 1% in fourth gravida. It was observed that 48% of the antenatal women included in the study population were in 2nd Trimester and 52% in third trimester. In the present study, when the distribution of the antenatal women according to the type of presentation was assessed, it was observed that majority were in cephalic presentation (72%). The other types of presentations observed were breech (10%), transverse lie (7%) and unstable lie (11%).

In the present study, the mean gestational age of the foetus, was calculated using various parameters likes last normal menstrual period (LNMP) and other bony parameters visualized on ultrasonography i.e., BPD and HC was given in the Table-1. And we observed that on analysis using Pearson correlation coefficient indicated a significant positive linear relationship between BPD and LNMP in estimating the foetal Gestational Age with correlation coefficient r value of 0.951 and correlation was significant at < 0.01 level (p value 0.000) was given in Graph 1

In the present study, correlation of the HL and LNMP was also done according to the pregnancy trimester.

In second Trimester: when analysis using Pearson correlation coefficient was done, it indicated a significant FL value helping in estimating the foetal gestational age, with r value of 0.885, and relation was significant at the 0.01 level (p value 0.000) was given in Graph 3.

In 3rd Trimester: On analysis using Pearson correlation coefficient was done, it indicated a significant FL value helping in estimating the foetal gestational age with r value of 0.621 and relation was significant at < 0.01 level (p value 0.000) was given in Graph 4.

The obtained values for HL, when it was observed that irrespective of the trimester, individually all the dimensions were having a significant positive linear relationship with

LNMP in estimation of foetal gestational age .When the study population was analysed according to the trimester and the correlation was assessed, it was observed that the r- value of HL parameters during the second trimester was slightly higher than 3rd trimester, indicating that all these parameters were more linearly associated with LNMP in estimating GA. In this study, it was also observed that from the correlation value of composite GA and Average GA with LNMP for estimating foetal GA, showed significant positive linear relationship.

For estimating the fetal gestational age, HL parameters were measured under ultrasonography guidance.

When the study population was analysed according to the trimester and the correlation was assessed, it was observed that the r- value of all the bony parameters during the second trimester was slightly higher than 3rd trimester, indicating that all these parameters worsened progressively as pregnancy proceeded. The similar finding were seen in the previous studies and suggested that the accuracy of estimating fetal age in 2nd and 3rd trimester decreases as pregnancy progresses due to increasing biological variation. The gestational age estimates done early in the 2nd trimester were more accurate than measurement done later in the second trimester or in the third trimester (7, 8). In general, the accuracy of gestational age prediction in the 2nd trimester is approximately +7 days before 20 weeks and +10 days after 20 week; the accuracy of fetal age prediction in the 3rd trimester is about +21 day (9, 10).

Normally, the ultrasonographic parameters assessed during the first trimester were the best predictors in estimating the foetal gestational age. But unfortunately, in developing countries, most of the antenatal women come for their first check up after their first trimester (11).

Conclusion

From the present study, it was concluded that ultrasonographically measured HL are reliable predictors in estimating the foetal gestational age. By estimating the foetal gestational age, appropriate measures can be taken to prevent the pre-term deliveries / maternal complications / post dated pregnancies, thereby decreasing peri-natal morbidity and mortality.

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