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Origional Research Article

A cross-sectional study to evaluate foetal foot and femur length and femur/foot length ratio for estimation of gestational age at a tertiary care centre

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Abstract: Introduction: Assessment of gestational age is an integral part of antenatal care. . It is required to assess expected date of delivery, foetal growth and predicting the outcomes of birth as preterm, intrauterine growth restriction, term or post term. The aim of the study was to evaluate foetal foot, femur length and femur/foot length ratio for estimation of gestational age. Material and methods: This was a cross-sectional study. 360 women with normal singleton pregnancy between 16 to 36 weeks of gestation were included in the study. Foot length ,femur length were measured by USG and femur/foot length ratio was calculated. The relationship between gestational age to foot length and femur length was analyzed by simple linear regression. Results: There was a significant linear relation between foot length and gestational age [Foot length =2.498 X gestational age (weeks) - 17.03] with high degree of correlation (R2=0.968 and p=<0.0001), femur length and gestational age [Femur length =2.405 X gestational age (weeks) - 15.40] with high degree of correlation (R2=0.954 and p=<0.0001) and foot length and femur length [Femur length = 0.9611 X foot length + 1.065] with high degree of correlation (R2=0.981 and p=<0.0001). Femur/foot length ratio was fairly constant throughout gestation between 16 -36 weeks. (R2= 0.017, p=0.01). Conclusion: Fetal foot length and femur length together can be used as an alternative fetal parameter to assess gestational age when other routine parameters are not conclusive. Femur/ foot length ratio of ≥0.9 can be used to differentiate between IUGR and skeletal dysplasias.

Keywords: Foetal foot length, femur length, gestation age, ultrasonography, pregnancy.

INTRODUCTION

Accurate assessment of foetal gestational age is an integral part of antenatal care. It is required to assess expected date of delivery, foetal growth and predicting the outcomes of birth as preterm, intrauterine growth restriction, term or post term (American College, O.G. 2017), ; Whitworth, M. *et al.*, 2015; Vishram, S. 2015), Apart from clinical examination, ultrasonographic measurement of multiple fetal parts have been used for evaluation of gestation. Nowadays ultrasound has become one of the indispensible tools to evaluate fetal growth during pregnancy.

In early pregnancy Gestational sac and crown rump length are used for determining gestational age. In second trimester biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC), femur length (FL) are used to determine gestational age (Vishram, S. *et al.*, 2015; Robin, B. *et al.*, 2005; Pandey, V. D. *et al.*, 2015). Normally these parameters are sufficient to determine gestational age. But there are situations where measurement of these parameters have some limitations or cannot be used such as hydrocephalus, anencephaly, hydrops foetalis, macrosomia, short limb dysplasia, femur achondroplasia. In these situations, we have to use other parameters for the estimation of gestational age. Foetal foot length and femur/foot length ratio are the useful parameters to estimate gestational age (Joshi, K. S. *et al.*, 2011; Hebbar, S. *et al.*, 2013; Meirowitz, N.B. *et al.*, 2000). Very few studies have been done to use femur/foot length ratio to measure gestational age. In this paper we have tried to find relationship between foot length and gestational age, femur length and

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gestational age and foot length and femur length/foot length ratio.

MATERIAL AND METHODS:

This was a hospital based cross-sectional study done in the Department of Obstetrics and Gynaecology, S.M.S. Medical College, Jaipur, Rajasthan. The period of study was from April 2017 to November 2018. Sample size was calculated at 95% confidence levels assuming Standard Deviation of 4.78mm in foetal foot length as found in reference study at 35 weeks, at the absolute allowable error (precision) of 0.5mm, minimum of 351 cases were required as sample size which was enhanced and rounded off to 360 cases as final sample size.

360 women with normal singleton pregnancy between 16 weeks to 36 weeks of gestation and who were willing to be enrolled in the study were included in the study. Women with medical disorders and with congenital anomalies of foetus were excluded from the study.

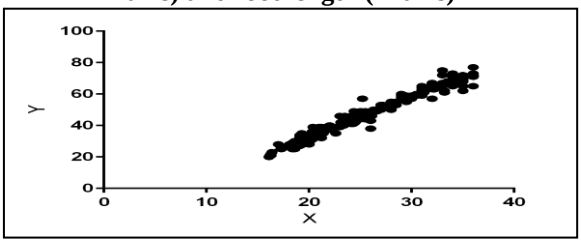
The transabdominal ultrasound scan was performed as part of antenatal assessment (VOLUSON E8, PHILIPS iU22 and LOGIQ S7 machine) and various foetal measurements were done in real-time. Data were collected using pre-prepared proforma. The result of ultrasound measurements (Foot length Measurements, BPD, HC, FL, AC and Expected Foetal Weight). All data were entered in to MS excel sheet and analyzed. The relationship between gestational age in weeks to foetal foot length in millimeters was analyzed by simple linear regression. Correlation of foetal foot length with femur length and femur/foot length ratio was also determined by using linear regression analysis. P value of less than 0.05 was considered as significant.

Results:

Mean age of the woman was 27.03 ± 4.23years, mean gravidity was 1.74±0.9 and mean Parity was 1.28±0.57.

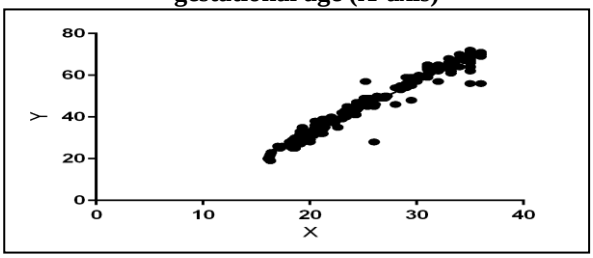
Simple linear regression analysis shows linear relationship between foot length and gestational age. Foot length =2.498 X gestational age (weeks) - 17.03 with high degree of correlation (R^2=0.968 and p=<0.0001) (Graph 1)

Graph 1: Correlation of gestational age (X-axis) and foot length (Y-axis)



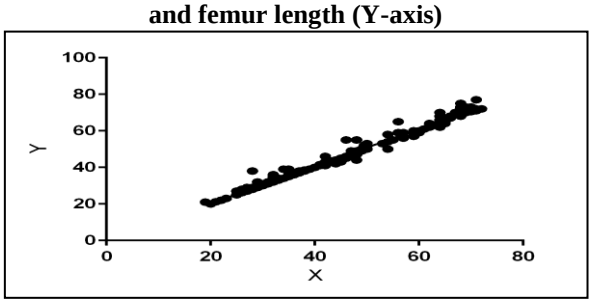
There is also a linear relationship between femur length and gestational age. Femur length =2.405 X gestational age (weeks) - 15.40 with high degree of correlation (R^2=0.954 and p=<0.0001) (Graph 2)

Graph 2: Correlation of femur length (Y –axis) with gestational age (X-axis)



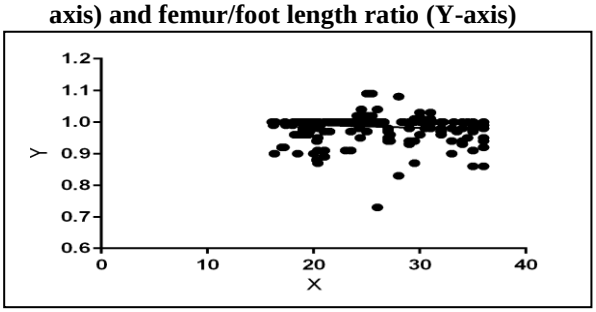
In our study a linear relationship was also seen between femur length and foot length. Femur length = 0.9611 X foot length + 1.065 with high degree of correlation (R^2=0.981 and p=<0.0001) (Graph 3)

Graph 3: Correlation between Foot length (X-axis) and femur length (Y-axis)



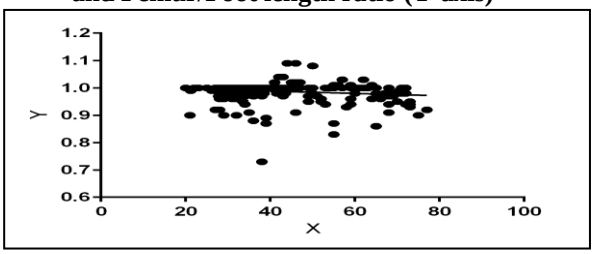
Femur/foot length ratio was fairly constant throughout gestation between 16 -36 weeks. (R^2= 0.017, p=0.01). (Graph 4)

Graph 4: Correlation between gestational age (X-axis) and femur/foot length ratio (Y-axis)



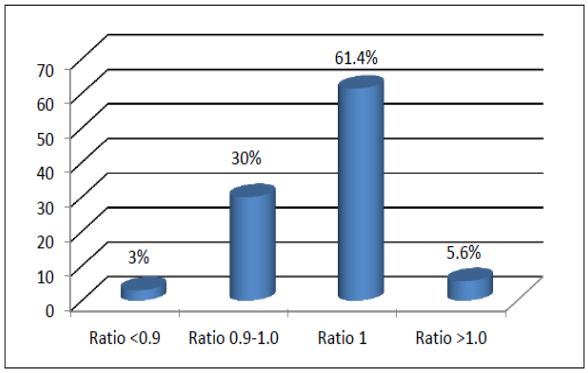
When fetal femur/foot length ratio was plotted against foot length, the results was fairly constant (R^2= 0.024, p=0.002). (Graph 5)

Graph 5: Correlation between foot length (X-axis) and Femur/Foot length ratio (Y-axis)



In approx. 30% (108 cases, n=360) of cases the ratio is between 0.9 to 1 and in approx. 61.4% (221cases, n=360) of cases the ratio is 1. In 3% (11 cases, n=360), the ratio was less than 0.9. In remaining 5.6% (20cases, n=360), the ratio was >1 (Graph 6). The mean Femur/ Foot length ratio was 0.99±0.04.

Graph 6: Femur/Foot length ratio



DISCUSSION

Accurate assessment of gestational age and evaluation of foetal growth is fundamental to any antenatal care. It assists the obstetrician in appropriately counseling women who are at risk of preterm delivery, about the likely neonatal outcome and is also essential in detection of intrauterine growth retardation. Ultrasound is an accurate and useful modality for the assessment of gestational age when clinical data such as menstrual cycle or uterine size are not reliable.

The mean age of the women in our study (27.03 ± 4.23 years) was lower than that observed by Hong Soo Wong (2017) in his study (32.2±4.3yers) and higher than that (24.7 years) observed by Hebber S *et al.*, (2013). Mean gravidity of the women (1.74±0.9) in our study was less than that (2.3±1.5) observed by Hong Soo Wong in (2017).

Simple linear regression analysis in our study shows linear relationship between foot length and gestational age. Foot length =2.498 X gestational age (weeks) - 17.03 with high degree of correlation (R^2=0.968 and p=<0.0001). The result of our study is consistent with the studies done by K S Joshi *et al.*, (2011) Moawia Gameraddin *et al.*, (2014), and Vishram Singh *et al.*, (2015), Which showed a strong linear relationship between foot length and gestational age with high degree of correlation. From our study and other studies done in the past we can conclude that the ultrasonographic measurement of foot length is a reliable indicator of gestational age.

There is also a linear relationship between femur length and gestational age. Femur length =2.405 X gestational age (weeks) - 15.40 with high degree of correlation (R^2=0.954 and p=<0.0001) in our study.

In our study a linear relationship was also seen between femur length and foot length. Femur length = 0.9611 X foot length + 1.065 with high degree of correlation (R^2=0.981 and p=<0.0001). Our results were comparable to those of (Moawia Gameraddin *et al.*, 2014; Joshi *et al.*, 2015; B Abdel Malik *et al.*, 2017; Hong Soo Wong 2017) who in their studies demonstrated a linear relationship between foot length and femur length.

Femur/foot length ratio was fairly constant throughout gestation between 16 -36 weeks. Correlation between foot length and femur/foot length ratio was also fairly constant throughout gestation between 16 -36 weeks. Our results were consistent with that observed by Hong Soo Wong (2017). In 91.4% cases Femur/foot length ratio was 0.9 or more to 1 and in 5.6% cases it was more than 1. Our results were similar to the study done by Moawia Gameraddin *et al.*, in (2014), who found the femur/foot length ratio to be approximately 1 throughout the gestation ages between 14-40 weeks. (Joshi *et al.*, 2015) in their study observed femur/ foot length ratio of ≥0.9 in approx. 50% of cases and 1 in approx. 40% of cases (mean 0.9 and SD 0.08). Campbell *et al.*, (1988) found the femur/foot length ratio to be approximately 1 throughout the gestation ages between 14-40 weeks. They have also concluded that femur/foot length ratio is a useful parameter to help differentiate fetuses that have dysplastic limb reduction from those whose limbs are short because of constitutional factors or IUGR. If the fetus is constitutionally small or there is symmetrical intrauterine growth retardation, the ratio is greater than or equal to 0.9 and in most skeletal dysplasias characterized by limb shortening, the ratio is generally less than 0.9 because of the relative sparing of the hands and feet (2005).

CONCLUSION

A strong linear relationship was observed between femur length and gestational age as well as between foot length and femur length. Fetal foot length and femur length together can thus be used as an alternative fetal parameter to assess gestational age when other routine parameters are not conclusive. Femur/ foot length ratio of ≥0.9 can be used to differentiate between IUGR and skeletal dysplasias characterized by limb shortening.

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