Correlation ‘K’ of foot length with crown rump length in fetuses: an anthropometric study from Kumaun region

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Abstract

Background and aims: Estimation of gestational age [GA] is of prime importance for favorable pregnancy outcome. Foot length is an important and under utilized marker of GA estimation. In this anthropometric study, the foot length of right and left foot was measured and correlated with crown rump length [CRL] to find out whether foot length shows correlation with CRL and act as a reliable marker for assessment of GA. Materials and method: This cross-sectional study was carried out in the Department of Anatomy, Government Medical College Haldwani, Uttarakhand, India. The material used for this study was 72 fetuses of different GA. The foot length of right and left foot was measured from the posterior most point of the heel of the feet to the second toe. The length of the feet was compared with CRL. The correlation and association of length of both feet with CRL was done. Observation: The right and left foot length increased with increase in the CRL. The mean foot length of right and left foot was found to be almost equal with a mean of 5.3 cm for both feet. Pearson correlation coefficient of both sides foot length and CRL showed strong positive correlation with a statistically significant association. Conclusion: In this study on 72 fetuses, both foot length was found to have a strong correlation with CRL. Foot length can act as an adjunct for estimation of GA. Foot length can differentiate between preterm and term baby. Foot length measurement is also useful in medicolegal purposes.

Keywords: crown rump length, anthropometry, fetus, foot length, gestational age

Introduction

Monitoring fetal growth and development by a reliable marker is the cornerstone of a good pregnancy outcome. Various parameters are measured by ultrasound to monitor fetal growth and development. In the first trimester, crown rump length [CRL] is a reliable parameter of gestational age [GA] while in second the trimester and third trimester, parameters like biparietal diameter [BPD], head circumference, abdominal circumference [AC] and femur length [FL] are the main parameters of fetal growth measurement. These parameters give a fair estimation of GA and therefore other potential parameters of fetal development remains underutilized. The foot length is such an important parameter which can be used as a marker of fetal development especially in conditions like anencephaly, short limb dysplasia, hydrocephalus and engaged head late in pregnancy where the above-mentioned markers cannot be used for accurate assessment of GA. In this anthropometric study, the foot length of right and left foot was measured and correlated with CRL to find out whether foot length shows correlation with CRL and acts as a reliable marker of assessment of GA.

Materials and Method

This cross-sectional study was carried out in the Department of Anatomy, Government Medical College Haldwani, Uttarakhand, India. The study material used was a collection of 72 fetuses available in the museum of Department of Anatomy. The fetuses used were of different CRL varying from 6.5 cm to 37 cm. The foot length of the right and left foot was measured by Vernier caliper from the posterior most point of the heel of the foot to the second toe. The length of right and left foot was compared with CRL. The correlation of length of both the feet with CRL was taken out to ascertain if the foot length shows significant association with CRL. The p value was also calculated to find out whether the association of foot length with CRL was statistically significant.
Correlation between foot length and CRL in fetuses - Jaiswal A et al

Observation

The study was conducted in the Department of Anatomy, Government Medical College, Haldwani, Nainital, Uttarakhand. A total of 72 fetuses were included in the study, these were assessed from collection of fetuses available in the museum of Department of Anatomy. Out of the 72 fetuses, 38 were male fetuses and 34 were female fetuses. The CRL of fetuses ranges from 6 cm to 37 cm. The right and left foot length increased with increase in the CRL [Fig. 1]. The mean foot length of right and left foot was found to be almost equal with a mean of 5.3 cm for both feet. The Pearson correlation coefficient between the right foot length and CRL showed strong positive correlation with r value of 0.96. The Pearson correlation coefficient between left foot length and CRL showed strong positive correlation with r value of 0.965. The p value showed statistically significant association between foot length of both sides with CRL, when p value of less than 0.05 taken as significant [Table 1]. The foot length of the right and left foot was categorized in to a different subgroups of CRL and showed progressive increase with increasing subgroups. The foot length of the right and left foot in different subgroups of CRL showed no marked difference [Table 2].

Table 1: Mean foot length, standard deviation, Pearson correlation and p value of right and left foot

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<thead>
<tr>
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<th>Right foot</th>
<th>Left foot</th>
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<tr>
<td>Mean±SD</td>
<td>5.3±2.144</td>
<td>5.34±2.16</td>
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<tr>
<td>Pearson correlation</td>
<td>0.96</td>
<td>0.96</td>
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<tr>
<td>p value</td>
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Fig 1: Right foot length [FLR] and left foot length [FLL] plotted against increasing crown rump length [CRL].

Discussion

The GA measurement can be done by different measurement techniques including clinical and radiological methods. The clinical parameters to assess GA include history like last menstrual period and uterine height on examination. Although the limitation includes inability by mother to correctly remember the last menstrual period date and irregular menstrual cycle. The uterine height also becomes unreliable in cases of fetal growth retardation, multiple pregnancy and maternal malnutrition. Therefore, ultrasound is routinely advised for accurate estimation of GA and correlated clinically for assessing fetal growth. The parameters used in ultrasound measurement include CRL, AC, BPD. These markers can reliably assess GA. However, in congenital abnormalities involving head like microcephaly, hydrocephalus and anencephaly, the parameters like BPD and CRL become unreliable. In other abnormalities like limb dwarfism and intrauterine growth retardation, parameters like FL and AC becomes unreliable. Foot length therefore has its place for assessing GA.²

In the early part of 20th century, Streeter found that fetal foot showed characteristic pattern of normal growth and can be used for estimation of GA. In a study done by Mercer et al on 223 postpartum and 224 ultrasound measurement found foot length to be a reliable parameter for use in assessment of GA.

In this study on 72 fetuses with 38 males and 34 female fetuses, we found that foot length of both right and left side increases with increase in CRL. We also...
found that foot length has a strong positive correlation with CRL with *r* value of 0.96 and a statistically significant association. Sharma et al. also studied accuracy of foot length and hand as measurement of GA in relation to CRL in 100 fetuses including 43 female fetuses and 57 male fetuses and found that foot length and hand length increases with increase in CRL and found statistically significant association.

Fetal length can be accurately measured by ultrasound and can be correlated with menstrual age of fetuses as measured by Platt et al. Similarly, Mhaskar et al. measured foot length in 105 fetuses in GA of 13 and 42 weeks and found foot length to be reliable indicator of GA.

Wong et al. studied foot length from 10 to 16 weeks gestation on 47 fetuses. They found that fetal foot length accurately estimates GA in early pregnancy. They also found that FL to foot ratio increases with increase in GA.

Chikkannaiah et al. assessed accuracy of foot measurement and other fetal circumferences for GA calculation on 60 fetuses with known GA by various obstetrical methods. They found foot length to be more accurate predictor of GA in comparison to other studied fetal measurement and concluded foot length to be a more reliable predictor of GA.

Manjunatha et al. estimated GA of 126 fetuses from foot length by vernier caliper and they observed that there was increase of 4.11 gestational week with increase in every 1 cm of foot length and found foot length to be a strong predictor of GA. They concluded that foot length can be used by the doctor and paramedical staff in a rural setup.

Foot length is an important parameter that can differentiate between preterm and term baby and can act as an easy and simple tool to be used by peripheral health workers. Srivastava et al. performed a study on 254 newborns with a GA ranging from 27 to 42 weeks of gestation. They found that foot length of 73.7 mm can be used as a cut-off point for differentiating between term and preterm babies. The baby with foot length less than this measurement can be considered premature.

Besides estimation of GA for obstetrical and pediatric management, foot length measurement is also useful in medicolegal purposes in forensic medicine, anatomy, fetal pathology and medical imaging. Since fetal measurement is a non-invasive method, it is an easy method for estimation of GA, especially in second the trimester.

Utility of foot size and foot length measurement is not limited to measurement of GA. Potdar et al. in their study on 305 students, correlated foot length with height and found foot length to have strong correlation with height of a person. Therefore, foot length can reliably predict height of individual and stature. This finding has an important bearing in case of mass disasters where foot remain protected by shoes.

**Conclusion**

In this study on 72 fetuses, foot length was found to have a strong correlation with CRL. Foot length can act as an adjunct in estimation of GA in fetuses with different age of gestation and is a valuable marker for estimation of GA in fetuses with various congenital abnormalities and in case of mutilated specimen.

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</tr>
<tr>
<td>Conflicts of interest :</td>
<td>None</td>
</tr>
<tr>
<td>Financial support :</td>
<td>None</td>
</tr>
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</table>

**References**


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