



Correlation between foot length and ear length of second and third trimester fetuses and its clinical significance

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Abstract

Introduction: Foot length has been used as a predictor of gestational age in human fetuses, because this data can be obtained from ultrasonographic examination and by manual measurement and it is particularly useful when other parameters do not accurately predict gestational age (for example in fetuses with hydrocephalus, anencephaly, short limb dysplasia).

Several authors have evaluated ear length during the second trimester, showing a correlation between ear length and gestational age as well as ear length and biparietal diameter.

Aims and Objectives: To determine the gestational age with the help of ear length in second and third trimester fetuses. To correlate the growth pattern of foot length and ear length of second and third trimester fetuses.

Material and Method: Study was conducted on 103 aborted or stillborn fetuses obtained from obs & Gynaecology dept. BRD Medical College Gorakhpur. LMP was noted for calculation of gestational age. fetal foot length and ear length were measured with the help of digital vernier caliper.

Result: Approximately 2fold increase in foot length and ear length are seen in 3rd trimester as compared to 2nd trimester. Linear association of foot length with ear length in different gestational age are found.

Conclusion: The data provided in our study for foot length and ear length could be beneficial for the clinicians not only for the assessment of gestational age of the fetus but also will help them for early diagnosis of trisomy 21.

Keywords: Ear length, Foot length, Gestational age.

Introduction

Gestational age determination is important in civil and criminal cases and Knowledge is needed for differentiating growth restriction from prematurity. Ultrasonologically, the fetal age is usually estimated by measuring physical parameters such as crown– rump length, biparietal

diameter, head circumference, abdominal circumference, femur length and foot length⁽¹⁻³⁾ but in some congenital anomalies like severe hydrocephalus, anencephaly, short limb dysplasia, post-mortem destruction or in mutilated cases the above parameters could not accurately predict the gestational age of fetus. Streeter used foot length

as a fetal measurement in 1920⁽⁴⁾ in 10% formalin fixed human fetuses with the purpose of determining age. Foot length measurement are often used to date the abortus fetus.

It is nearly a century ago when Molenhauer, His, Tartaroff, Schwalbe and many other investigators elucidated the developmental process of the auricle. Wood-Jonnes and Wen, 1934⁽⁵⁾ and Wilson, 1959⁽⁶⁾ described very well the development of external ear and part of the knowledge is utilized for clinical medicine (Tanzer, 1977)⁽⁷⁾. Shimohara et al 1991,⁽⁸⁾ determined the growth pattern of the auricle and discussed the developmental significance of the measurements. Abnormal fetal pinna length are features of many chromosomal anomalies and aneuploid conditions^(9,10). Many authors give the ultrasonographic ear length measurement in normal second and third trimester fetuses^(11,12). Joshi et al⁽¹³⁾ measures the fetal pinna length sonographically in normal pregnancies and found linear relationship between pinna length and gestational age $\text{pinna length (mm)} = 1.044 \times \text{gestational age (weeks)} - 3.857$.

Aims and Objectives

To determine the gestational age with the help of ear length in second and third trimester fetuses. To correlate the growth pattern of foot length and ear length of second and third trimester fetuses.

Material and Methods

103 spontaneously aborted and still born fetuses were collected from the departments of obstetrics and gynaecology, BRD Medical college, Gorakhpur. Cases with structural anomalies were excluded from the study. Legal consent of the respective parent was taken. Gestational age of the fetus was calculated from LMP. These fetuses were fixed with 10% formalin solution using immersion technique. Fetuses were divided in to 2 groups based on gestational age:-

Group A – second trimester (13-28wks)

Group B – Third trimester (29-40wks)



Fig-1 Measurement of Foot length



Fig-2 Measurement of ear length

Foot length was measured with the help of digital vernier caliper from the back of heel to the tip of the second toe or the toe which is longest (Fig-1). Fetal ear length was also measured using the digital vernier caliper which was positioned at the apex of the helix extending to the most caudal part of the earlobe (Fig-2).

Observation

Table -1 correlation of gestational age with foot length

S.No	Gestational age group(weeks)	No. of Fetus	Mean Foot Length (SD) (mm)
1	13 -16	7	14.80 ± 5.26
2	17 – 20	18	27.82 ± 3.84
3	21 – 24	14	42.71 ± 2.37
4	25 – 28	14	51.68 ± 4.52
5	29 – 32	14	63.00 ± 2.82
6	33 – 36	22	72.25 ± 3.88
7	37 - 40	14	82.33 ± 4.71

Table -2 correlation of gestational age with ear length

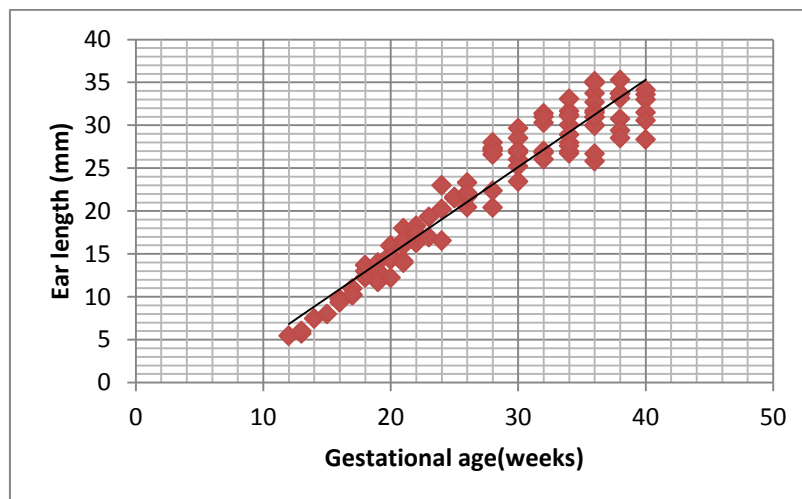
S.No	Gestational age group(weeks)	Mean ear length (Rt) (mm)	Mean ear length(Lt) (mm)	p value
1	13 – 16	7.45 ± 1.74	7.45 ± 1.62	No difference
2	17 - 20	13.13 ± 1.75	13.22 ± 1.58	0.44
3	21 - 24	17.42 ± 2.34	16.65 ± 2.71	0.79
4	25 - 28	23.68 ± 2.84	23.45 ± 2.39	0.59
5	29 - 32	27.59 ± 2.29	27.91 ± 1.81	0.34
6	33 - 36	30.42 ± 2.66	30.69 ± 0.23	0.32
7	37 - 40	32.10 ± 2.23	31.59 ± 2.43	0.72

Table 3 - comparison of growth of foot length and ear length

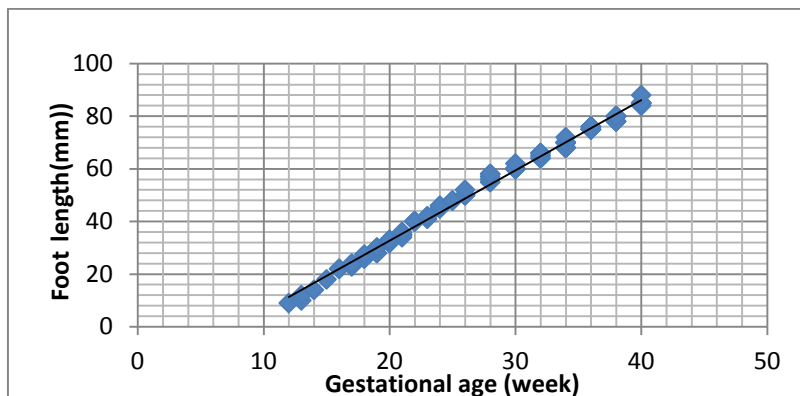
S.No	Gestational age group (weeks)	Growth of Foot length (mm)	Growth of Ear length (mm)
1	13 – 16	–	–
2	17 – 20	13.02	5.68
3	21 – 24	14.89	4.29
4	25 – 28	8.97	6.26
5	29 – 32	11.32	3.91
6	33 – 36	9.25	2.83
7	37 – 40	10.08	1.68

Table 4 Comparison of mean foot length and ear length in 2nd and 3rd trimester

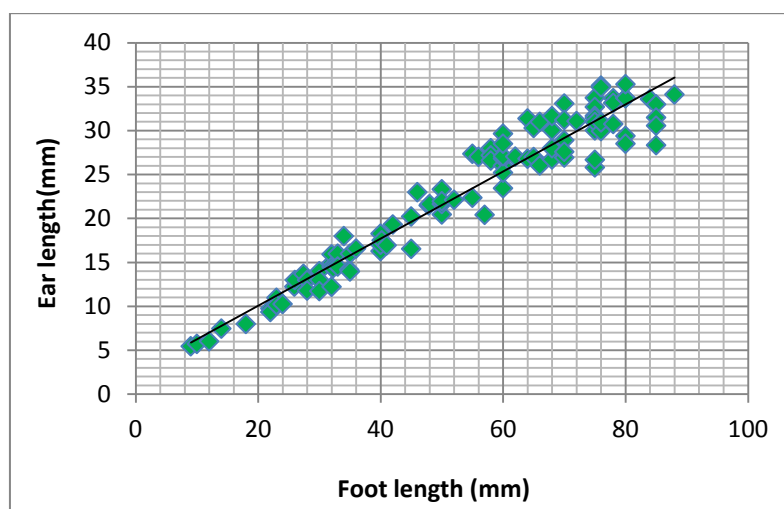
Trimester	Gest. Age group	Mean foot length (mm)	Mean ear length (mm)
Second	13 - 28	34.25	15.42
Third	29 - 40	72.52	30.04
Ratio of mean		1 : 2.11	1 : 1.97



Graph 1- Relation between Gestational age and Ear length



Graph 2-Relation between Gestational age and Foot length



Graph 3 Relation between Ear length and Foot length

Results

- The mean ear length in the 13th to 40th week of gestation increased from 5.87mm to 31.86 mm.
- The mean foot length in the 13th to 40th week of gestation increased from 14.8 mm to 82.33mm.
- At the age of 28th week foot length and ear length was 56.71 mm and 25.56 mm respectively.
- No significance difference was found between right and left ear length.
- Maximum growth of foot length (14.89mm) occurs in 21-24 weeks. While maximum growth of ear length (6.26mm) occurs in 25-28 weeks.
- Approximately 2 fold increase in foot length and ear length are observed in 3rd trimester as compared to 2nd trimester.

Clinical significance

- ▶ Reduced ear length is considered the most consistent phenotypic characteristic of neonates for diagnosis of trisomy 21. According to Aase et al⁽⁹⁾ the average ear length of neonates with Down Syndrome is 21% less than that of euploid neonates and about 84% are below the third percentile.
- ▶ Pinna length measurement is relatively simple and straight forward technique which can be obtained in nearly all fetus by manual measurement. So it can be used as a good predictor for the determination of gestation age of fetus.

Discussion

- ▶ Maroun and Gream⁽¹⁴⁾ found foot length to be a reliable predictor of gestational age in infants with maceration . The present study

supports this finding with maceration not affecting the foot and ear.

- ▶ Usher and Mclean⁽¹⁵⁾ have used foot length measurement in classification of postpartum fetus .
- ▶ Mandarim⁽¹⁶⁾ found very high and statistically significant coefficients of determination between foot length and crown rump length, gestational age and weight in fresh fetuses and indicate foot length as a good predictor of age.
- ▶ Shinohara et al⁽⁸⁾ measured the auricle length and width in 94 formalin preserved human fetuses and also the crown rump length. They found auricular length and auricular width were all increased linearly with the increase in the CRL, suggesting that these measurement values are possible parameter to indicate intrauterine fetal growth .
- ▶ Our data suggest linear relationship between ear length- gestation age, foot length - gestation age and ear length – foot length, this is in accordance to Birnholz study of 180 normal subjects found ear length increased from about 6mm at 15 weeks to 33mm at term and this was well fit by linear regression ($r^2=0.96$).⁽¹⁷⁾ Lettieri et al also found linear relationship between ear length and gestational age across second trimester⁽¹⁰⁾.
- ▶ According to Streeter the mean foot length for 28th week of gestation is 55 mm but in our study foot length is 56.71 mm and ear length is 25.56 mm

Conclusion

Foot length and ear length measurement is an easy and reliable method of fetal age evaluation in anatomical studies. The data provided in our study for foot length and ear length could be beneficial for the clinicians not only for the assessment of gestational age of the fetus but also will help them for early diagnosis of trisomy 21.

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