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To study Interorbital distance of foetuses in second trimester of pregnancy by ultrasonography and correlation with Gestational age

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Abstract

Introduction: Gestational age is crucial for healthcare providers to schedule screening tests and assessments during pregnancy. The WHO recommends all pregnant women receive at least one ultrasound scan before 24 weeks' gestation. However, this is not common in low-/middle-income countries (LMICs) due to limited access to reliable antenatal ultrasounds. This study aims to study fetal inter-orbital distance as a predictor of gestational age in the second trimester in North India population.

Materials and Methods: A cross-sectional study was carried out over the duration of 24 months in the Department of Radiodiagnosis with the collaboration Department of Obstetrics and Gynaecology at a tertiary care centre on Women with singleton pregnancies of gestational age of 13 to 28 weeks based on the last menstrual period. Pregnant women with multiple pregnancies and pregnancy related complications such as pre-eclampsia, gestational diabetes, IUGR and those foetuses with suspected anomalies were excluded from the study. All the patients falling within the sampling frame were evaluated using ultrasound as a modality.

Results And Discussion: The study involved patients with varying gestational ages, parity, and gravida, with the majority being primipara (54.6%), with the remaining being multi-gravida. Mean IOD was 12.49±2.24 mm and ranged between 7.82 and 18.07 mm. On the overall it can be said that the measurement of the foetal IOD is a

crucial parameter in predicting the future neurological and cognitive outcomes of the fetus.

Conclusion: IOD findings can be used as reference range for the Indian population to predict gestational age and also to check for fetal maldevelopment.

Keywords: Interorbital Distance (IOD), Gestational Age, Parity, Fetal Anomalies

Introduction

Gestational age is a key piece of data used by healthcare providers to determine the timing of various screening tests and assessments of the foetus and mother throughout pregnancy. Gestational age may be assessed at any time during pregnancy, and several modes of assessment exist, each requiring different equipment or skills and with varying degrees of accuracy. [1]Further, the WHO recommends all pregnant women receive at least one ultrasound scan before 24 weeks' gestation to estimate gestational age, detect fetal anomalies, reduce labor induction, and improve a woman's pregnancy experience. [2]

While countries like the United States recommends that every pregnancy undergo ultrasound in second trimester for anatomic evaluation and confirmation of dating at 18–22 weeks gestation. [3]Ironically, this is not common in low- or middle-income countries (LMICs), where women's access to reliable antenatal ultrasound is limited or only available in certain contexts. Limited infrastructure in rural health facilities further impacts the ability to implement traditional or conventional ultrasound machines. [4]It is therefore also important for clinicians, especially in lower-income and third-world countries, to derive as much information from these imaging findings to predict adverse outcomes, understand fetal features, defining normative ranges at different gestational ages in order to lay the foundation of future findings.

With a similar background, the present study was conducted to study the fetal inter-orbital distance as a predictor of gestational age in the second trimester and define the normative range for inter-orbital distance during the second trimester in the North Indian population.

Materials and Methods

A cross-sectional study was carried out over the duration of 24 months in the Department of Radiodiagnosis with the collaboration of the Department of Obstetrics and Gynaecology at a tertiary care center, i.e., Era's Medical College & Hospital, Lucknow. Women with singleton pregnancy of the gestational age of 13 to 28 weeks based on the last menstrual period and, as confirmed in the ultrasound, attending outpatient services of the Departments of Obstetrics and Gynaecology, Era's Lucknow Medical College & Hospital, Lucknow, were selected for study. Pregnant women with multiple pregnancies and pregnancy related complications such as pre-eclampsia, gestational diabetes, and IUGR and those foetuses with suspected anomalies were excluded from the study. The sample size was calculated on the basis of the overall average and variation with GA in the IOD using the formula:

$$n = \frac{(k+1)\left(z_{\alpha} + z_{\beta}\right)^2 \sigma^2}{2d^2}$$

Whereσ= 11.18, The SD of IOD; d = 0.15 times mean IOD (=40.01), the minimum mean difference consider to be clinically significant; k = 13, the number of within groups of gestational age (Ref. Islam et. al.)[5]; type I error α = 5% corresponding to 95% confidence level; type II error β = 20% for detecting results with 80%

power of study; Data loss = 10%; so the required sample size $n = 280$

Ref-Sonographic Biometry of Fetal Interorbital Distance as a Predictor of Gestational Age in Enugu, Southeast Nigeria UI Nwadike et al.2016.

All the patients falling within the sampling frame (13-28 weeks POG) and fulfilling the inclusion criteria will be included to participate in the study, which will be then subjected to imaging evaluation using ultrasound as a modality.

The transducer is then placed sagittally across the fetal skull. From this position, the transducer is rotated 90° into the transverse position. From this position, the transducer is gradually swept down through the frontal bone to the glabella and then the nasion. The Sonographic image that will be obtained.

Values will be obtained and correlation will be done with gestational age.

Result

The present study was conducted with the aim of measuring fetal interorbital distance and correlating it with the gestational age. These values were used to develop a nomogram for the North Indian population. For this purpose, 291 women attending the department of Radiology, ELMC&H for ANC visits during the second trimester were screened for inclusion and exclusion criteria, and those fulfilling them were enrolled in the study. The mean age of the study population was 24.34±2.66 years, as shown in Table 1.

Table 1: Distribution of Maternal Age (N=291)

Sn.	Age Group (Years)	No. of Patients	Percentage (%)
1	≤20 yrs	12	4.1
2	21-25 yrs	186	63.9
3	≥26 yrs	93	32.0
Mean Age in years ±SD (Range)		24.34±2.66 (19-30) years	

Most of the patients were Laborers (43.0%), followed by housewives (33.3%), maids (8.6%), students (8.6%) and nurses (6.5%).

The study involved patients with varying gestational ages, parity, and gravida, with the majority being primipara (54.6%) and the remaining being multi-gravida, as discussed in Table 2.

Table 2: Distribution of Maternal Characteristics

Sn.	Characteristic	Min	Max	Mean	SD	Median
1	Gestational Age (Weeks)	15.0	28.0	19.86	3.34	19.00
2	Parity	1.0	3.0	1.47	0.54	1.00
3	Gravida	1.0	4.0	2.38	0.63	2.00
		No. of patients		Percentage (%)		
4	Parity					
	Primipara	159		54.6		
	Multipara	132		45.4		

5	Gravida		
	Primigravida	18	6.2
	Multi-gravida	273	93.8

Mean IOD was 12.49±2.24 mm and ranged between 7.82 & 18.07 mm, as discussed in Table 3

Table 3: Distribution of Ultrasonography Values

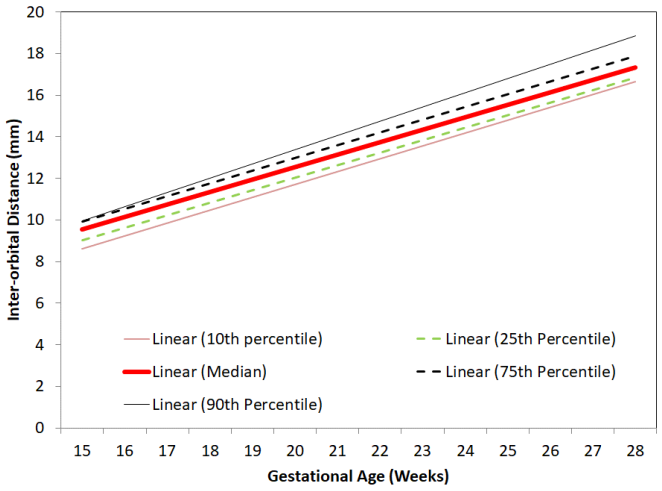
Sn	Characteristic	Min	Max	Mean	SD
1	Inter-orbital Distance (mm)	7.82	18.07	12.49	2.24

Nomogram for Prediction of Gestational Age with Interorbital Distance, as discussed in Table 4

Table 4: Comparison of Mean Interorbital Distance among different gestational age groups and derivation of normative range (n=291)

Sn	GA (wks)	n	Mean	SD	Median	Interquartile Range		Normative Range	
						25^{th} Percentile	75^{th} Percentile	10^{th}Percentile	90^{th}Percentile
1	15	27	8.94	0.57	9.02	8.42	9.46	7.91	9.63
2	16	22	9.69	0.51	9.69	9.23	10.15	8.98	10.43
3	17	18	10.66	0.48	10.66	10.23	11.08	9.97	11.34
4	18	65	11.60	0.97	11.51	11.21	11.95	10.72	12.22
5	19	25	11.62	0.46	11.6	11.22	11.94	11.02	12.36
6	20	28	13.04	0.58	13.13	12.54	13.5	12.15	13.79
7	21	10	13.90	0.67	13.95	13.29	14.5	12.92	14.86
8	22	14	14.26	0.68	14.33	13.66	14.83	13.25	15.23
9	23	28	14.61	0.58	14.72	14.12	15.14	13.77	15.36
10	24	28	14.87	0.38	14.92	14.64	15.16	14.24	15.36
11	25	11	15.55	0.73	15.55	14.89	16.21	14.49	16.61
12	26	6	15.80	0.60	15.67	15.29	16.36	15.12	16.36
13	27	5	16.28	0.44	16.21	15.87	16.72	15.87	16.72
14	28	4	17.22	0.60	17.23	16.64	17.79	16.55	17.79

F=227.681; p<0.001



The mean IOD ranged from 8.94±0.57 mm to 17.22±0.60 mm through 15 weeks of gestation to 28 weeks of gestation. The mean IOD showed an incremental trend with increasing gestational age ($p<0.001$). Normative range values ranged from 7.91-9.63 mm at 15 weeks of gestation to 14.49-16.61 mm at 25 weeks of gestation. The normative ranges showed overlapping range values.

Discussion

The development of the fetus in the mother's womb is a complex and intricate process that involves the growth and differentiation of various body parts and organs.The foetal IOD is typically measured during routine ultrasound scans during pregnancy. [6] This non-invasive method of imaging provides high-resolution images of the fetal anatomy. The IOD can be measured in two planes, namely, the axial [Figure 1]and coronal planes [Figure 2]. The inner corners of the two eye sockets are identified, and the distance between them is measured at the level of the lateral ventricles of the brain. In the axial plane, ultrasound probe is placed perpendicular to the midline of the fetal face, and in the coronal plane, ultrasound probe is placed perpendicular to the axial plane. Several factors can affect the foetal IOD, including genetic, environmental, and developmental factors. The measurement of the foetal IOD is crucial in diagnosing various craniofacial syndromes and anomalies. Some of the syndromes and anomalies that is associated with abnormal IOD.

Figure 1: An ultrasound image showing measurement of interorbital distance (IOD) and biorbital distance (BOD) in axial plane in a pregnant women in 22 week of gestation.

Figure 2: An ultrasound image showing measurement of interorbital distance (IOD) and biorbital distance (BOD) in coronal plane in a pregnant women in 23 week of gestation.

Hypertelorism is a congenital anomaly characterized by widely spaced eyes[widened IOD]; often associated with Apert syndrome, Pfeiffer syndrome, and Crouzon syndrome.[7] Microphthalmia, a congenital anomaly with reduced IOD, often associated with anomalies like Hallermann-Streiff syndrome and Waardenburg syndrome. Down syndrome and Turner syndrome [8]are genetic disorders causing intellectual disability and facial

features, respectively in which foetal IOD is reduced. Overall, the measurement of the foetal IOD is a critical aspect of prenatal care that aids in predicting the future neurological and cognitive outcomes of the fetus. The aim is to study the IOD in normal singleton pregnancies in the North Indian population and define the normative range of IOD in healthy pregnancies. Our study examined gestational age and IOD measurements in women aged 15 to 28 weeks. Ultrasound was used for IOD measurements, which were directly proportional and linearly associated with gestational age. The mean IOD was 12.49±2.24 mm in our study, which was significantly associated with gestational age, similar to a Turkish study by Pala *et al.*[9]that found the IOD in 19 to 23 weeks of gestation was 1.28±0.24 cm. these findings suggest that IOD is not affected much by ethnicity and hence can be used to predict gestational age among all ethnic populations.

Further, studies by Gupta *et al.*[10] Reported that ocular and orbital parameters were positively correlated with gestational age and might be useful in diagnosing fetal mal developments. Velasco-Annis*et al.*[11] also reported that orbital volumes have the greatest correlation with GA using volumetric MRI reconstruction.

Gareeballah et al. [12] studied the correlation between fetal binocular distance (BOD), ocular distance (OD), and interocular distance (IOD) in the second and third trimesters of pregnancy. They collected data from 107 normal singleton pregnant women. The study found strong correlations between BOD per mm, OD per mm, and IOD per mm with gestational age, with BOD having greater values than IOD and OD.

IOD is typically performed during routine ultrasound scans that are performed during pregnancy. Any abnormalities in the IOD can lead to various craniofacial anomalies and syndromes. Overall, it can be said that the measurement of the foetal IOD is a crucial parameter in predicting the future neurological and cognitive outcomes of the fetus.

Conclusion

The present study was conducted at the Department of Radiodiagnosis to measure the fetal interorbital distance and correlate it with the GA. 291 singleton pregnancies meeting the inclusion criteria were included in the study. Maternal age ranged from 19 to 30 years (mean±SD: 24.34±2.66). Most of the women were daily-waged laborers (43.0%), followed by homemakers (33.3%). The gestational age ranged from 15 to 28 weeks. Majority of the primipara (54.6%) and multigravida (93.8%). The findings of the study can be summarized as follows:

Overall, IOD ranged between 7.82-18.07 mm. The mean IOD was 12.49±2.24 mm. A significant difference was observed for IOD at different gestational age. The normative range at 15 weeks was 7.91-9.63 mm and at 28 weeks it was 16.55-17.79 mm. Overlapping IOD was found at all gestational ages.

It can be concluded that IOD findings can be used as a reference range for the Indian population to predict gestational age and to check for fetal mal development.

Abbreviations: IOD = Interorbital distance, IUGR= Intrauterine Growth Restriction, Binocular Distance = BOD

References

1. Skinner C, Mount CA. Sonography Assessment of Gestational Age. [Updated 2023 Apr 24]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK570610/
2. Whitworth M, Bricker L, Mullan C. Ultrasound for fetal assessment in early pregnancy. Cochrane database of systematic reviews. 2015(7). PMID: 26171896 ;

PMCID: PMC6464767DOI: 10.1002/14651858.CD007058.pub3

3. American College of Obstetricians and Gynecologists. 'Committee on Practice Bulletins–Obstetrics and the American Institute of Ultrasound in Medicine. Practice Bulletin.(175).
4. Franklin HL, Mirza W, Swanson DL, Newman JE, Goldenberg RL, Muyodi D, Figueroa L, Nathan RO, Swanson JO, Goldsmith N, Kanaiza N. Factors influencing referrals for ultrasound-diagnosed complications during prenatal care in five low and middle income countries. Reproductive Health. 2018 Dec;15:1-9. PMCID: PMC6291965 ; PMID: 30541560
5. Islam MM, Akter T, Islam S, Alam F, Goswami U, Al-Azad SU, Selim S. Ultrasonographic Evaluation of Foetal Binocular Distance in Second &Third Trimester of Pregnancy and Correlation with Gestation Age. Journal of Current and Advance Medical Research. 2016
6. Bronshtein M, Zimmer E, Gershoni-Baruch R, Yoffe N, Meyer H, Blumenfeld Z. First- and second-trimester diagnosis of fetal ocular defects and associated anomalies: report of eight cases. Obstet Gynecol. 1991 Mar;77(3):443-9. PMID: 1992414.
7. Shipp TD, Benacerraf BR. Second trimester ultrasound screening for chromosomal abnormalities. PrenatDiagn. 2002 Apr;22(4):296-307. doi: 10.1002/pd.307. PMID: 11981910.
8. Monteagudo A, Timor-Tritsch IE. Normal sonographic development of the central nervous system from the second trimester onwards using 2D, 3D and transvaginal sonography. PrenatDiagn. 2009 Apr;29(4):326-39. doi: 10.1002/pd.2146. PMID: 19003788.
9. Pala HG, Artunç-Ülkümen B, Koyuncu FM, Uyar Y, Bülbül-Baytur Y. Normal ranges of biorbital and interorbital distances in healthy Turkish pregnancies at 19-23 weeks of gestation and correlation with craniofacial structures. J Turk Ger Gynecol Assoc. 2015 J PMID: 26401111; PMCID: PMC4560475.
10. Gupta T, Kapoor K, Singh B, Huria A. Fetal orbital and ocular biometry at different gestational ages. journal of the anatomical society of india. 2013 Dec 1;62(2):157-65.
11. Velasco-Annis C, Gholipour A, Afacan O, Prabhu SP, Estroff JA, Warfield SK. Normative biometrics for fetal ocular growth using volumetric MRI reconstruction. Prenatal diagnosis. 2015 Apr;35(4):400-8.
12. Gareeballah A, Fadul EAS, Mohammed NA, Daoud IMM, Khalifa S. Sonographic Estimation of Gestational Age using Fetal Orbital Measurements. Scholars Journal of Applied Medical Sciences. 2019;7(5):1765-1789