CORRELATION BETWEEN FETAL ORBITAL BIOMETRY AND GESTATIONAL AGE

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ABSTRACT
Sonologists uses various parameters for determining gestational age. Although not very popular, orbital dimensions are one such parameter which helps in determining age of fetus. Therefore, the aim of the paper was to construct a nomogram of the size of the fetal orbit as well as the interorbital and binocular distance followed by evaluation of correlation between gestational age and biometrics of fetal orbit. Studied in 128 orbits from 64 fetuses belonging to Manipuri population, different dimensions of orbit were measured using vernier calipers. Measured dimensions include orbital height, orbital width, interorbital distance and binocular distance and subsequent determination of orbital index. The data was elaborated statistically by t-test. Correlation and regression analysis was performed. It was observed that with age, all the dimensions increases, however, difference in growth rate between dimensions were noted. Furthermore, it was observed that there was difference in the orbital values of previous studies as compared to the present study, which could be due to ethnicity of the study group. This easily assessable anatomical part can be used by Sonologists in lieu of biparietal diameter and also, in medicolegal cases of determination of unknown gestational age of fetus.

KEYWORDS: Fetus, orbit, interorbital distance, binocular distance, ethnicity

INTRODUCTION:

Human orbit is present on either side of sagittal plane of the skull between the cranial and facial parts. Basically, orbit develops around the eyeball and helps to protect it from injury. Orbital margin is derived from membranous viscerocranium which gives rise to maxilla and zygomatic bones as well as from membranous neurocranium which gives rise to frontal bone. During fetal life, size of the orbit is big owing to the advanced stage and large size of eyeball.

Orbital dimensions were introduced as new parameters for prenatal diagnosis and dating nearly three decades ago. Ocular biometrics can diagnose congenital anomalies like holoprocencephaly and fetal hydantoin syndrome in which hypertelorism and hypotelorism is an important feature. However, fetal age determination using orbital biometrics is not very popular unlike the biparietal diameter. These dimensions are useful in determining fetal age when the fetal head is abnormal or, in certain position of fetal head like occipitoposterior, in which the face of the fetus faces forward and biparietal diameter could not be measured.

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Correlation Between Fetal Measurements.

Following measurements were recorded:

1. Height of orbit was measured as the vertical dimension from middle of superior margin to the middle of inferior margin of orbit.
2. Width of the orbit was measured as the distance between frontomaxillary suture and frontozygomatic suture of the same side.
3. Inter orbital distance was measured between right and left frontomaxillary sutures (Fig 1).
4. Binocular distance was measured from frontozygomatic (FZ) suture of one side to the opposite FZ suture (Fig 2).
5. Orbital index was calculated as percentage of orbital height to orbital width and interpreted as mesoconch, hypsiconch or chamaeconch.

The data was subjected to statistical analysis. Correlation and Regression analysis was done.

**OBSERVATION:**

Orbital height and width: Both the dimensions significantly increase with advancing fetal age as evident by $r = 0.87$ and $r = 0.86$ respectively; $p < 0.05$

<table>
<thead>
<tr>
<th>Gestational age in weeks (n)</th>
<th>Orbital width mean±SD</th>
<th>Orbital height mean±SD</th>
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</thead>
<tbody>
<tr>
<td>12-16 (7)</td>
<td>8.1± 1.6</td>
<td>7.2± 1.9</td>
</tr>
<tr>
<td>16-20 (23)</td>
<td>10.6± 2.0</td>
<td>8.9± 1.7</td>
</tr>
<tr>
<td>20-24 (8)</td>
<td>12.1± 2.1</td>
<td>11.2± 1.3</td>
</tr>
<tr>
<td>24-28 (6)</td>
<td>16.3± 2.3</td>
<td>14.8± 1.7</td>
</tr>
<tr>
<td>28-32 (7)</td>
<td>18.8± 1.8</td>
<td>16.0± 2.8</td>
</tr>
<tr>
<td>32-36 (5)</td>
<td>22.4± 2.6</td>
<td>17.6± 2.3</td>
</tr>
<tr>
<td>36-40 (8)</td>
<td>23.7± 2.9</td>
<td>18.3± 1.6</td>
</tr>
</tbody>
</table>

$r = 0.86$ $p-value < 0.05$

TABLE-I Orbital width & height (in mm) and gestational age

TABLE-II - Binocular distance and interorbital distance (in mm) to gestational age

TABLE-III - Mean growth rate per week (mm)

TABLE-IV - Orbital index and gestational age
TABLE-V - Comparative 'r' value of inner and outer orbital distance observed by investigators

<table>
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<tbody>
<tr>
<td>Binocular</td>
<td>0.93</td>
<td>0.98</td>
<td>0.95</td>
<td>0.86</td>
</tr>
<tr>
<td>Interorbital</td>
<td>0.76</td>
<td>0.97</td>
<td>0.80</td>
<td>0.93</td>
</tr>
</tbody>
</table>

Therefore, the growth of the skull predominates over that of the face, and the face grows more rapidly along its vertical axis than along its horizontal axis.

Interorbital and binocular distance to determine fetal age was first reported nearly three decades ago. Later, many similar studies by ultrasound were carried out as well as on the skeletons of fetuses wherein orbital dimensions had correlation with fetal age. However, its applicability is not widely popular like the biparietal diameter. Orbital development affects fetal ocular development hence, knowledge of orbital measurements would be useful in diagnosis of clinical cases. Anomalies involving orbital region includes - hypertelorism, hypotelorism, hemifacial microsomia, craniosynostosis, Treacher Collins syndrome. Many of these anomalies require complex orbital surgeries for orbital dystopia.

The present study observed increase in height and width of orbit as the gestational age advances with a significant correlation r=0.87 and r=0.86 respectively (Table I) also observed by Tuli et al in North Indian fetuses. A significant correlation with inner and outer orbital distance and fetal age was observed by present study and by various authors too (Table V). A small, but statistically significant difference was observed for the fetal binocular distance between fetuses of Moroccan origin verses those of Belgian or Turkish. However, the orbital index showed no correlation with fetal age in the present study (r=0.55, Table IV). This observation is in contrast to the study among North Indian fetuses wherein they observed a significant correlation coefficient of 0.71. No other data on fetal orbital index could be found. The main findings concerning the changes of the orbital index with fetal age were: a variation of orbital width starting from 24th week from LMP compared to the height (differential growth of height and length of orbit), a relatively rapid growth of transverse dimensions near term. Therefore, Manipuri fetuses have hypsiconch or long orbit upto 20 weeks and thereafter becomes mesoconch or medium orbit. Such a change in the orbital index is expected in these fetuses in which cephalic index also changes from mesocephalic upto 16 weeks to brachycephalic at term. Present study brings forth a strong ethnic variation in orbital study wherein a growth spurt in the orbital width was observed after 32 weeks with the resultant variation in orbital index but in North Indian fetuses, a gradual increase in width of orbit was reported and so also the orbital index. Orbital parameter depends on development of cheek bone.
And, mongoloid race is known to have high cheek bones. Faster growth of orbital width as compared to the height in the present study is assumed to be due to faster growth of zygomatic bone a, hence a higher cheek bone in this racial group. The assumption is supported by the faster growth rate of bizygomatic width as compared to the superior facial height in the same study population18. Therefore, mesoconch type of orbit observed in the term fetuses of the present study is due to a faster growth of orbital width as compared to the height of the orbit. A need for normative data especially for different region because of racial variation is well documented5. A baseline metric measurement of different ethnic groups will not only help in accurate estimation of fetal age of the particular racial phenotype but also to rule out anomalies of orbit An important aspect of forensic anthropology is determination of the racial phenotype of an unknown skeleton. Medico legal experts carry out investigations related to facial traits and classify a victim as Caucasoid, Mongoloid or Negroid from skeletal remains. From the present study, by using the regression equation, age of fetus can be determined in doubtful cases of fetal age as orbital height, orbital width, interorbital and biorbital distance correlated well with gestational age of the fetus. Last but not the least, sonologists can use these dimensions in lieu of biparital diameter when biparital diameter is difficult to interpret the age when the fetal head is in occipitoposterior position or head is abnormal.

REFERENCES
4. Rajakshmi Ch, Singh MS, Singh LC. CRL-predictor of foetal age. JMS 2003, 17(2), 60-61.