Cephalic Index of Foetuses of Manipuri Population—A Baseline Study

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Abstract. Limited data on the foetal craniofacial dimensions of Manipuri population is a big hurdle in the accurate estimation of gestational age not only in medicolegal cases but also in Obstetrics management. Ultrasonic measurement of BPD (Biparietal diameter) is commonly used to assess foetal age and growth. But it gives misleading conclusions due to differing craniofacial dimensions arising out of ethnic diversity. A study was conducted on 64 manipuri foetuses ranging from 12 weeks to 40 weeks in the Department of Anatomy, Regional Institute of Medical Sciences, Imphal, Manipur. Standard bony landmarks on the cranium were used to measure the dimensions with standardized anthropometric instruments. The values were statistically analyzed after deriving at relevant indices. The regression equation calculated will provide the age evaluation of an unknown foetus by means of skull measurements. The study observed a mean caphalic Index with a positive correlation coefficient value (r) = 0.82 (p<0.05). The study reveals that foetal skull of the Manipuri population is mesocranial in the early weeks and brachycranial at term pregnancy.

Key words : Cranial length, cranial breadth, caphalic index, brachycranial.

Introduction :

Manipuris, the indigenous people of Manipur, comprise of two ethnic groups—the Meiteis (inhabiting the plain) and the Tribals (inhabiting the hills) of Manipur. Both groups are of Mongoloid origin. Ethnicity is a variable that affects craniofacial dimensions, yet to be studied covering all ethnic groups of India.

Singh and Bhasin (1968) have cited the various categories of cranium on the basis of height & breadth index and described the commonly accepted seven groups of crania.

Okupe et al (1984), in a comparative study of biparietal diameter of foetuses of two ethnic groups viz, Nigerian and Caucasian, showed no significant statistical difference until near term when the Nigerian foetus showed a consistently larger BPD. Foetal skull may provide foetal age by means of regression curves (Guihard Costa, 1988).

Cussenot, et al, 1990 reported that skeletal measurements were used as the basis of foetal anthropometry and age determination by Balthazard and Dervieux in 1921.

Cephalic index varies with advancing gestational age, with the highest and lowest values being 81.5 and 78.0 at 14 and 28 weeks respectively (Gray et al, 1989). On the contrary Jeanty (1984) found that cephalic index is independent of gestational age. In India, Tuli et al (1995) found dolichocranial type of cephalic index in 73% of foetuses at term.

The shape of the vault is not directly related to the cerebral growth but to genetic factors. This is supported by the great range of cranial Indices and shapes in racial groups however sexual differences are minimal (Williams et al in Gray’s Anatomy, 1995).

The present study provides a baseline data of cephalic index and estimation of age of unknown foetus by using regression equation.

Materials and Methods :

The study was conducted in the Department of Anatomy, Regional Institute of Medical Sciences, Imphal, Manipur.

Sixty-four (64) intact foetuses of different gestational ages ranging from 12 weeks to 40 weeks were collected from Department of Obstetrics & Gynaecology, RIMS. Patients chosen for the study met the following criteria:

1. Singleton pregnancy.
2. good menstrual dating, regular menstrual cycle, known LMP, no oral contraceptive pills (OCP) within 2 months of LMP.
3. Physical examination that tallied with the menstrual dating.
4. No obstetric or medical complications
5. Patient was either Meitei or Tribal of Manipur.

The foetuses free from gross anatomical abnormalities were selected.

The specimens were divided into seven groups (Group I to Group VII) with age intervals of four weeks each. Dissection of the head region was carried out after proper preservation. Length and width of the cranium were recorded by using Martin’” Spreading Calipers. Cephalic index was calculated as follows:

Cephalic index = (Biparietal diameter/Length of cranium) * 100

The data were subjected to statistical analysis.
Results:

Both the length and the breadth of cranium correlated well with gestational age with a positive correlation coefficient of 0.86 (Table I)

TABLE I

CORRELATION OF MEAN LENGTH AND WIDTH OF CRANIUM WITH INCREASING GESTATIONAL AGE

<table>
<thead>
<tr>
<th>Gestational Age (n)</th>
<th>Mean Cranial Length (mm) ± S. D.</th>
<th>Mean Cranial Width (mm) ± S. D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 – 16 (7)</td>
<td>35.7 ± 7.3</td>
<td>28.1 ± 5.3</td>
</tr>
<tr>
<td>16 – 20 (23)</td>
<td>50.0 ± 6.6</td>
<td>39.5 ± 4.8</td>
</tr>
<tr>
<td>20 – 24 (8)</td>
<td>58.1 ± 4.9</td>
<td>46.8 ± 4.2</td>
</tr>
<tr>
<td>24 – 28 (6)</td>
<td>71.8 ± 5.1</td>
<td>59.6 ± 7.5</td>
</tr>
<tr>
<td>28 – 32 (5)</td>
<td>84.4 ± 3.5</td>
<td>70.0 ± 3.5</td>
</tr>
<tr>
<td>32 – 36 (5)</td>
<td>90.2 ± 3.7</td>
<td>80.0 ± 2.0</td>
</tr>
<tr>
<td>36 – 40 (8)</td>
<td>99.3 ± 4.0</td>
<td>87.8 ± 3.8</td>
</tr>
<tr>
<td>r</td>
<td>0.86</td>
<td></td>
</tr>
<tr>
<td>t-value</td>
<td>3.758</td>
<td>3.758</td>
</tr>
<tr>
<td>p-value</td>
<td>&lt; 0.05</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>Remark</td>
<td>S</td>
<td>S</td>
</tr>
</tbody>
</table>

n = Number of cases, r = Correlation coefficient, S = Significant at 5% level of significance, S. D. = Standard deviation.

Mean length of cranium:

Between 12–40 weeks of gestation, the mean length of cranium ranged between 35.7 ± 7.3 mm to 99.3 ± 4.0 mm. The growth rate was 3.1 mm/week during 12-16 weeks and increased to 6.6 mm/week during 36-40 (Table II). The regression equation for the parameter was \( Y_1 = 0.48 + 0.37 X_1 \), suggesting that with the increase of 1 mm in cranial length, the gestational age \( (Y_1) \) increases by 0.37 weeks (=2.59 days)

Width of Cranium:

The mean width of cranium between 12 to 16 weeks of gestation was 28.1 ± 5.3 mm and it attained a maximum mean width of 87.8 ± 3.8 mm at full term pregnancy.

The growth rate at 12-16 weeks gestation was 2.5 mm/week. The maximum rate of growth of 6.6 mm/week was observed during 24-28 weeks. At term pregnancy the growth rate was 6.1 mm/week. This trend of growth of cranial width was near parallel to growth of cranial length (Fig 1). The regression equation for the parameter was \( Y_2 = 7.78 + 0.35 X_2 \) showing that with the increase of 1 mm in cranial width there will be advancement of 0.35 weeks (=2.45 days) in gestational age.

Cephalic Index:

An increasing value of cephalic index with advancing foetal age was observed which is statistically significant \((P<0.05\) and \(r = 0.82\), Table III) showing that the foetal skull of this population is mesocranial at 12-16 weeks of pregnancy changing to brachycranial type at term pregnancy (36-40 weeks)

TABLE II

MEAN GROWTH RATES OF CRANIUM

<table>
<thead>
<tr>
<th>Gestational Age In Weeks (n)</th>
<th>Length of Cranium (mm)</th>
<th>Width of Cranium (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 – 16</td>
<td>3.1</td>
<td>2.5</td>
</tr>
<tr>
<td>16 – 20</td>
<td>3.4</td>
<td>2.6</td>
</tr>
<tr>
<td>20 – 24</td>
<td>4.1</td>
<td>1.6</td>
</tr>
<tr>
<td>24 – 28</td>
<td>5.5</td>
<td>6.6</td>
</tr>
<tr>
<td>28 – 32</td>
<td>3.8</td>
<td>4.0</td>
</tr>
<tr>
<td>32 – 36</td>
<td>5.1</td>
<td>5.1</td>
</tr>
<tr>
<td>36 – 40</td>
<td>6.6</td>
<td>6.1</td>
</tr>
</tbody>
</table>

\( r \) = Correlation Coefficient, \( S \) = Significant, \( S. D. \) = Standard deviation.

Hence, this study brings forth a striking feature of the ethnicity in the cranial length, width and cephalic index of the Manipuri population.

Discussion:

A racial variation in the cranium is recorded in Gray’s Anatomy by Williams et al (1995). Okupe (1984) reported higher foetal BPD in Nigerian women than those of Europeans, with a mean weekly increase of 4.9 mm (13-30 weeks), 3.3 mm (30-36 weeks) and 1.7 mm (37-40 weeks) Statistical analysis with student’s t - test showed significant difference near term. Dubowitz and Goldberg (1981) studied foetuses of Caucasian, Negro, Indian and mixed origin but found no significant differences...
except after 30 weeks of gestation. Parker et al (1982) further reported that there was no significant differences between Asian and European foetuses.

Campbell (1969), Dewhurst et al (1971), Varma (1973), Sabbaghia et al (1974), Ott (1985) and Tuli et al (1995) described close correlation between BPD and foetal age. They observed that the growth of foetal head is almost linear until approximately the 30th week of gestation after which the co-ordinates showed a flattening pattern.

A comparison of BPD (in mm) reported by various workers is given in Table IV.

### TABLE IV

<table>
<thead>
<tr>
<th>Week of gestation</th>
<th>Hern 1984</th>
<th>Campbell 1985</th>
<th>Tuli 1995</th>
<th>Rajan 1996</th>
<th>Present Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 – 16</td>
<td>26.5</td>
<td>27.4</td>
<td>18</td>
<td>30</td>
<td>28.1</td>
</tr>
<tr>
<td>16 – 20</td>
<td>42.5</td>
<td>43.6</td>
<td>26</td>
<td>41</td>
<td>39.5</td>
</tr>
<tr>
<td>20 – 24</td>
<td>54.0</td>
<td>56.3</td>
<td>31</td>
<td>52</td>
<td>46.8</td>
</tr>
<tr>
<td>24 – 28</td>
<td>60.5</td>
<td>69.2</td>
<td>46</td>
<td>65</td>
<td>59.5</td>
</tr>
<tr>
<td>28 – 32</td>
<td>81.7</td>
<td>93.5</td>
<td>75</td>
<td>80</td>
<td>70.0</td>
</tr>
<tr>
<td>32 – 36</td>
<td>89.7</td>
<td>63</td>
<td>82</td>
<td>80</td>
<td>80.0</td>
</tr>
<tr>
<td>36 – 40-</td>
<td>94.7</td>
<td>63</td>
<td>87</td>
<td>87</td>
<td>87.8</td>
</tr>
</tbody>
</table>

Campbell (1969), Varma (1973) and Tuli et al (1995) observed higher growth rates up to 30th week and slower growth rates from 30th to 40th week of gestation. In the present study too, a uniform growth rate was not observed wherein highest rates were noted during 24 – 28 weeks and slowest rate during 28 – 32 weeks of pregnancy.

Various authors observed Mesocranial skull. A constant cephalic index of 78.3 ± 4.4 from 14 – 40 weeks was observed by Hadlock et al (1981) with no significant change as the foetal age increases. Tuli et al (1995) too noted a constant value of 76.4 ± 5.1 from 12 – 40 weeks. Jeanty et al (1984) found that cephalic index was age independent. On the contrary, Gray et al (1989) observed a change in cephalic index with increasing age of fetus, and reported a wide normal range for cephalic index. The findings of the present study are similar to that of Gray et al (1989) observed a change in cephalic index with increasing age of fetus, and reported a wide normal range for cephalic index. The findings of the present study are similar to that of Gray et al (1989) with cephalic indices of 78.3 ± 1.4 during 12 – 16 weeks of gestation which increased to 88.4 ± 1.1 at full term pregnancy. A detailed study of various craniofacial dimensions and its correlation with foetal age any confirm the effect of ethnicity of foetal craniofacial dimensions. The age of a foetus can be determined by using the regression equation when a gestational age is uncertain.

The present study showed that the cephalic index of the foetuses of Manipuri population changes from mesocranial type at 12 to 16 weeks of gestation to brachycranial type at full term. This may be attributed to the ethnic speciality of this particular race.

### References:


Fig. 1. Cranial Length: Nasion to external occipital protuberance

Fig. 2. Cranial Width: Distance between parietal prominences
Graph No. 1: Scatter Diagram (Growth Trends) of Cranial Length With Gestational Age.

Graph No. 2: Scatter Diagram (Growth Trends) of Cranial Width With Gestational Age.