A STUDY OF THE DIAMETERS OF THE HEAD IN THE NEW-BORN

BY

K. Bhasker Rao, M.D.,

Assistant Professor of Midwifery,

Stanley Medical College, Madras-1.

In an attempt, to understand the mechanism of childbirth, attention was focussed only on the female pelvis from the time of Hippocrates till the beginning of the 18th century. It was Huwe who first measured the true pelvis and the foetal head. Later on Smellie (1697-1763) clearly described the mechanism of labor and explained the different pelvic diameters and their relation to the foetal head during parturition. Nearly a century later, James Simpson revived interest in cephalometry and showed that there is variation in the size of the head depending on the sex of the infant. In the obstetric text-books of the last century the diameters of the foetal skull were given. But the interest in cephalometry was very little when compared with the researches in the size and shape of the pelvis. With the advent of X-rays, an attempt was made by Thoms in 1930 to measure the foetal skull in utero. Subsequently numerous other workers (Clifford, Reece, and Moir) have devised different methods of roentgen cephalometry.

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All workers agree that roentgen-cephalometry is not as accurate as radio-pelvimetry. Cephalometry is helpful in the management of cephalopelvic disproportion and in assessing the maturity of the foetus in a case, like severe toxaemia, where induction of premature labor is indicated. The foetal head is an "awkward object" to measure and cannot be manipulated into position as desired. Thoms (1930) and later Clifford (1934) measured only the occipitofrontal diameter of the foetal head in utero and maintained that the maturity of the child could be guessed with sufficient degree of accuracy from the intrauterine measurement of this diameter. A foetus with an intrauterine occipitofrontal diameter of 11.5 cm. or more was considered mature; and one with a diameter of 11 cm. slightly, if at all, premature and those with diameters under 10.5 cms. definitely premature. The biparietal diameter was obtained indirectly by subtracting 1.5 cm. or 2 cm. from the occipitofrontal diameter of 10.5 cms. and 11.5 cms. respectively. Thoms also found that 2 mm. should be added to the intrauterine measurements for the thick-

ness of the scalp which is not radiologically visualised. Hastings Ince (1939) after a study of 1,060 babies, disagrees with the findings of earlier workers and states that the intrauterine diameters of the foetal skull can give only a rough estimate of the probable weight of the foetus. Besides, according to him, the range of variation in the relationship between occipitofrontal diameter and the biparietal diameter is too great to allow any accurate prediction. Reece (1935) pointed out that as the foetal head is an ovoid it could give 2 types of shadows (i) a circular or (ii) an oval, short axis of which will give the greatest circular section of an ovoid. He thus measured the biparietal diameter directly from the anteroposterior radiograph of the pelvis, and corrected the reading obtained, by applying a formula; the error in these cases rarely exceeded 0.15 inch. Moir (1946) has shown that from lateral pelvi-radiograph, the biparietal diameter of the foetal head can be easily measured, as this diameter is very often clearly visible in this view of the pelvis. According to him the next best is the suboccipitobregmatic diameter. If an oblique diameter is visible, one is not definite of the size of the head and one could only say that the biparietal diameter will be less than the visible shortest diameter. In 20 cases who delivered spontaneously the biparietal diameter of the foetus was measured by us from the lateral radiograph of the pelvis taken a few days before labor. In 18 of them, the biparietal diameter was found to be $3\frac{1}{2}$ inches and only in two cases it was $3\frac{3}{4}$ inches. These measurements were later confirmed by direct measurement of the child's head on the third day after delivery. If the radiograph is taken before term, an allowance of 2 mm. (Moir) or 2.5 mm. (Scammons and Calkins) per week is made in the biparietal diameter obtained from the radiograph.

Clinical Cephalometry:

The diameters of the head were measured by means of calipers in 200 newborn babies on the third or fourth day after the delivery. All these babies were born spontaneously, per vaginam. The weight, crown-heel length, occipitofrontal circumference of the head and six diameters of the head detailed below were carefully measured in each infant.

1. The biparietal diameter—The distance between the 2 parietal eminences.

2. The bitemporal diameter—The greatest distance between 2 temporal sutures.

3. The suboccipitobregmatic diameter—from the junction of the head and neck behind, to the middle of the anterior fontanelle.

4. The submentobregmatic diameter—from a point just below the chin to the middle of the anterior fontanelle. (Majority of the text books describe the cervicobregmatic diameter—from the junction of the chin and neck in front to the middle of anterior fontanelle).

5. The occipitofrontal diameter—from the root of the nose to the occipital protuberance.

6. The verticomental diameter—from the chin to the most distant point of the vertex.

Munro Kerr defines it as the distance from the tip of the chin to the

posterior fontanelle; Mayes—from the point of the chin to the centre of the vertex. Some American authors—Curtis, Stander etc.—describe the occipitomental diameter which is the distance from the chin to the occipital protuberance.

Of the 200 babies, 48 (24 per cent) were premature (less than 5½ lbs.) (Table I). Fifty-three per cent of the babies were males and the remaining (47 per cent) were females. The length of the babies varied from 16 inches to 21.5 inches and the mean length for 200 babies was 18.4038 inches. The mean value obtained for the different diameters of the head and for the occipitofrontal circumference have been shown below in Table II.

The diameters of the foetal skull mnetioned in the standard text-books of Midwifery differ from author to author (Tables III and IV.)

The Biparietal Diameter:

Students are always taught that the biparietal diameter is equal to the suboccipitobregmatic diameter in length. Moir (1949), pointed out that this traditional teaching is not strict-

TABLE I

Weight in relation to maturity

Weight	No. of babies	
Over 3 pounds and upto 4 lbs.	4	
Over 4 „ „ 5 lbs.	20	48 (24 per cent)
Over 5 „ „ 5½ lbs.	24	
Over 5½ „ „ 6 lbs.	43	
Over 6 „ „ 7 lbs.	79	
Over 7 „ „ 8 lbs.	26	152 (76 per cent)
Over 8 „ „ 9 lbs.	2	
Over 9 „ „ 10 lbs.	2	
Total	200	

Range: 3¾ pounds to 9½ pounds.
Mean weight: 6.250 pounds.
Variance = 0.9340.

TABLE II

Showing the mean length of the different diameters of the head in the newborn.

Diameter of the Head	Mean length	Range
1. The Biparietal Diameter	3.4588 inches	3.00″ — 3.75″
2. The Bitemporal Diameter	3.1613 „	2.75″ — 3.50″
3. The Suboccipitobregmatic Diameter ..	3.6263 „	3.25″ — 4.00″
4. The Submentobregmatic Diameter ..	3.7788 „	3.50″ — 4.00″
5. The Occipitofrontal Diameter	4.3063 „	3.75″ — 4.50″
6. The Verticomental Diameter	5.0050 „	4.50″ — 5.25″
7. The occipitofrontal circumference ..	12.4670 „	11″ — 14″

TABLE III

Diameters of the Foetal Skull — According to Different Authors, Mainly British. The Measurements are given in inches.

The diameters	Playfair (1898)	Moses (1920)	Jellet (1921)	Berkeley (1925)	Munro Kerr (1946)	Shaw 3¾″ (1947)	Queen Charlotte 3¾ (1952)	John-stone 3¾ (1952)	Ours 3.459.
Biparietal Dm. ..	3¾″—4″	3½″	3¾″	3¾″	3½″	3¾″	3¾″	3¾″	3.459″
Bitemporal Dm. ..	3½″	2½″	3 1/5″	3½″	—	3¼″	3½″	3¼″	3.161″
Suboccipitobregmatic Dm. ..	3¼″	4″ or less	3¾″	3¾″	3¾″	3¾″	3¾″	3¾″	3.626″
Submentobregmatic Dm. ..	—	—	3¾″	3¾″	3½″	3¾ Fronto-mental	3¾″	3¾″	3.779″
Occipitofrontal Dm. ..	4½″—5″	4½″	4½″	4½″	4½″	4½″	4½″	4½″	4.306″
Vertico Mental Dm. ..	5¼″—5½″	5″	5½″	5¼″	5¼″	5½″	5¼″	5½″	5.005″
Occipitofrontal circumference	—	—	13 3/5″	13 4/5″	14″	—	13½″	—	12.467″

TABLE IV

Diameters of the Foetal Skull According to Different Authors, Mainly American Workers. The Measurements are given in Centimeters

Diameters	Williams White	Williams Coloured	Seammon & Calkins	Stander	De Lee & Greenhill	Heyns (Bantus-African)	(Ours)
Biparietal Dm.	9.25	9.05	9.7	9.25	9.5	9.22 (Just under 9 cm. in Negroes)	8.804
Bitemporal Dm.	8.0	7.81	—	8.0	8.0	—	8.028
Suboccipito-bregmatic Dm.	9.7	9.29	10.6	9.5	9.5	9.68	9.208
Submentobregmatic Dm.	—	—	—	—	—	—	—
Occipito-frontal Dm. (Occipito-Mental)	11.71	11.26	12.2	11.75	11.0	11.3	10.93
Vertico-Mental Dm.	13.33	13.31	12.0	13.5	13.0	13.27	12.72
Occipitofrontal circumference	34.5	—	35.2	34.5	—	—	31.66

ly correct and that it is seldom that the biparietal diameter exceeds the suboccipitobregmatic diameter. In a series of 50 cases, very carefully measured by him, it was only in four that the biparietal diameter exceeded the suboccipitobregmatic diameter and that too by not more than 2 mm. This he thought, was due to slight "bossing" of the parietals. He also found that the suboccipitobregmatic diameter usually exceeds the biparietal, sometimes, by as much as 8 or 9 mm. In 36 out of 43 cases, Thoms and Godfried (1934) found that the suboccipitobregmatic diameter was equal to or more than the biparietal diameter. The average value for these two diameters, they stated as 9.5 cms. (3¾ inches) and 9 cms. (little over 3½ inches) respectively. In none of our cases, was the biparietal diameter greater than the suboccipitobregmatic. In one-third (34.5 per cent) of the babies the two diameters were equal in length and in the remaining two-thirds (65.5 per cent) the suboccipitobregmatic was greater than the biparietal diameter. As pointed out earlier, the mean value for the biparietal diameter is 3.4588" (nearly 3½ inches) in our series, and 3.554 inches in a series of 225 babies reported by Sen in this country. It was found to be 3.75 inches in length only in 6.5 per cent of our cases. The biparietal diameter, being the greatest transverse diameter, is the best guide to the size of the foetal head. It can be measured radiologically as well as clinically because of the bony landmarks. During delivery it is reduced by moulding, by 1-2 mm. and occasionally by 3.5 mm. when it will be dangerous to the life of the foetus. The reduction in the length of the diameter caused by moulding completely disappears by

the 4th day after the delivery. The biparietal diameter increases with weight of the foetus; but when it exceeds 9.5 cm. (or $3\frac{3}{4}$ inches), the head does not mould and delivery is likely to be difficult (Moir, 1946).

The occipitofrontal circumference is nearly thrice the occipitofrontal diameter.

TABLE V

The Occipitofrontal Circumference of the Head According to Sex of the Child

Sex	Length of occipitofrontal Circumference
(i) Female	Mean: 12.2606 inches. Variance = 0.2761
(ii) Male	Mean: 12.4670 inches. Variance = 0.4406
For difference of the two means: t (198 d.f.) = 2.4084 (significant)	

It definitely increases with the weight of the child. (In this series, the correlation between the birth weight and the circumference of the head is 0.7060). There are some exceptions to this. A small child may have a slightly bigger head and give rise to dystocia; and a large baby, where we anticipate difficulty, may pass through easily because of a small head. Playfair mentions that the circumference of the head in the male is about half an inch more than in female babies. Sir James Simpson attributed great importance to this fact and thus explained the greater incidence of stillbirths of male babies than females, and also the increased operative delivery rate, maternal mortality and morbidity connected with the birth of male children. He calculated that between 1834-1837, there were lost in Great Britain as a consequence of slightly larger size of male than female head at birth, about 50,000 lives—including those of about 46,000 or 47,000 infants and of between 3,000 and 4,000 mothers who died in child-bed. From Table V, it is clearly made out that there is statistically significant difference in the size of the head in the two sexes, the occipitofrontal circumference in male being definitely greater than in female infants. In1898, Playfair wrote, "It is probable that race and other conditions such as civilisation and intellectual culture have considerable influence on the size of the foetal skull but we are not in possession of sufficiently accurate data to justify any very positive opinion on these points". From a study of Table IV, it may be seen that there is variation in the size of the foetal head in the different races. But as Heynes has pointed out that in the Bantus the head in the newborn is as large as that of an average American or European infant, it cannot be assumed that in the highly civilised and intellectual classes or races, the foetal head at birth is larger than in the less civilised and intellectually backward racial groups.

Summary:

The interpretation of the diameters of the foetal skull obtained radiologically by different methods is mentioned in brief.

The biparietal diameter was measured from the lateral radiograph of the pelvis in 20 patients at term and the findings were confirmed after the delivery.

The occipitofrontal circumference and six diameters of the head (biparietal, bitemporal, suboccipitobreg-

matic, submentobregmatic, occipitofrontal and verticomental) have been measured in 200 spontaneously delivered newborn infants and the findings are compared with those given in standard text books.

The biparietal diameter is not equal to suboccipitobregmatic as is usually taught but less than the latter in two-thirds of the cases studied.

The occipitofrontal circumference is nearly thrice the occipitofrontal diameter and increases with weight of the child. It is definitely greater in male than in female babies.

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