

**Some Observations on Pelvimetry.**

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IN the present number of this JOURNAL<sup>1</sup> I have described a new pelvigraph, by means of which it is possible to obtain accurate tracings of the median plane of the pelvis in the living subject and so estimate the length of the various antero-posterior diameters.

The internal measurements discussed in the present article have been obtained in this way, and serve to illustrate the limitations of the various indirect methods of pelvimetry.

In all, 119 pelves were examined—100 in the living subject and 19 dry specimens from the valuable collection in the Radford Museum of St. Mary's Hospital.

In the living subject most of the measurements were taken during pregnancy or the puerperium, but a certain number were obtained in labour, these being cases where some obstetric operation was performed and an anæsthetic administered.

In considering the various measurements, I have employed the averages obtained from them in order to make the results more readily understood, but it is necessary to point out that the pelves examined do not form a normal series, as they include an unusually large number of cases of pelvic deformity. This is especially so in the case of the dry specimens which consist largely of examples of extreme contraction of one or other type.

Thus, the amount of deformity as indicated by the length of the true conjugate is as follows:—

*Dry pelvis (19 specimens).*

True conjugate measures 4" and over in	5 cases.
"    "    "    3"    "    3    "	
"    "    "    2"    "    7    "	
"    "    "    1"    "    4    "	
Percentage of deformity	73.

*Living subject (100 cases).*

True conjugate measures 4·0" and over in	49 cases.
"    "    "    3·5"    "    28    "	
"    "    "    3·0"    "    19    "	
"    "    "    under 3" in	4 cases.
Percentage of deformity	51.

Looking at the same series from the point of view of obstetric treatment, the result is as follows:—

Delivery by natural forces ... ..	54 cases.
„ forceps ... ..	14 „
„ induction ... ..	7 „
„ craniotomy ... ..	1 „
„ Cæsarean section ... ..	17 „
Nulliparæ ... ..	7 „

Nevertheless, the cases give much useful information as to the relative size of the various pelvic diameters, and it is with this aspect that the present observations are chiefly concerned.

#### *The True Conjugate.*

This diameter being the one most frequently affected in pelvic deformity, has been the subject of infinitely more investigation than any of the others, and most of the methods of pelvimetry have been solely devised for its more or less accurate estimation.

In the pelvis I have examined the measurement has been obtained directly from the tracings and represents in the pelvis the distance between the sacral promontory and the nearest point on the posterior surface of the symphysis pubis.

Previous to the work of Michaelis,<sup>2</sup> the anatomical conjugate was regarded as the most important antero-posterior measurement of the pelvic inlet, but this author found that there existed a smaller diameter, namely, that which is now known as the obstetric or true conjugate.

Pinard<sup>3</sup> called further attention to this measurement and termed it the *diamètre minimum* or *diamètre utile*.

In 19 dry pelvises examined, the largest measurement of this diameter was 4.9", the smallest 1.25", the average being 3.75".

In the living subject, 100 cases, the highest measurement obtained was 5.0", the lowest 2.5", average 3.84".

In actual practice it is exceedingly difficult to measure this diameter directly without the aid of some complicated instrument; consequently its length is more or less accurately obtained by deducting a certain amount from some more readily accessible diameter, such as the external or the diagonal conjugate respectively. It therefore becomes of great importance to recognize the shortcomings of these methods and not to place too implicit a trust in the results so obtained.

#### *The External Conjugate.*

This diameter was obtained by taking the measurement, as suggested by Crédé, from a point in the middle line behind, half an inch above the depressions on the skin over the posterior superior iliac spines, to the surface of the integument covering the anterior surface of the symphysis pubis.

In the living subject (100 cases), the highest measurement obtained was 8.25" (C.V. 3.9"), the lowest 6.0" (C.V. 3.75", 3.2", 2.5", 2.6"), the average being 7.21".

The importance of this measurement as a sign of pelvic contraction is shown by the following figures:—In 48 cases the diameter measured less than 7.0", and in 33 of these the pelvis was contracted; in 22 cases the measurement was less than 6.75", and in 21 of these definite contraction was present. In other words, if the external conjugate measure 7.0" or less, the pelvis is contracted in 70 per cent., if 6.75" or less in 95 per cent. of cases.

Baudelocque,<sup>4</sup> who was the first obstetrician to employ this method in midwifery, believed that the length of the true conjugate could be estimated with absolute accuracy from this diameter by means of a simple correction, and described his procedure as follows:—

"To demonstrate how much the superior strait is defective in the sacro-pubic diameter and measure it by means of the compasses, we take the thickness of the woman, from the middle of the mons veneris to the centre of the depression of the base of the sacrum posteriorly, by applying one of the points of the instrument before, against the symphysis of the pubis and the other behind, a little under the spine of the last lumbar vertebra; and deduct 3.0" from that thickness in women who are thin, for the base of the sacrum and the anterior extremities of the ossa pubis; the thickness of these latter being at most six lines and that of the base of the sacrum 2½"; and so constantly so that I have not found a difference of a line in about five-and-thirty pelvises distorted and contracted in all manner of ways and in all possible degrees. . . . The results of this procedure are so exact that the pelvis, measured with the common compasses after opening the body, was not above a line over or under my estimation in any one of my experiments."

Baudelocque's own method must have been much more perfect than any practised since his time, as all authorities are now agreed that the two diameters vary widely and disproportionately and bear no absolutely constant relationship to each other.

Michaelis<sup>2</sup> thought the diameter of considerable value, and concluded, as a result of his experiments, that the shortening of the external conjugate expressed half that of the true conjugate.

Litzmann,<sup>5</sup> on the other hand, considered the method exceedingly fallacious, and in thirty post-mortem examinations found the average deduction to be 3½", but to vary widely in individual cases owing to the difference in thickness of the bones and integument.

Schroeder<sup>6</sup> found that the spinous processes were subject to great variation quite independently of the length of the true conjugate.

Galabin<sup>7</sup> considered that moderate values of the external conjugate gave little indication and found the amount to be deducted increased in rhachitic pelvises.

Whitridge Williams<sup>8</sup> states that when the external conjugate measures between 7·9" and 8·25" the true conjugate is rarely shortened, between 7·0" and 7·5" it is shortened in 50 per cent., and when below 6·75" contraction in this diameter is almost always present.

My own measurements give very similar results to those of the last-named author, and prove that the length of the external conjugate, as an indication of pelvic contraction, gives very doubtful information unless its difference from the normal be considerable.

In the living subject, the greatest difference between the two diameters was 4·75" (C.V. 2·75"), the smallest 2·25" (C.V. 3·75", 4·74"), the average being 3·37".

When the true conjugate measured 4·0" or over, the amount to be deducted from the external conjugate varied from 2·25" to 4·0", although the commonest figure lay between 2·75" and 3·75"; where the true conjugate measured 3·5" or over, the amount varied from 3·0" to 3·9", the figure being most commonly between 3·25" and 3·74"; with the true conjugate under 3·5", the difference lay between 3·25" and 4·5", although most commonly between 3·25" and 4·0". That is to say, the shorter the length of the true conjugate, the larger the amount to be deducted; or, in other words, the contraction of the external conjugate is always proportionately less than that of the true conjugate.

To sum up, if the external conjugate measure 7·0" or less, the pelvis is probably contracted and almost certainly so if the same diameter measure less than 6·75".

There is no accurate method of estimating the length of the true conjugate from that of the external conjugate, the margin of error in Baudelocque's calculation being so great as to render it useless, not to say dangerous, in practice.

Table I shows the difference between these two diameters and its relation to the length of the true conjugate.

TABLE I.  
RELATION BETWEEN C.EXT.—C.V. AND LENGTH OF C.V.  
*Living Subject (100 Cases).*

Length of C.V.	Difference between C. Ext. and C.V.									
	2·25 to 2·49	2·5 to 2·74	2·75 to 2·9	3·0 to 3·24	3·25 to 3·49	3·5 to 3·74	3·75 to 3·9	4·0 to 4·24	4·25 to 4·49	4·5 and over
2·5"—2·74"	—	—	—	—	1	1	—	—	—	1
2·75"—2·99"	—	—	—	—	—	—	—	—	—	1
3·0"—3·24"	—	—	1	—	—	2	1	—	—	2
3·25"—3·49"	—	—	—	—	5	3	1	4	—	—
3·5"—3·74"	—	—	—	2	5	3	1	—	—	—
3·75"—3·99"	1	—	1	4	2	3	3	2	1	—
4·0" and over	2	5	6	12	11	9	3	1	—	—

*The Diagonal Conjugate.*

This is the most readily accessible of the internal pelvic diameters, and derives its chief importance from the fact that the length of the true conjugate is usually calculated from it. When considerably shortened, however, it gives in itself definite evidence of contraction, but the converse of this is not always true owing to variations in the height and inclination of the symphysis pubis, although many years ago Madame La Chapelle formulated the axiom "that the best proof of a good conformation of the pelvis is the impossibility of reaching the sacro-vertebral angle with the finger."

In 19 dry pelvises examined the greatest measurement obtained of this diameter was 5.6" (C.V. 4.6"), the smallest 2.0" (C.V. 1.6"), the average being 3.83".

In 100 cases in the living subject, the corresponding figures were 6.0" (C.V. 5.0"), 3.25" (C.V. 2.5"), average 4.67".

Table II shows the various measurements of the true conjugate obtained in the dry pelvis and living subject respectively, together with the relationship which they bear to the diagonal conjugate.

TABLE II.  
RELATION BETWEEN C.V. AND C.D.—C.V.  
A. *Dry Pelvis (19).*

Length of C.V.	Difference between C.D. and C.V.				
	0.25-0.49	0.5-0.74	0.75-0.99	1.0-1.24	1.25-1.5
1.0"—1.49"	—	—	—	1	1
1.5"—1.99"	1	1	—	—	—
2.0"—2.24"	—	—	—	—	—
2.25"—2.49"	—	1	2	—	—
2.5"—2.74"	—	—	—	—	—
2.75"—2.99"	—	1	—	1	2
3.0"—3.24"	1	—	—	—	—
3.25"—3.49"	—	—	—	—	—
3.5"—3.74"	—	1	—	—	—
3.75"—3.99"	—	—	1	—	—
4.0" and over	1	2	1	1	—

B. *Living Subject (100).*

Length of C.V.	Difference between C.D. and C.V.					
	0.25-0.49	0.5-0.74	0.75-0.99	1.0-1.24	1.25-1.49	1.5-1.74
2.5"—2.74"	—	—	2	—	—	1
2.75"—2.99"	—	1	—	—	1	—
3.0"—3.24"	—	1	1	2	3	—
3.25"—3.49"	—	4	4	3	—	—
3.5"—3.74"	1	3	5	3	1	—
3.75"—3.99"	—	6	7	3	1	—
4.0" and over	4	16	15	9	1	2

It will be seen that in the dry pelvis the difference between these two diameters varied from 0.25" to 1.5"; in three cases from 0.25" to

0.49", in six from 0.5" to 0.74", in four from 0.75" to 0.99", in three from 1.0" to 1.24", and in three from 1.25" to 1.5". Of the six cases with a difference of from 1.0" to 1.5", five were examples of pelvic contraction.

The difference in the living subject varied from 0.25" to 0.49" in five cases, 0.5" to 0.74" in thirty-one cases, 0.75" to 0.99" in thirty-four cases, 1.0" to 1.24" in twenty cases, 1.25" to 1.49" in seven cases, and 1.5" to 1.74" in three cases.

A correct estimate of the length of the true conjugate to within a quarter of an inch would therefore be obtained in 20 per cent. of cases by a deduction of 0.5" from the diagonal conjugate, in 65 per cent. by a deduction of 0.75", in 55 per cent. by a deduction of 1.0", in 27 per cent. by a deduction of 1.25", and in 10 per cent. by a deduction of 1.5".

This method of calculating the length of the true conjugate is therefore open to a large margin of error, but the safest amount to deduct would appear to be 0.75", as this would be correct to within a quarter of an inch in 65 per cent. of all cases.

The amount should vary, however, according to the type of case dealt with as the inclination and height of the symphysis have also to be taken into account.

The inclination is represented by the angle which the diagonal conjugate makes with the symphysis pubis and in the 19 dry pelvis which I examined varied between 64° (C.V. 4.9", funnel-shaped pelvis) and 13° (C.V. 1.25"), the average being 43°.

In the living subject, the largest angle obtained was 70° (C.V. 4.75", funnel-shaped pelvis), the smallest 29° (C.V. 2.6"), the average being 51°. In forty-eight cases the angle measured 50° to 59°, in twenty-eight 40° to 49°, in seven 30° to 39°, and in sixteen 60° to 69°.

It is noteworthy that the largest angle obtained in each class was in the funnel-shaped variety of pelvic deformity.

Table III shows the varying size of this angle in the case of the living subject and also the influence which it has upon the relative lengths of the two conjugates, *i.e.*, the larger the size of the angle, the smaller the difference between these two diameters.

TABLE III.

SHOWING RELATION OF C.D.—C.V. TO INCLINATION OF SYMPHYSIS.

*Living Subject (100 Cases).*

C.D.—C.V.	Angle C.D. Symph.					
	20—29°	30—39°	40—49°	50—59°	60—69°	70—79°
0.25"—0.49" ...	—	—	—	—	5	—
0.5"—0.74" ...	—	1	2	16	11	1
0.75"—0.99" ...	—	1	6	28	—	—
1.0"—1.24" ...	—	2	17	2	—	—
1.25"—1.49" ...	—	3	3	1	—	—
1.5"—1.74" ...	1	—	—	—	—	—

Goth<sup>9</sup> has investigated this subject, and gives the average size of the angle for twenty cases as 62°, while Winkler,<sup>10</sup> in forty-one dry pelves, found it to measure 37° in two cases, 40° to 50° in five cases, 50° to 60° in nineteen cases, 60° to 70° in fourteen cases and 72° in one case.

By the second factor is meant the height of the anterior extremity of the true conjugate or post-pubic point, and not that of the entire symphysis pubis.

In the dry pelvis, the highest measurement obtained was 1.5" (3 cases), the lowest 0.9" (5 cases), the average being 1.17".

The measurements obtained in the living subject are shown in Table IV, and varied from 2.25" (1 case) to 0.75" (3 cases), the average being 1.55".

TABLE IV.

SHOWING RELATION BETWEEN HEIGHT OF SYMPHYSIS AND C.D.—C.V.  
*Living Subject (100 Cases).*

C.D.—C.V.	Height of Symphysis (Post-pubic Point).				
	0.75-0.99	1.0-1.24	1.25-1.49	1.5-1.74	1.75-2.0
0.25"—0.49" ...	2	1	1	1	—
0.5"—0.74" ...	2	5	7	10	8
0.75"—0.99" ...	—	2	6	14	12
1.0"—1.24" ...	—	—	2	9	10
1.25"—1.49" ...	—	—	—	2	5
1.5"—1.74" ...	—	—	—	—	1

The higher the situation of the post-pubic point, the greater is the difference between the two conjugates; in my own cases, where the difference is less than 0.75", the height of this point measures over 1.5" in nineteen cases, and under it in eighteen cases; with a difference of more than 0.75", the height measured over 1.5" in fifty-two cases and under it in ten cases.

The two factors, the inclination and height of the symphysis pubis have therefore an important bearing upon the length of the true conjugate, and must be taken into account when estimating the length of this diameter from that of the diagonal conjugate.

Great difference of opinion exists as to the amount to be deducted. Michaelis recommended 0.75" as a mean, 0.6" when the bones were badly developed, and 0.9" when they were strong made; he found the same average for both normal and contracted pelves, but only examined 26 of the latter.

Skutch<sup>11</sup> suggests as an average 0.6", and Goth,<sup>9</sup> for twenty cases, gives a mean of 0.5".

Spiegelberg<sup>12</sup> was the first to emphasize the importance of taking the height and angle into consideration in arriving at a correct estimate; he stated that a steep anterior pelvic wall increases, whilst a horizontal one diminishes the amount to be deducted; also, the

longer the symphysis the greater the difference between the conjugates.

Pinard<sup>3</sup> considers that in always deducting 0.6", regrettable errors will be committed; he thinks the deduction ought to be proportionate with the height and direction of the symphysis, and also to a certain extent with its thickness.

Van der Hoeven,<sup>13</sup> in his recent work on this subject, has come to the conclusion that the indirect method of measuring the true conjugate is open to grave errors, and finds the deduction from the diagonal conjugate to vary between 0.0" and 1.6".

This author measured the true conjugate directly with Gauss's instrument, which he considers to be the most accurate pelvimeter yet introduced.

My own results lead me to the same conclusions as those of Van der Hoeven, but it must be remembered that the indirect method is the only one capable of general application, and when used with a full knowledge of its limitations gives sufficiently accurate results in the great majority of cases.

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