

OUTLET PELVIMETRY; WITH THE DESCRIPTION OF A
NEW PELVIMETER FOR MEASURING THE TRANS-
VERSE AND POSTERIOR SAGITTAL DIAMETERS
OF THE PELVIC OUTLET WHEN THE TRANS-
VERSE IS BETWEEN 8 AND 5.5 CM. IN
WIDTH.

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(With two illustrations.)

GRANTED an aseptic technic, the first principle in the scientific conduct of labor which shall provide the greatest safety to the mother and child, is a knowledge of the relative size of the pelvis and fetal body; yet a large proportion of physicians give little if any attention to its importance. While it is not possible to obtain accurate measurements of the child's head antepartum, it can to a certain extent be estimated; but the diameters of the pelvis can be very accurately measured; externally with the pelvimeter and internally with the hand. The relative size of the head and pelvic *inlet* has doubtless received more attention than the head and pelvic *outlet*; in spite of the fact that at the outlet difficulties are frequently encountered. It is here that injurious and impossible forceps extractions are often blindly attempted because measurements are not taken during pregnancy or labor. The outlet, except in the hands of experts, remains an unexplored field until after the head has become wedged in the lower pelvis; and even then it may not be recognized that the *outlet is so contracted* that it is impossible for the head to pass through it.

There are two reasons for this oversight: first, the importance of

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the pelvic outlet measurements is not generally appreciated; and second, the relative values of the respective diameters and how to measure them is not understood. It may appear strange that this should be so, for *contractions at the outlet are far more frequent than any other pelvic deformity*. At the Johns Hopkins Hospital, Dr. Herbert Thoms found that 5 per cent. of typical funnel pelvis occurred in 4000 consecutive labors. The frequent occurrence of difficult labors when the head has reached the lower pelvis, is the experience of every physician who practises obstetrics; but the reasons are often not recognized. We all recall instances where the forceps has been applied at this stage, and powerful traction has been made without knowing that the outlet was too small for the head to pass; and we are too familiar with the consequent disastrous results to mother and child. It must be admitted that there is a wide field for education in the line of appreciation of outlet de-

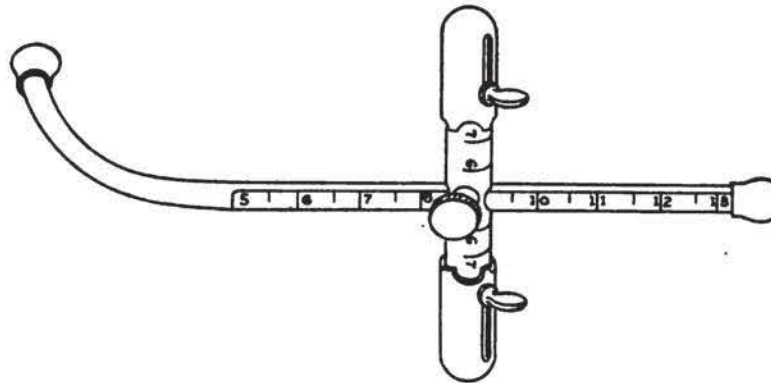


FIG. 1.

formity and its management. It must be more generally shown, what the available diameters in funnel pelvis are and how to measure them. Physicians who come to the antepartum clinics of the New York Post-Graduate Medical School and Hospital are especially interested in outlet pelvimetry. Recent books upon obstetrics describe the outlet diameters and the methods of measuring them; but it has been difficult to take the measurements of the two diameters upon whose relative lengths chiefly depend the passage of the head. These are the *transverse* or *tubero-ischial*; and the *posterior-sagittal of Klien*. The lower portion of the latter diameter, as also of the anteroposterior diameter of the outlet, is in reality an internal diameter; and the true lengths of both must in part be estimated; just as the length of the internal conjugate must be estimated from the diagonal conjugate; but with a simple instrument this is readily done.

It is not surprising that in general so little is known of these two important outlet diameters. The older practitioners were taught

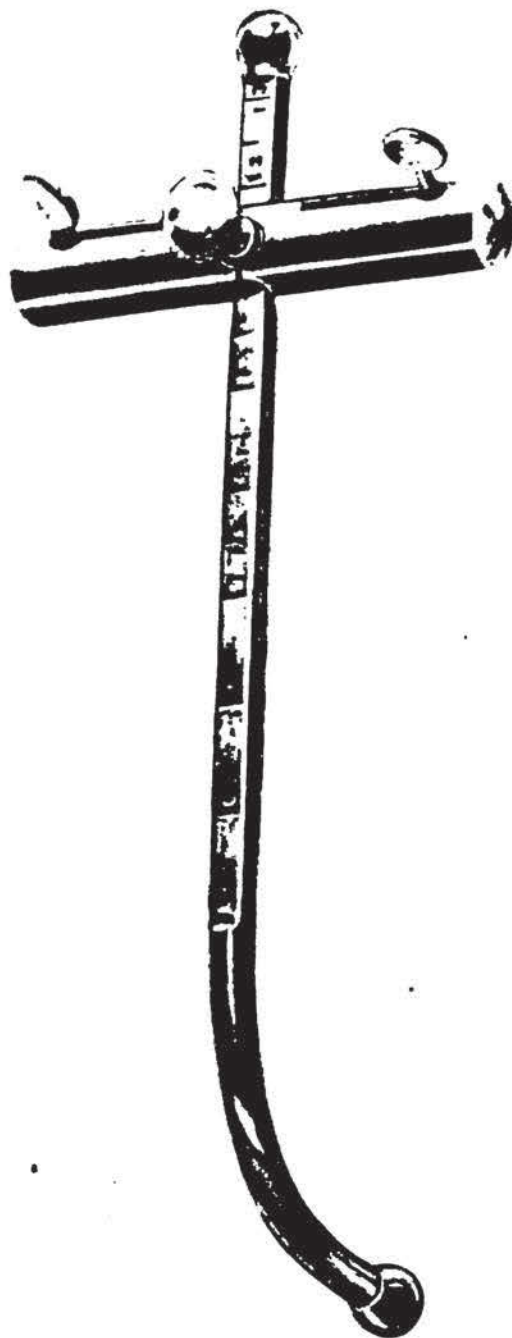


FIG. 2.—The instrument as it would *measure* a transverse diameter of 5.5 cm. and posterior-sagittal of 10 cm.

that the diameters of the “inferior” or “perineal strait,” were the anteroposterior or coccy-pubal; the bischial or transverse; and the oblique diameters, extending from the middle of the great sacro-



FIG. 3.—The instrument measuring in the bony pelvis the *transverse diameter of the outlet*, and the distance from the transverse to the *posterior* tip of the sacrum. The distance from the transverse to the *anterior* tip of the sacrum is the *posterior-sagittal diameter*. The distance in a straight line from the center of the transverse to the *sub-pubic arch* is the *anterior-sagittal diameter*; and from sub-pubic arch to the *anterior* tip of the sacrum is the *antero-posterior diameter* of the pelvic outlet. Geometrically these lines form a triangle.

In funnel pelves the available outlet is practically between the transverse and the anterior tip of the sacrum.

| | | | | | | |
|------------|-----|-----|--------------------|------------------|-----|-----|
| Transverse | 8 | cm. | Posterior-sagittal | must be at least | 7.5 | cm. |
| " | 7 | " | " | " | 8 | " |
| " | 6.5 | " | " | " | 8.5 | " |
| " | 6 | " | " | " | 9 | " |
| " | 5.5 | " | " | " | 10 | " |

sciatic ligaments to the junction of the ascending branch of the ischium with the descending ramus of the pubis. It was recognized that transverse contractions at the outlet were more frequent than anteroposterior contractions; and the reason was ascribed to the fact that the tuberosities of the ischium support the weight of the body in the sitting posture. They will recall the text consumed in describing the direction of the *irregular planes* of the inferior strait; and the difficulty which it presented because of its *different levels*. Referring to this, Dugès came very near the solution of the problem of outlet dystocia when he divided the inferior strait into *anterior* and *posterior portions*; the tubero-ischial diameter being the dividing line. But here his foresight stopped; for he says: "As this method of proceeding, uselessly complicates the question, we prefer considering the terminal plane of the pelvis, as represented by the coccy-pubal line, thus leaving out the lateral projections (at the tuberosities) altogether;" and the leading question was: "What is the direction of the line that extends from the point of the coccyx to the inferior part of the symphysis pubis?" Had reasoning stopped here, scientific obstetrics would have been deprived of the enlightenment which it has more recently received from Klien; who in 1896 promulgated the fact that in funnel pelvis an interrelationship exists between the width of the outlet at the inner lowest level of the tuberosities of the ischium (the transverse of the outlet) and the distance in a straight line from the center of this transverse to the anterior tip of the sacrum. So that if the transverse (which represents the available width of the pubic arch) is so narrow, the passage of the head is difficult. Compensation may be obtained however if the distance from this transverse to the anterior tip of the sacrum is sufficiently lengthened. He thus substituted for the classical, anatomical anteroposterior diameter of the outlet, the new *available diameter* which he named the *posterior-sagittal diameter of the pelvic outlet*.

In like manner he created (scientifically), a new diameter extending from the same center of the transverse, to the symphysis pubis within the vagina; which he named the *anterior-sagittal diameter*. Klien thus discovered the practical significance of the areas of the *different levels* of the "anterior and posterior portions" of the inferior strait into which it had been divided by Dugès; showed the relationship which must exist between the lengths of the newly created posterior-sagittal diameter and the transverse, tubero-ischial diameter which forms the common base line between the "anterior and posterior portions;" and demonstrated the

correlation of each, in outlet contraction, or funnel pelvis. The significance of these demonstrations has a very important bearing upon the outcome of labor in outlet contraction. In the *anterior portion*, the width of the pubic arch is the determining factor and in the *posterior portion*, the length of the posterior-sagittal diameter is its relative complement.

In pelves of normal size the subpubic arch is wide enough for the head to pass immediately beneath it; but with a narrow pubic arch, as shown in the table below, the head must pass, if at all, below the arch at a distance from it down the pubic rami, varying according to the degree of narrowing; and in order to do this, the tip of the sacrum must be located farther back than it is in its normal position. If sufficient compensation exists, it forms a *new available outlet*; the transverse, tubero-ischial diameter being substituted for the pubic arch and the posterior-sagittal diameter being substituted for the anatomical anteroposterior.

TO MEASURE THE PELVIC OUTLET DIAMETERS.

The pelvic outlet diameters are the *tubero-ischial* or *transverse*, the *posterior-sagittal* and the *anteroposterior*. The transverse measurement is made between the lowest inner margins of the tuberosities of the ischium. The anteroposterior is measured from the subpubic arch within the vagina, to the tip of the sacrum *posteriorly* and deducting 1 cm. to allow for the thickness of the sacral tip. The posterior-sagittal diameter cannot be measured directly, but may be approximated by carrying the tip of the pelvimeter backward over the tissues to the tip of the sacrum *posteriorly* and subtracting 1 cm. to allow for the thickness of the tip. It is *impossible* to measure this diameter without having a *fixed transverse base line*. It was for the purpose of providing this base, adaptable to the varying widths of the transverse, together with a means in a single instrument for measuring from this base to the sacral tip *posteriorly*, that the new pelvimeter was devised.

According to Klien (113 cases) the *normal* measurements of the outlet are:

| | | | |
|------------------------|-----|-------------------------|------|
| | Cm. | | Cm. |
| Transverse..... | 11 | Posterior-sagittal..... | 9.95 |
| Anterior-sagittal..... | 6 | Anteroposterior..... | 11.5 |

According to Williams, in 185 normal pelves, the measurements were as follows:

| | | | |
|------------------------|------|-------------------------|------|
| | Cm. | | Cm. |
| Transverse..... | 10.5 | Posterior-sagittal..... | 7.5 |
| Anterior-sagittal..... | 5.0 | Anteroposterior..... | 11.5 |

The latter measurements correspond with our own as taken at the New York Post-Graduate Medical School and Hospital. (Occasionally the transverse diameter measures a little over 8 cm. but the posterior-sagittal generally measures 7.5 cm. and it rarely happens that great difficulty is experienced in these cases during labor.)

The normal length (Williams) of the transverse, tubero-ischial diameter as measured in the living subject, *i.e.*, over the tissues, is 10.5 cm.; and the normal length of the posterior-sagittal diameter is 7.5 cm. Spontaneous birth of the head is still possible with the tubero-ischial diameter shortened to 8 cm.; the posterior-sagittal remaining 7.5. If the tubero-ischial diameter is shorter than 8 cm. the head will not pass unless the posterior-sagittal is lengthened.

If the tubero-ischial 8.0 cm. the posterior-sagittal must be at least 7.5 cm.
 If the tubero-ischial 7.0 cm. the posterior-sagittal must be at least 8.0 cm.
 If the tubero-ischial 6.5 cm. the posterior-sagittal must be at least 8.5 cm.
 If the tubero-ischial 6.0 cm. the posterior-sagittal must be at least 9.0 cm.
 If the tubero-ischial 5.5 cm. the posterior-sagittal must be at least 10.0 cm.

—(Williams)

But these compensations may not be present; and to add to the difficulty, the child's head may be unusually large and hard so that it will cease to advance when it has reached this plane of the obstetric outlet; and if the forceps is applied, fatal injury may be done to the mother and child. Especially is there danger of rupturing the symphysis; fracturing the child's skull; producing paralyses; or brain lesions which may continue through life. This is a condition which demands more than a passing notice. It is the key to the obstetric mechanism which oftenest confronts us. The child's head becomes fixed in the lower pelvis, too large to pass through it; and notwithstanding the certainty of inflicting serious injury from compression and lacerations; or death from these and sepsis; the forceps is frequently applied in the blindest manner without regard to the relative size of the pelvis and head; and even without consideration of the position of the head. The pelvis can be very accurately measured; and the occipito-frontal diameter of the child's head can often be quite accurately measured with a pelvimeter through the abdomen; from which the length of the biparietal may be estimated. In this way we may obtain a fair knowledge of the length of two of the cephalic diameters. If the pelvis is found antepartum to be inadequate for the passage of the head, we are then forewarned that special treatment is necessary. Either the child's head must be prevented from obtaining its full size, by

inducing labor at an appropriate time; or if one does not elect to do this; pubiotomy or Cesarean section should be anticipated, to spare the mother and child the injuries incident to the attempt at a destructive forceps extraction. The size and molding capacity of the head are always the least known factors; knowledge of the character of the uterine pains; and the mother's power of assistance may practically be disregarded; for a case of this kind will be at least a difficult forceps case, the patient being under an anesthetic. Every case should be measured antepartum; but this does not mean that every case will be difficult. By knowing the measurements we can at least be informed as to the pelves which are of normal size and in which normal labor may be predicted; and as to the pelves which present outlet contractions, or in other words are *small in their outlet diameters, funnel shaped*.

The question is asked what shall be the treatment of extreme cases which are either recognized antepartum or not until labor is well advanced; by physicians who have had no experience in pubiotomy or Cesarean section; or where the case is far removed from a hospital or assistance? The answer must be the same as where under similar conditions the dystocia is at the inlet.

If the forceps without too great compression and without too great traction is ineffectual; craniotomy must be done; for it is better to spare injury to the mother if possible; where the death of the child is inevitable. Axis-traction forceps may be able to drag the head through a certain degree of pelvic contraction, but if the advantage gained by compression is followed up by tightening the screw of the forceps, it will be found that the forceps has been converted into a cephalotribe. We believe this is a common occurrence.

THE PELVIMETER.

The pelvimeter consists of a transverse bar, adjustable, with a scale measuring from 8 cm. down to 5.5 cm.; and an adjustable rod (the tip at its top unscrews) which passes through the center of the bar and curved at its lower end so as to pass around to the sacral tip. This is also marked at $\frac{1}{2}$ cm. intervals, from 5 cm. from the curved tip in a straight line, to 14 cm., the upper end of the rod. The cross bar is made adjustable by means of caps or hoods which may be drawn out to a total width of 8 cm. When these hoods are pushed in, the bar measures 5.5 cm. The caps may be fixed at any point by thumb-screws. The curved rod which passes through the transverse bar is also held by a thumb-screw. The combination

measurements of transverse and anteroposterior diameters may thus easily be made.

Between these points 8 and 5.5 cm. (on the bar of the instrument) are scale markings at 6 and 7 cm.; which means that when the depth of the scallop at the inner end of each cap is at the mark 7, the length of the bar thus represented by the caps will be 7 cm.; and when they are at the figure 6 it will be 6 cm. The first, lowest mark on the curved rod is at 5 cm. distance in a straight line from the tip of the curve. This was selected to aid in keeping in mind the *average* normal length of the *anterior-sagittal diameter*. (Williams 185 cases.) (The length of this diameter is generally given as between 5 and 6 cm.)

At the distance of 8.5 cm. from the tip of the curved rod to the lower anterior edge of the cross bar in a straight line the figures $8\frac{1}{2}$ are placed; because the measurement from this point on the cross bar to the tip of the sacrum *externally*, less 1 cm., represents the normal length of the posterior-sagittal diameter 7.5 cm. (the measurement to the tip of the sacrum *internally*). *The posterior extremity of the true sagittal diameter is at the tip of the sacrum on its anterior surface, internally; so that 1 cm. must always be subtracted from the distance actually measured externally.* Other figures up to 14 cm. are similarly placed on the rod at 1 cm. and $\frac{1}{2}$ cm. intervals. *They indicate the other distances to which the posterior-sagittal diameter must be lengthened to compensate for the variations in shortening of the tubero-ischial diameter.* Thus, for example:

If the reading for the

Posterior-sagittal is 8.5 cm. subtracting 1 cm. equals 7.5 cm.

Posterior-sagittal is 9.0 cm. subtracting 1 cm. equals 8.0 cm.

Posterior-sagittal is 9.5 cm. subtracting 1 cm. equals 8.5 cm.

Posterior-sagittal is 10.0 cm. subtracting 1 cm. equals 9.0 cm.

Posterior-sagittal is 11.0 cm. subtracting 1 cm. equals 10.0 cm.

USE OF THE PELVIMETER.

A good light and posture of the patient are essential, especially if the patient is stout and the tuberosities thickly covered. One should not feel that he must hurry in defining the landmarks. A good method of procedure is to place the patient in the *extended lithotomy posture* on a table, with the hips well over the edge, so that the tip of the sacrum may be palpated. It is well to have the sacrum rest on a pad to protect the patient from the edge of the table. The lithotomy posture may be maintained with leg holders; or by having the feet with slippers on, rest against the top of the backs of two

chairs, which are higher than the table; one chair being placed for the right and one for the left foot. This posture brings the tuberosities into prominence and *prevents the tendency* to measure the transverse diameter at a point *higher than the tips of the tuberosities* which would give a false measurement, viz., one *too narrow*. It is more convenient if the physician is seated. The instrument measures any distance transversely, from 8 cm. down to 5.5 cm. If the transverse diameter is apparently between 8 and 7 cm., the pubic arch may be palpated from above downward with the thumbs. When the greatest width is estimated in this manner or with the knuckles of the hand bent at the second phalangeal joint pressed between the tuberosities, or measurement is taken with a steel tape measure (if desired as a preliminary), the caps of the transverse bar are to be drawn out to their full extent of 8 cm. and trial made *to see if the distance between the tips of the tuberosities is as long as the bar fully drawn out*. If it is not, the instrument is taken off, and the sliding caps set for 7 cm., etc., and trial again made. (This is easier than attempting to measure the distance directly by holding the ends of the caps between the thumb and fingers and palpating and moving the caps at the same time.)

The bar now measuring the transverse diameter is held by the operator in position, and the *posterior-sagittal* diameter is next measured by bringing the tip of the curved rod around to the tip of the sacrum, *and subtracting 1 cm.* from the distance measured. A screw holds the curved rod in place in the transverse bar. For trial the curved rod may be fixed at the 8.5 cm. mark.

To locate the tip of the sacrum: Palpate the coccyx, by introducing the index-finger of one hand into the vagina; and making counter-palpation with one or two fingers of the other hand on the outside. The rectum should be empty. The coccyx is composed of four bones, which in my experience are partially movable, especially in young subjects.

Again, the coccyx is about 1¼ inches long (3 cm.); so that, bearing in mind its usual length, its upper termination will be approximately 1¼ inches above its tip.

TO MEASURE THE ANTERIOR-SAGITTAL DIAMETER.

Place the *tip of the short curve* of the curved rod against the subpubic arch, *within the vagina*; and bring the transverse bar to the level of the tubero-ischial line. Normal length, 5 to 6 cm.

TO MEASURE THE ANTEROPOSTERIOR DIAMETER OF THE PELVIC
OUTLET.

Place the *tip of the short curve* of the curved rod against the tip of the *sacrum* and measure in a straight line to the symphysis pubis *within the vagina*. Subtract 1 cm.

ESSENTIALS.

1. *Posture*: Place the patient in the exaggerated lithotomy posture with the tip of the sacrum well over the edge of the table.

2. Draw out the caps to the fullest extent of 8 cm.

3. Fix the transverse bar at the point $8\frac{1}{2}$ on the curved rod, ready for a trial measurement of the posterior-sagittal diameter.

4. Palpate the ischial rami downward with the thumbs to their inner lowest limit; at least to the level of the anus.

5. Make trial to see if the *transverse diameter* at this point is as wide as the full length of the bar. If not, slide both caps inward to the marks 7 or 6 cm., etc., and turn the screws to hold them.

6. Make another trial measurement.

7. Having measured the transverse, lay the instrument aside for a moment and palpate the coccyx to locate the tip of the sacrum. Keep a finger here or have an assistant hold his finger here, or place a small strip of adhesive plaster. The tip of the sacrum may also be palpated or located, first, by placing the patient on her side. Replace the transverse bar at the tubero-ischial level and see if the tip of the curved rod, fixed at the $8\frac{1}{2}$ -cm. mark will swing around to the tip of the sacrum; if so, the length of the *posterior-sagittal diameter* will be 7.5 cm., the normal length. If it does not reach this point, draw the rod down or push it up until it does reach it.

8. Do not forget to measure the occipito-frontal diameter of the child's head through the abdominal wall (normal 11.50 to 11.75 cm.) and subtract 2 cm., which will give approximately the bi-parietal diameter (normal 9.25 to 9.50 cm.).

I am indebted to Dr. J. Whitridge Williams for allowing me to demonstrate the use of my pelvimeter at the Johns Hopkins Hospital; and to Dr. George L. Brodhead for reviewing this paper.

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