

PELVIC MEASUREMENTS BY X-RAY¹

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IN 1921, Chamberlain and Newell published in detail a method of pelvimetry by means of roentgen-ray which they had developed in the department of roentgenology at Stanford University Hospital. This method is a simplification of the method published by Runge and Gruenhagen in 1915 with the use of the stereoscope as recommended by Manges in 1912.

The distinctive points in the new technique consist first, in the use of a plumb-bob hanging from a lead ring under the target which is set 80 centimeters above the plane of the film; second, a wire stretched across under the patient; and third, a 10 centimeter rod which is placed on the body of the patient just above the symphysis.

For taking the stereoscopic plates the patient is placed on a Potter-Bucky diaphragm and the plumb-bob is adjusted vertically below the target (Fig. 1). This is accomplished by tilting the tube-holder until the shadows of the plumb-bob and the lead ring are concentric. The tube is brought over the right iliac region and an exposure made with the Coolidge tube about 15 seconds at 25 milliamperes at a nine-inch gap. The tube is then shifted 10 centimeters to the left, parallel to the wire above mentioned, and another film is exposed. When dry, the films are placed in the stereoscope, and the desired points to be measured are marked with a small ink dot. Then, on the light box a piece of clear celluloid is laid over one of the films and on it are marked, first, two dashes over the shadow of the wire; second, the center of the plumb-bob; and third, the points on the pelvis which are to be measured, labeling each pair. The celluloid is then laid over the other film, setting the dashes over the shadow of the wire, and the mark for the plumb-bob placed exactly 10 centimeters from the first plumb-bob shadow. The points in the pelvis are then marked in their new positions and lines are drawn connecting the plumb-bob dots with the pelvis dots belonging to each plate, and a third line connecting the intersections. This connecting line is marked *Y*. The line connecting the two points marking the sacrum is labeled *A* and the line connecting the two points marking the point of the promontory is labeled *B*. A centimeter scale laid on the *Y* gives the length in centimeters of the horizontal projection of the required diameter. A special scale laid on *A* and *B* gives the height

in centimeters of each end of the conjugate above the plane of the film. The length of the conjugate is then computed from the formula:

$$X = \sqrt{Y^2 + (A - B)^2}$$

It is not necessary for the understanding of the method to go into the mathematic computations for making the scale. But for measuring the various diameters of the pelvis it is necessary to possess a scale made according to the mathematics involved. The details of making this scale are published in the paper by Chamberlain and Newell.

To correct for errors due either to a shifting of the patient or to a wrongly made scale, one can measure the 10 centimeter rod placed on the patient. If this gives accurate measurement, then the various diameters of the pelvis will be

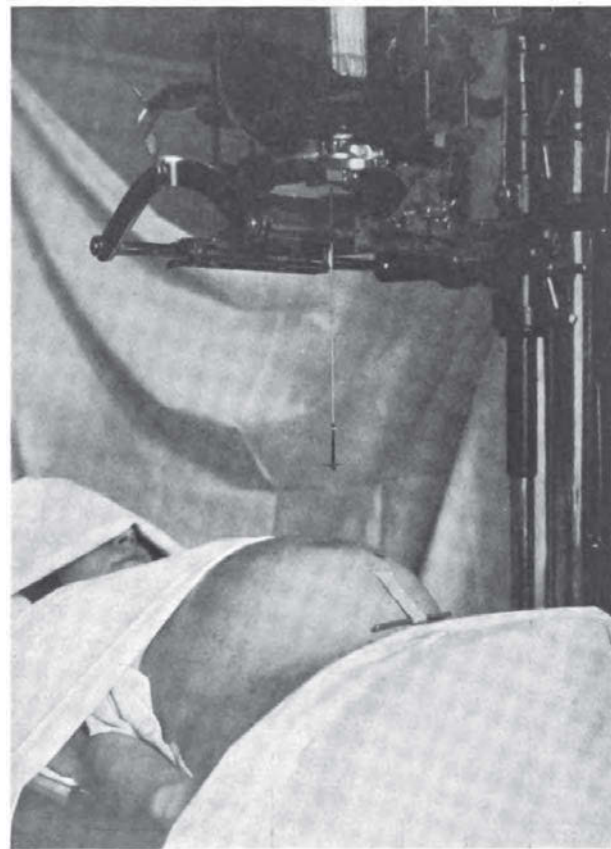


Fig. 1. The patient is placed on a Potter-Bucky diaphragm and the plumb-bob is adjusted vertically below the target.

¹ Read before the Chicago Gynecological Society, May 19, 1922. (For discussion see p. 831.)

TABLE I.—Summary of fourteen patients measured by roentgenologist.

	Type of Labor	Pelvimeter								Roentgen Ray								Remarks		
		SP	CR	T	LO	EC	RO	BI	PS	Inlet				Spines		Outlet				
										AP	T	LO	RO	AP	T	AP	BI		AS	PS
1	Breech Term	26 ⁵	28	31	22 ⁵	20	22	9		12 ⁵	13 ⁵	12 ²	12 ⁸	12 ⁸	10 ⁵	10 ⁵	9 ⁷	7 ¹	8 ¹	
2	Spontaneous Term	26 ⁵	30	35	25	23	25	9		12 ⁴	14 ⁹	13 ⁴	13 ¹	13 ⁴	12	13 ³	10 ²	5 ¹	9 ²	Justomajor
3	Spontaneous Term	26	30	32	24	21	23 ⁵	7	8	13	13 ⁸	14 ¹	13 ⁹	13 ⁵	10 ¹	12	7 ⁷	4 ⁷	11	Clinical diagnosis, funnel pelvis
4	Transverse Version	26	28	31	23	20	23	8 ²		11 ⁶	12 ²	11 ²	11 ⁸	11 ⁵	8 ⁴	9	7 ⁶	5	7 ¹	Funnel pelvis
5	Breech Term	24	27	34	24	20	24	7	9 ²	12 ²	13 ⁵	12 ⁶	12 ⁶	12 ⁵	11 ³	12	9 ⁵	5 ⁶	9 ²	Clinical diagnosis, funnel pelvis
6	Breech Term	26	28	33 ⁵	22 ⁵	19 ⁵	23	7 ⁵	9 ⁴	11 ⁸	13 ⁵	13 ²	12 ⁸	11 ⁸	9 ⁵	10 ⁵	8 ⁴	5 ⁴	9 ⁷	Clinical diagnosis, funnel pelvis
7	Breech Term	27	29 ⁵	32 ⁵	23	19 ⁵	22	8 ⁵		11 ⁵	14 ²	13 ⁵	14	13 ³	11 ²	12	8 ³	6 ⁷	9 ³	
8	Mid-Forceps Term	22	24	27	21	19	21	6	8 ⁵	11 ⁵	12 ⁹	12 ²	12 ⁵	12 ⁵	10	11	6 ⁵	5	9 ⁷	Clinical diagnosis, funnel pelvis
9	Bags Mid-Forceps Term	23 ⁵	26 ⁵	30	22	20 ⁵	22 ⁵	7		12 ⁹	13 ²	12	12 ⁵	11	9 ⁵	8 ²	7 ⁷	4 ²	8 ⁷	Clinical diagnosis, funnel pelvis
10	Spontaneous Term	21 ⁵	26	38	21 ⁵	19	22 ⁵	8		12	13 ³	12 ¹	12 ³	10 ⁵	9 ⁵	9 ⁵	8 ⁴	5 ¹	8 ⁸	
11	Low-Forceps Term	25 ⁵	28	32 ⁵	25	21	25	7	9	13 ¹	14	12 ⁸	13 ⁹	11 ⁹	10 ⁵	10	9	6 ³	9 ⁷	Clinical diagnosis, funnel pelvis
12	Cæsarean Eclampsia	25	28	32	24	19	23	7	6 ⁵	12 ⁴	13 ⁸	14	13 ⁵	10 ⁷	9 ⁷	10 ¹	9 ⁴	6 ²	6 ⁶	Clinical diagnosis, funnel pelvis
13	Cæsarean after 12 Hrs. Labor	26 ⁵	27	32	21	17	21	9	7	8	14 ³	11 ⁵	13	10 ¹	11 ⁵	9 ⁵	9 ²	7 ²	8 ²	Rachitic flat D.C. 10 Est. T.C. 8 ⁵
14	Cæsarean 2nd	25	27	31	21	18	21	8		10 ²	12 ¹	12	12 ⁵			9 ²	10 ⁸			Flat pelvis; 1st at N. Y. Lying-In

TABLE II.—Comparison of pelvic measurements by pelvimeter and roentgenologist. 1 and 2, by roentgenologist. A to L, by clinical staff with pelvimeter.

	I. S.	I. C.	B. T.	L. O.	E. C.	R. O.	B. I.	P. S.
X-ray 1	19.1	24.0	28.1	20.0	18.2	20.0	8.9	9.0
X-ray 2	19.6	23.3	27.2	18.5	17.3	18.1	10.3	7.4
A	19.75	24.75	28.5	18.5	17.75	19.0	9.25	7.0
B	21.25	25.5	28.5	20.75	18.5	21.0	9.5	6.0
C	21.0	25.5	30.0	20.0	18.0	20.25	8.5	8.0
D	21.0	25.0	29.5	20.5	19.0	20.5	9.0	7.0
E	21.5	26.0	...	20.0	18.5	20.5	9.0	7.0
F	20.5	26.0	30.0	22.5	17.25	23.0	11.0	8.75
G	22.5	25.5	29.0	20.0	18.5	21.0	8.75	6.25
H	21.5	25.75	29.5	20.5	19.0	21.25	9.0	6.5
I	22.0	26.0	29.5	21.0	19.75	21.0	8.75	7.0
J	21.0	25.5	28.5	20.0	18.0	21.0	9.0	7.0
K	21.5	26.0	...	20.5	20.75	20.75	10.5	7.5
L	21.0	26.0	...	20.0	21.0	21.25	10.25	6.5

accurate, providing the dots have been accurately placed on the plates. This is the one point in the

method which depends upon individual technique for accurate mensuration. In measuring dried pelvises the method has been found to be accurate within 2 millimeters.

The method is too expensive to be used as a measure of routine, but we have found it very helpful in cases with suspected abnormalities of the pelvis detected either with the usual methods of pelvimetry or from an abnormal progress in labor. Particularly has it been helpful in gauging more accurately the diameters of the outlet of the pelvis, and in two instances has been the deciding factor in inducing labor rather than resorting to a preliminary cæsarean section. In both instances the outcome of the labor proved the accuracy of the X-ray measurements. A summary of fourteen patients so measured is given in Table I. We have not utilized so far cephalic measurements, but with greater experience it does not seem unjustifiable to expect that with this method we should not be able to judge correctly the proper time for inducing labor in patients with moderate degrees of pelvic contraction.

In a marked obliquely contracted pelvis the impression given by external measurements was entirely changed by the accurate measurements for both oblique diameters which were found to be nearly equal.

An additional practical point that we have observed in the use of the X-ray measurements during the progress of a delayed labor is the accurate diagnosing of the position of the presenting part which is shown by the X-ray photograph.

It is more difficult for the roentgenologist to place the points accurately for external measurements because of the shadows of the iliac bones, but the method has great teaching value in correlating the various methods of external pelvimetry used by different members of the staff. This has been tested in a very interesting contest where the entire staff, including the attending obstetricians, senior house staff, junior house staff, and students have entered into a competition with the X-ray department. In this contest not only was the fact brought out that certain of the pelvimeters in regular use gave erroneous measurements, but also that different methods for measuring the pelvis showed quite varying degrees of accuracy (see Table II).

Not only did the measurements made by the clinical staff vary, but also there was a considerable variation in the two measurements made by different roentgenologists. At first glance, this might seem to throw doubt on the value of the X-ray measurements, but after considerable discussion in staff meeting, it was found on the side of the clinicians that not only were some of the

instruments used defective, but also there was not a unanimity of opinion as to the exact points from which the different measurements should be taken. This was particularly noticeable in the outlet measurements of the pelvis. Because of the size of the tuberosity of the ischium, different measurements will be obtained if the bis ischial is measured from the anterior edge, the middle portion, or the posterior edge, of the tuberosity. However, it will be noted in the chart that where short bis ischial measurements are made the same individual usually measured a long posterior sagittal. The measurements made by different roentgenologists are due not to errors in the technique of the method, but rather to misunderstandings as to the exact points between which the measurements should be taken.

Moreover, the roentgenologist, unless he is also a trained obstetrician, is not capable of expressing to patients the prognosis of labor based upon X-ray measurements. So many factors must be considered in regard to prognosis such as pelvic inclination, presentation and position, mechanism of labor, etc., that the obstetrician must rely on his training and past experience in this important matter, and can utilize X-ray measurements only as one factor to aid him in arriving at his decision. It is not sufficient for the obstetrician to read merely the written report from the roentgenologist, but he must study with the roentgenologist the stereoscopic pictures of the pelvis and satisfy himself that the points from which the measurements are taken are the points which in his judgment are essential.