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X-Ray Pelvimetry

by

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Roentgen examination of the female pelvis was increasingly employed since the beginning of this century. The early workers were from the Continent, especially France and Germany. Great advances were made between 1920-50, and many of the major contributions of this period were made by American and British investigators (1, 2). The value of X-ray pelvimetry lies not only in accurate estimation of various pelvic diameters, but valuable information can be obtained by a study of pelvic morphology.

There are many techniques of roentgen pelvimetry. The simpler methods employ perforated or notched radio-opaque scales or markers (isometric scale) placed along certain planes of the body. This method, in fact, is eminently suitable for lateral X-ray pelvimetry. The patient usually stands upright and the radio-opaque scale is placed along the sagittal plane of the body. This enables the various antero-posterior diameters of the true pelvis to be measured by a pair of dividers with a high degree of accuracy (Fig. 1.). This position is so well standardised that most hospitals throughout the world adopt it.

Measurement of the transverse diameters of the pelvic cavity is not so straightforward owing to the fact that the various planes of the pelvic inlet, mid-pelvis and outlet cannot be accurately located from the outside. Again, perforated radio-opaque scales or plates may be used. For example, in the Thoms' technique (3) which is currently employed in the Kandang Kerbau Maternity Hospital, the patient is first exposed in the semi-sitting position on a special frame called the Torpin-Thoms' roentgen pelvimeter and thus a true brim view of the pelvis is obtained. The approximate plane of this pelvic brim is next ascertained and fixed by a pair of movable indicators. The patient then gets off the pelvimeter, a perforated opaque lead plate or grid is then placed along the plane as indicated by the pointers and a second X-ray exposure is made on the same X-ray film. When the X-ray film is processed, the distance of perforations in the grid, which are 1 c.m. apart, are clearly seen superimposed over the pelvic brim, and therefore the anterior-posterior and transverse brim and interspinous diameters can be measured off straightaway (Fig. 2.).

More elaborate modifications make use of a series of radio-opaque scales which are placed at different planes of the pelvis, so that different diameters can be simultaneously read off on the same radiograph. Obviously, such methods are rather complicated to use, and therefore less popular.

Other more precise techniques are based on triangulation or geometrical principles. One well known technique, called the parallax method, requires two X-ray exposures—the first film is made with the X-ray tube in a certain position, and the second film is made with the X-ray tube shifted about 10 c.m. lengthwise along the sagittal plane of the body. This is the so-called stereometric method (4, 5, 6). The X-ray reading is more complicated and time consuming. Tables may be used, or direct calculations may be done; or diameters may be measured on pointers with an apparatus called the stereoroentgenometer.

An even more elaborate method makes use of a stereoscopic pair of films of the pelvis viewed through a precision stereoscope (3). This method is even more difficult to master and is limited to those with good stereoscopic vision. An advantage is that pelvic form and shape can be accurately studied.

Individual workers also employ their own modifications based on any one of the principles mentioned above.

Roentgen ray examination of the female pelvis, like any other method of examination, also has its limitations. However, when judiciously employed in correlation with clinical findings, radiography can prove invaluable if not essential in certain cases where clinical examination could not supply the necessary information, e.g., information of shape of pelvic inlet and certain diameters like the inlet and perhaps interspinous diameters. Frank disproportion can be detected easily enough in radiographs, even without use of precise measurements. However, it is to be admitted that difficulty usually arises in clinically borderline cases; for often, X-ray findings are equally equivocal. This, however, should in no way detract the great value of X-rays in pregnancy. It stands to reason that it becomes a more valuable tool in the hands of the experienced.

The present method of X-ray pelvimetry adopted in the Kandang Kerbau Maternity Hospital has been in use for almost a decade. This was drawn up by the previous Senior Radiologist, Dr. D.R. McPherson, in collaboration with Prof. B. H. Sheares. For a full pelvimetry, three views are taken:— (1) Lateral View (Fig. 1), (2) Thoms' Inlet (or brim) view, (4) (Fig. 2), and (3) Outlet or Chassard-Lapine view (Fig. 3). A detoiled table (Fig. 4) together with normal measurements are supplied on a foolscap sheet, in which the various findings can be recorded for each individual case. Data given in the table are based on the systems of Thoms (5) and Snow (6). This table has proven itself satisfactory for routine work, although some of the norms supplied for some pelvic diameters may seem to be either too large or too small for the local population.

This paper attempts to analyse the results of some obstetric inpatients delivered in the Kandang Kerbau Maternity Hospital who had had X-ray pelvimetry. Because of time and other limitations, most of the cases reviewed were those seen in 1962. A review of case histories during the early stage of the investigation soon showed that the majority of cases for X-ray pelvimetry only had a lateral pelvimetry film. Only a minority had both lateral and brim views, and very few patients had the full three-view pelvimetric examination. The reason would appear to be that with the report by Stewart et al (7) in 1956 in which was stressed the danger of X-ray radiation to the foetus, X-ray requests for full pelvimetries in the Kandang Kerbau Maternity Hospital had progressively dropped, and were usually limited to lateral films only. It is only in the recent months that requests for additional brim views are on the increase, following increasing awareness of the importance of mid-pelvic dystocia from the teachings of Prof. J. L. McKelvey.

Because of the small number of full pelvimetries, it has been decided to limit the present presentation to 107 patients who had only lateral pelvimetries.

Analysis of 107 Cases of Lateral X-ray Pelvimetries

Type of presentation: Table 1 shows the incidence of the type of presentation of the 107 cases. The majority of cases are vertex presentations (84%), with breech coming a low second (13%).

Table 1

TYPE OF PRESENTATION OF 107 CASES OF LATERAL PELVIMETRIES

Presentation	Number of Cases
Vertex - - -	90 (84%)
Breech - - -	14 (13%)
Face - - -	2 (2%)
P.O.P. - - -	1 (1%)

Type of delivery: Table 2 shows the incidence of the method of delivery of the 107 cases. Normal vertex deliveries form a fair majority of cases (38%), with caesarian sections (all L.S.C.S.) coming a fairly close second (28%). In decreasing order of frequency comes forceps delivery (15%), breech (11%) and vacuum extraction (5.5%). It may be concluded that over half the cases (62%) referred for pelvimetry end up in deliveries other than the normal vertex delivery.

Table 2

TYPE OF DELIVERY OF 107 LATERAL PELVIMETRIES

Type of Delivery	No. of Cases	Percentage
Normal delivery (Vertex) - -	41	(38%)
Caesarian Section -	30	(28%)
Forceps - - -	16	(15%)
Breech - - -	12	(11%)
Vacuum Extraction	6	(5.5%)
Persistent Occiput Posterior - -	1	(1%)
Face - - -	1	(1%)
Total	107 cases	

Age period of mother in relation to type of delivery: From Table 3, it can be seen that the majority (59%) of mothers referred for pelvimetries are in the third decade of life, with those in the second and fourth decades coming next (17%) each. This table also shows that the majority of normal and abnormal deliveries also occur in the third decade. Caesarian section shows a somewhat higher incidence with increasing age. There is a slightly higher incidence of forceps in the second decade. Most of the vacuum extractions fall in the third decade.

Table 3

SHOWING RELATION OF AGE PERIOD OF MOTHER TO TYPE OF DELIVERY

Type of Delivery & Position

Mother's age in decade	LOA	ROA	Caesarean Section	Forceps	Vacuum Extraction	Breech	POP	RMA	Total number per decade
2nd	7	1	3	4	—	3	—	—	18 (17%)
3rd	28	1	14	9	5	6	—	—	63 (59%)
4th	3	—	9	3	1	2	1	1	19 (17%)
5th	1	—	4	—	—	1	—	—	7 (6%)
Total	39	2	30	16	6	12	1	1	107 cases

Details of 90 cases of vertex presentations: As depicted in Table 4, the majority (46%) of vertex presentations delivered normally. Caesarian sections (30%) came a close second. Forceps deliveries came third (16%), and vacuum extractions fourth (6%).

Table 4

DETAILS OF 90 CASES OF VERTEX PRESENTATION

Type of Delivery	No. Cases	Position & No of cases	
A. Normal Delivery - - -	41 (46%)	LOA	39
		ROA	2
B. Caesarean section - - -	28 (30%)	Not stated	25
		ROA	2
		LOT	1
C. Forceps - - - - -	15 (16%)	Not stated	12
		LOA	2
		ROA	1
		ROP	1
D. Vacuum Extraction - - -	6 (6%)	Not stated	2
		LOA	3
		ROA	1
Total	90 cases		

Details of 30 cases of caesarian section: Table 5 shows that caesarian sections was needed mostly (94%) for vertex presentations. There was one case of breech and another of face. Many of the cases (60%) had a small inlet true conjugate diameter; there was only one case with a small antero-posterior outlet diameter. Most of the mothers were in the third decade of life. Multigravidae constitute the majority of patients (60%). Half the mothers had previous obstetric difficulties, namely, caesarean section (27%) and forceps delivery (23%). Analysis of the indications for operation shows that maternal and foetal distress come first (50%), with contracted pelvis coming a close second (40%); there were 2 cases of P.E.T. (7%).

Table 5

DETAILS OF 30 CASES OF CAESAREAN SECTION

A. **Type of Presentation**

1. Vertex 28 cases (94%)
2. Breech 1 case (3%)
3. Face 1 case (3%)

B. **Size of A-P Diameter**

	Large	Medium	Small
Inlet True Conjugate	3 (10%)	9 (30%)	18 (60%)
A-P Outlet	11 (37%)	18 (60%)	1 (3%)

C. **Age Incidence**

Decade	No. of cases
2nd	3 (10%)
3rd	14 (47%)
4th	9 (30%)
5th	4 (13%)

D. **Others**

1. Multigravidae 20 (60%)
2. Previous obstetric difficulties — (a) Caesarean section 8 (27%)
   (b) Forceps 7 (23%)
3. Main Indications for Operation — (a) Maternal & Foetal Distress — 15 (50%)
   (b) C. P. D. — 12 (40%)
   (c) P.E.T. — 2 (7%)

Details of 16 cases with forceps delivery: Table 6 shows that almost all cases presented as vertex ((94%); there was only one case of breech. Small pelvic diameters did not appear to play an important role in forceps cases (less than 30%). The chief indications for forceps delivery were a prolonged second stage of labour, with combinations of foetal and/or maternal distress. There were 14 cases of low forceps and only 2 of mid-forceps deliveries.

Table 6

DETAILS OF 16 CASES WITH FORCEPS DELIVERY

A. **Type of Presentation**

(i) Vertex 15 cases (94%) — LOA 2
ROA 1
ROP 1
Not stated 11

(ii) Breech 1 case — LSA with prolapse of cord

B. **Size of A.P. Diameter**

1. Inlet true conjugate	(a) Large	7
	(b) Medium	4
	(c) Small	5
2. Outlet A.P. diameter	(a) Large	5
	(b) Medium	10
	(c) Small	3

C. **Indications for Forceps**

1. Prolonged 2nd stage - - - - 5
2. Prolonged 2nd stage with either foetal or maternal distress or combination of both - - - - - - - - 8
3. Prolonged 2nd stage and transverse arrest - - - - - - - - 1
4. R.O.P. - - - - - - - - 1
5. Breech with prolapse of cord - - 1

D. (a) Low forceps 14 cases
(b) Mid-forceps 2 cases —
(i) Prolonged 2nd stage
(ii) Foetal distress

Details of 14 cases of breech presentation: Table 7 shows that the majority of cases were in the L.S.A. position. Fourteen cases (86%) were delivered as breech; of the remaining 2 cases, forceps had to be applied on one and caesarean section performed on the other. There were 4 still births (25%)—three of these cases had small internal true conjugate diameter and small foetus; one case had an internal version.

Table 7

DETAILS OF 14 CASES OF BREECH PRESENTATION

A. **Position**	**N. of Cases**	**Details**	
L.S.A. - - - - - - -	8	(a) Footling - - -	2
		(b) Extended legs - -	3
		(c) Footling with prolapse of cord needing forceps	1
R.S.A. - - - - - - -	1	With extended legs	
Not exactly stated with footling -	3	Caesarean - - -	1
Not exactly stated with extended legs	2		
B. **Mode of Delivery** — (a) Breech -	12 (86%)		
(b) Forceps -	1 (7%)		
(c) Caesarean section -	1 (7%)		

C. **Still-birth in 4 cases** —
(a) 3 cases with small inlet true conjugate diameter and small foetus
(b) Internal version done on 1 case

D. Small Internal True Conjugate in 3 Cases

Details of 6 cases of vacuum extraction: All 6 cases presented as vertex (Table 8). All antero-posterior pelvic diameters were of medium dimensions. Five mothers were in the third decade of life. The indications were prolonged labour or foetal distress, with combinations including maternal distress.

Table 8

DETAILS OF 6 CASES OF VACUUM EXTRACTION

1. PRESENTATION—ALL VERTEX
2. A-P PELVIC DIAMETERS—All medium
3. 5 mothers in 3rd decade and 1 in 4th decade
4. **Indications:**
   (a) Prolonged labour - - - 2
   (b) Prolonged labour and foetal distress - - - - - 1
   (c) Prolonged labour and foetal and maternal distress - 1
   (d) Foetal distress - - - - 2

Incidence of type of delivery in relation to size of internal true conjugate diameter:

Table 9 shows that the majority of cases coming for pelvimetry had either medium (42%) or small (40%) internal true conjugate diameters. Most of the cases of normal vertex deliveries had medium-sized internal true conjugate diameters, but there was a fair proportion with small diameters. Small internal true conjugate diameters were the rule for caesarean sections. In forceps cases, the pelvic diameters tended to be on the larger side. Vacuum extraction cases had medium diameters. Diameters tended to be on the small side in breech cases.

Table 9

INCIDENCE OF TYPE OF DELIVERY IN RELATION TO SIZE OF INTERNAL TRUE CONJUGATE DIAMETER

Type of Delivery

Inlet true conjugate diameter	Normal (Vertex)	Caesarean Section	Forceps	Vacuum extraction	Breech	POP	Face	Total
Large (above 115 mm.)	5	3	7	—	3	—	1	19 (18%)
Medium (105-115 mm.)	22	9	5	6	2	1	—	45 (42%)
Small (below 105 mm)	14	18	4	—	7	—	—	43 (40%)
Total cases	41	30	16	6	12	1	1	107 cases

Detailed breakdown of small internal true conjugate diameter by 5-10 mm. step in relation to type of delivery:

The majority of small internal true conjugate diameters (Table 10) fall within the 105-101 mm. (49%) and 100-91 mm. (47%) groups. Very few (2 cases) were below 90 mm.

Table 10

DETAILED BREAKDOWN OF SMALL INTERNAL TRUE CONJUGATE DIAMETER BY 5-10 mm. STEP IN RELATION TO TYPE OF DELIVERY

Type of Delivery

Small inlet true conjugate diameter	Normal (Vertex)	Caesarean section	Forceps	Vacuum Extraction	Breech	POP	Face	Total
105-101 mm.	8	9	1	—	3	—	—	21 (49%)
100-91 mm.	6	7	3	—	4	—	—	20 (47%)
90 mm. & below	—	2	—	—	—	—	—	2 (4%)
Total	14	18	4	—	7	—	—	43 Cases

X-Ray prediction in various types of presentation: An attempt was made to predict the outcome of labour radiologically and to compare these predictions with the actual mode of delivery (Table 11.) The exercise is designed to indicate whether any delivery can be effected normally or with difficulty, but without any attempt at predicting the outcome or type of delivery. Predictions can be placed in three categories, (1) adequate, (2) borderline, and (3) inadequate. The table shows that X-ray prediction is fairly accurate for normal (vertex) and breech deliveries, and moderately accurate for caesarean section cases. No sound prediction can be made in cases ending in forceps deliveries and vacuum extraction. In conformation with general experience elsewhere, a fair proportion of borderline predictions fall in the group of cases needing caesarean section or forceps delivery and it is in these groups where the obstetrician needs to be supplied the most precise information.

Table 11

X-RAY PREDICTION IN VARIOUS TYPES OF PRESENTATIONS

TYPE OF DELIVERY	X-RAY PREDICTION			
	ADEQUATE	BORDERLINE	INADEQUATE	TOTAL
Normal (Vertex)	32	8	1	41
Caesarean Section	7	10	13	30
Forceps	8	7	1	16
Breech	9	1	2	12
Vacuum Extraction	4	2	—	6

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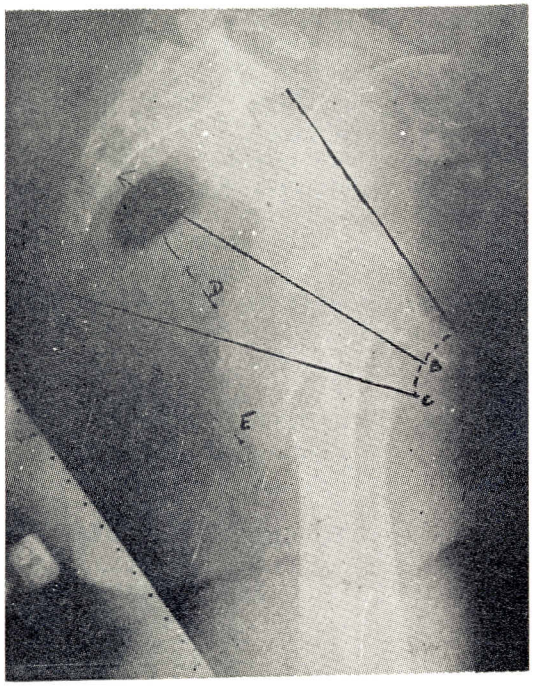

Fig. 1 X-ray pelvimetry — lateral projection, showing various antero-posterior diameters. A = inlet true conjugate. B = antero-posterior diameter of mid-pelvis. C = antero-posterior of outlet. D = post-sagittal diameter of mid-pelvis. E = post-sagittal diameter of outlet.

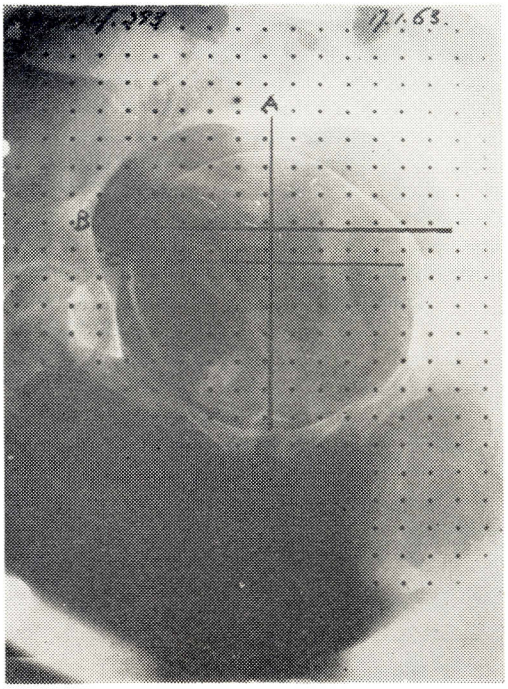

Fig. 2. X-ray pelvimetry — Thoms' inlet view. A = inlet true conjugate diameter. B = inlet transverse diameter. C = mid-pelvic interspinous diameter.

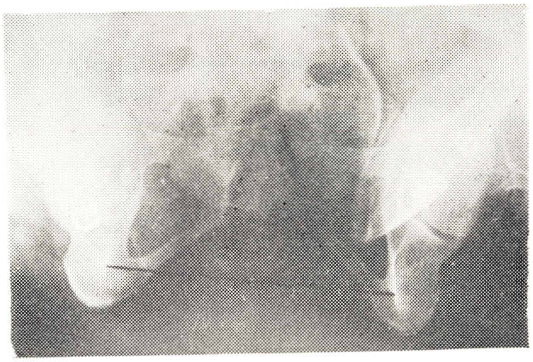

Fig. 3. X-ray pelvimetry — Chassard - Lapine view. The horizontal line shows the intertuberous diameter.

X-RAY PELVIMETRY REPORT

Name: ..... Register No: .....

Date of X-ray: ..... Date due: .....

Measurement in millimetres	Large	Medium	Small	Variations	
				Small	Large
INLET True Conjugate				Less than 105	More than 115
Transverse				„ „ 115	„ „ 135
MID-PELVIS Antero-posterior				„ „ 110	„ „ 120
Post Sagittal				„ „ 35	„ „ 45
Interspinous				„ „ 100	„ „ 110
OUTLET Antero-posterior				„ „ 90	„ „ 115
Post Sagittal				„ „ 70	„ „ 80
Intertuberous				„ „ 95	„ „ 105

PELVIS ARCHITECTURE

Inlet: Posterior Segment:	Round	Trilateral	Flat
Anterior Segment:	Round	Wedged	
Direction of Inlet Plane:	Near horizontal	Near oblique	near vertical
Direction of Uterine Axes:	Posterior	Oblique	Pendulous
Promontory:	Posterior	Medical	Forward Double
Sacrum:	Short	Medium	Long
	Curved	Shallow	Flat Convex
Ischial Spines:	Large	Medium	Small
Acetabular Bulge:	None	Slight	Marked
Lateral Wall Convergence:	None	Moderate	Funnel
Sub-public Notch:	Large	Medium	Small

FOETUS

POSITION

ENGAGEMENT: RECUMBENT:	High	Dipping	Deep
ERECT:	High	Dipping	Deep

THEORECTICAL SKULL PERIMETER:

PLACENTA:

AMNIOTIC FLUID: