

X-Ray of the Female Pelvis As an Aid in Obstetrics

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THE application of roentgenology to the study of labour has brought about a most enlightening advancement in the field of obstetrics. It has enabled an actual visualization of the whole mechanism of labour, which has been, until now, a matter of logic, conjecture and opinion, rather than of fact. It has made possible the actual measurement of maternal pelvis and foetal head on roentgen plates, so that diagnosis of disproportion can be made with much greater degree of certainty than formerly. Abnormalities of pelvic shape can be recognized before labour has commenced and so aid in obstetrical prognosis. In cases of obstetrical complication arising during labour, such as transverse arrest or persistent posterior position, a roentgenogram very often shows the cause of the delay and aids in determining the correct anatomical method of dealing with the difficulty.

A criticism of the old methods of obstetrical prognosis may serve by contrast to show the real value of the new. For years obstetricians and general practitioners have been making measurements of inter-cristal, inter-spinous, external conjugate and diagonal conjugate diameters of the pelvis. The first two measurements are supposedly of value in diagnosis of rachitic pelvis which, I have heard an obstetrician state, are practically extinct in this country today but were common in the vitamin deficiency period about the time of the industrial revolution. The external and diagonal conjugate diameters would be of value if an accurate measurement could be obtained from them. Unfortunately the error introduced by bony and fleshy parts intervening renders them also of little value. Statistics have established average measurements for all these diameters but such laws of averages cannot be applied without fallacy to particular cases because the problem is a biological one. Vaginal examination when properly done, does give a good indication of the roominess of the lower pelvis, the curve of the sacrum, the prominence of the ischial spines, and so on, but no accurate conclusion can be drawn from it as to the size or shape of the pelvic inlet. The best clinical test for disproportion at the inlet is to determine the relationship of the foetal head to the pelvis by pushing it down into the inlet to determine if engagement will occur.

The work of Caldwell and Moloy has been outstanding in adapting roentgenology to obstetrical problems. They began their work by studying the morphology of a large number of museum specimens of dried pelvises and classifying them. They studied then the female pelvis in life-sized stereoroentgenograms. Plates are taken in an antero-posterior plane parallel to the inlet, and in a lateral plane. With their "precision stereoscope" they are able to view a life-sized image of the pelvis and to measure directly the pelvic or foetal parts of the stereoscopic image. Without a precision stereoscope the actual measurements of the pelvis cannot be made,

but with good stereoscopic plates taken in proper planes, most of the details of pelvic shape and evidences of disproportion can be discovered.

Caldwell and Moley recognized four parent morphological types of pelves, long ago described by anatomists, but hitherto largely disregarded by obstetricians as a factor of importance in labour.

I. The GYNECOID or typical female pelvis, has a rounded inlet, wide sub-pubic angle, straight side-walls, and unobtrusive ischial spines. This is the type which long has been described in text books as a normal female pelvis. This parent type is roomy throughout and rarely causes obstetrical difficulty, except in the small forms.

II. The ANDROID pelvis has characteristics simulating the normal masculine pelvis. It has a wedge shaped inlet with flat base posteriorly and narrow angle anteriorly. The sub-pubic angle and sacro-sciatic notch are narrow, the side walls of the pelvis converging and the ischial spines prominent. This type of pelvis is the most dangerous one from an obstetrical viewpoint.

III. The ANTHROPOID pelvis resembles the pelvis of anthropoid apes. It has an oval shaped inlet with long antero-posterior and narrow transverse diameters. This pelvis is also characteristically deep, having long pubic and ischial rami. Spontaneous delivery is usual with this type.

IV. The PLATYPELLOID or flat pelvis, a rare type, has a transverse oval shaped inlet.

Many pelves are not altogether characteristic of any one of these types but show degrees of variation between them as well as intermingling of the characters of different types. To fit these into the classification Caldwell and Moley considered the shape of the posterior segment of the inlet, that is the segment lying behind the widest transverse diameter, as determining the pelvic type. A pelvis having a posterior segment of GYNECOID type and anterior segment of ANTHROPOID type, they classify as a Gynecoid Pelvis with Anthropoid tendency, or a "Gynecoid-Anthropoid" pelvis. Or, again, a pelvis with an Android posterior segment and a Gynecoid anterior one, is classified as an "Android Pelvis with Gynecoid tendency, or an "Android-Gynecoid" type. This method gives a descriptive classification of any type of inlet.

Pelvis vary also in other respects which have marked effect on the mechanism of labour.

The *size* of the pelvic inlet varies and may be classified as large, medium or small. In a series of two hundred and fifty primiparae studied by Caldwell and Moley, the Android types presented a small inlet in 44% of cases. The Anthropoid Type tends to have a large but narrow inlet. The Gynecoid type most often presents average dimensions.

The *sub-pubic angle* is important as it influences the amount of space in the lower anterior pelvis. It is characteristically wide in the Anthropoid type, medium or wide in the Gynecoid and narrow in the Android.

The *splay of the side walls* of the pelvis also influences the capacity of the lower pelvis. The walls are most frequently divergent in the Anthropoid, straight in the Gynecoid and convergent in the Android types.

The *ischial spines* may be long and sharp as is characteristic in the Android type; they may be average as in the Gynecoid; or blunt as in most Anthropoid types. It is the long ischial spines of the Android type, associated with convergent side wall intruding on the lower pelvic strait and flat posterior wall which account for the great proportion of transverse arrests and persistent posterior positions.

The *sacrum* varies in width, curvature and inclination. The typical Android pelvis has a sacrum of average width, straight, and with increased forward inclination. The Anthropoid type has a narrow sacrum with an average or marked curvature without any typical inclination. The Gynecoid sacrum is average in all respects.

It can be seen from this summary of important features of pelvic architecture that the Android types of pelvis present all the characters which are most likely to give rise to obstetrical difficulties; small triangular inlet, narrow sub-pubic angle with converging side walls, sacrum with forward inclination, and long prominent ischial spines. It must be remembered, however, that any type of pelvis may present one or more of these unfavorable characteristics. They are not confined to the Android pelvis alone.

The relative frequency of occurrence of these types of pelvis in the series studied has been: Gynecoid types 55—60%; Android types 20—25%; Anthropoid types 15—20%; Flat 1—2%.

The whole pelvis may be divided into anterior and posterior parts by a vertical plane from the widest transverse diameter of the inlet through the ischial spines. The sagittal diameters of these segments are known as the anterior and posterior sagittal diameters. The anterior sagittal diameter is almost invariably the longer. In comparing these diameters in the different pelvic types the posterior sagittal is longest in the Anthropoid and shortest in the Android. In other words, the widest transverse diameter lies closest to the posterior wall of the pelvis, in Android types, and furthest from it in the Anthropoid. These proportions usually persist throughout the length of the pelvis.

The study of the mechanism of engagement with stereoscopic plates according to the different types of pelvis, has shown that the present generally accepted theory of engagement occurring in the oblique diameters, is incorrect. The transverse position occurs in by far the greatest number of cases. In a series of two hundred primigravidae, studied by Caldwell and Moloy, the foetal head engaged in a transverse position in 69% of the Gynecoid types and 71% of the Android types. In the long narrow Anthropoid types, however, only 37.5% occurred in the transverse even though this group included the wider Anthropoid-Gynecoid pelvis and other variations of the Anthropoid group. These figures definitely show the influence of pelvic shape on the mechanism of engagement.

In the same series the combined left and right anterior oblique positions, supposedly the commonest positions of engagement, occurred in only 20% of the Gynecoids, 8.5% of the Androids, and 17% of the Anthropoids. Another 17% of the Anthropoid types showed engagement to have occurred in the direct occiput-anterior position, a position of engagement not previously recognized but readily explained by the long, narrow, oval-shape of this pelvis, to which the foetal head adapts itself to best advantage.

The combined posterior oblique positions occurred in only 10% of the Gynecoid types but in 20.5% of the Android types, a marked increase over the 8.5% of anterior positions found in this type of pelvis. Engagement occurred in a posterior oblique of the Anthropoid types in 28.5% of cases. In both the Android and Anthropoid pelvis the posterior segment of the inlet is more roomy than the anterior and so is better suited to receive the occiput, while the narrow sinciput adapts itself to the anterior segment. The transverse position is, however, the most favorable one in Android pelvis. The direct posterior position of engagement does not occur in the Anthropoid pelvis as might be expected from the shape, because the foetal back is pushed aside by the maternal vertebrae.

Several points of particular interest are suggested by these figures. First, cases of transverse arrest are not necessarily, as generally thought, due to arrest during rotation from a posterior position to the anterior, but may either occur thus or may represent the arrest of a head which engaged and has persisted in the transverse diameter. Roentgen plates of such cases have shown that transverse arrests, in most instances, engage in the transverse position. Secondly, it should be noted that the Android pelvis is again notorious in being associated with a majority of posterior over anterior positions.

The mechanism of engagement has been described by most writers as occurring by the method of synclitism. In this mechanism of engagement the anterior parietal bone of the foetal head passes down behind the symphysis pubis, below the plane of the inlet, in advance of the posterior parietal. Engagement then takes place by a lateral rotation of the head, the anterior parietal bone pivoting behind the symphysis while the posterior parietal swings down into the posterior pelvis. Study of stereoroentgenograms taken during engagement show that this forward inclination of the head as it approaches the pelvic inlet rarely occurs, and that the usual mechanism of engagement is the reverse of this process. The posterior parietal bone passes down behind the promontory of the sacrum with the sagittal suture pointing toward the symphysis. Then engagement takes place by a pivoting of the posterior parietal bone below the promontory while the anterior parietal slips down behind the symphysis. This movement is accompanied by forward inclination of the whole body of the uterus so that the foetal axis at the completion of engagement is pointing into the posterior pelvis. This is the usual mechanism whether the position is oblique or transverse.

Caldwell and Moloy believe that in a roomy pelvis with an average

sized head passing, the bony structure has little to do with the actual mechanism of engagement and descent; but that this is governed rather by the lower uterine segment and its fascial supports. The lower uterine segment guides the head into the roomy posterior pelvis through which it descends, avoiding the narrower, hence less favorable, anterior pelvis. When the presenting part reaches the bony and ligamentous floor of the posterior pelvis formed by the sacrum, coccyx and ischial spines and their attached ligaments, rotation occurs, and the head moves forward into the lower anterior pelvis by a series of up and down movements occurring with the uterine contraction. Descent then continues stretching the muscular floor of the anterior pelvis until the parietal eminences of the foetal head are on a level with the ischial spines and the occiput lies between the pubic and ischial rami below the symphysis. The head is then born by extension, the occiput sweeping up in front of the pubes while the back of the neck or sub-occipital region is fixed in the sub-pubic angle.

In most cases where mechanical interference is required during the progress of labor, the foetal head should be made to follow this same course through the pelvic straits. Less often the course taken by the foetal head is through the middle of the pelvis, in large types; or through the anterior pelvis, especially in the anthropoid types with a very oblique inlet so that the uterine axis is pointing into the anterior pelvis.

In Android types due to the short sagittal diameter of the posterior segment, the head descends very close to the flat posterior wall and forward rotation is prevented from occurring even though the presenting part has reached the pelvic floor. The head must move forward in a transverse position into the anterior pelvis. Rotation then occurs only when sufficient space is made at the back of the pelvis to allow the temporal regions of the foetal skull to rotate posteriorly. When transverse arrest occurs during this movement, provided that there is not marked convergence of the side walls, the head should be taken through the same course in forceps delivery, that is, to the bottom of the posterior pelvis in the transverse, then forward in the same position till the influence of the posterior wall is removed and rotation may be effected. When the side walls are convergent rotation into the antero-posterior diameter has to be effected at a higher level even though it brings the occiput into the more dangerous narrowed fore-pelvis.

Posterior arrests were found to occur especially in Android types with slight convergence of the side walls and in flat pelvis with a backward inclination of the sacrum. These were treated most effectively by rotation into the more ample transverse diameter, then dealt with as other transverse positions.

Other less common mechanisms of labor and the treatment of even the more common obstetrical difficulties can only be mentioned here. For their description the reader is referred to the well illustrated articles of the above authors in current journals. It suffices to say that X-ray promises to clarify our conception of the mechanism of labor and to throw light on the most effective treatment of obstetrical difficulties.