

**Staff Meeting Bulletin
Hospitals of the » » »
University of Minnesota**

Roentgen Pelvic Morphology

STAFF MEETING BULLETIN
HOSPITALS OF THE . . .
UNIVERSITY OF MINNESOTA

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Published for the General Staff Meeting each week
during the school year, October to May, inclusive.

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William A. O'Brien, M.D.

I. LAST WEEK

Date: January 10, 1941
Place: Recreation Room
 Powell Hall
Time: 12:15 - 1:25 p.m.
Program: Movie: "Mr. Duck Steps Out"
 Military Tuberculosis
 Frank Gratzek
 Discussion
 Leo G. Rigler
Present: 151

Gertrude Gunn
 Record Librarian

- - -

II. MOVIE

Title: "Home Early"
 Released by: M-G-M

- - -

III. ANNOUNCEMENTS1. FROM THE MAIL BAG

Dear Doctor:

I took Preventive Medicine and Personal Health this last quarter and received an F. If I thought I had it coming to me I would keep quiet, but--

I am not an F or a D student.

I received a middle C in the midquarter.

I think your grading department made one big mistake, or I made a lot of little mistakes.

I know that I did fairly well on the final exam.

If you will please look into this matter and reply, I will either be indebted to you or I will have pronounced delusions of persecutions.

Dear Doctor:

About 2 or 3 years ago I wrote you stating that the proceedings of the staff meetings of the University Hospitals were not of interest to the general practitioner and, therefore, not practical.

I, now, retract that statement in full, for I find as time passes that they are very practical, current, and of interest to anyone practicing modern medicine.

Sincerely, W.R.

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2. THE MINNESOTA PATHOLOGICAL SOCIETY

The University of Minnesota
 Medical School
 Institute of Anatomy

Tuesday, January 21, 1941, 8:00 p.m.

"Some chemical, medical and philosophical aspects of viruses.

Dr. W. M. Stanley,
 Rockefeller Institute, Princeton,
 New Jersey.

- - -

3. SIGMA XI

14th Annual Series of Lectures by
 Minnesota Faculty Members at
 Northrop Memorial Auditorium,
 8:15 p.m.

Friday, Jan. 31st.

"Chemistry and our national defense"
 Dr. Lloyd H. Reyerson

Friday, Feb. 7th.

"Your heart and you"
 Dr. Maurice B. Visscher

Friday, Feb. 14th.

"The common cold"
 Dr. Harold S. Diehl

Friday, Feb. 21st.

"Meeting middle age"
 Dr. William A. O'Brien.

These lectures are sponsored by the Minnesota chapter of Sigma Xi, honorary scientific society. Lectures will be illustrated. You are cordially invited.

Admission free.

IV. ROENTGEN PELVIC MORPHOLOGY AND PELVIMETRY

A. Louis Dippel

Studies in roentgen pelvic morphology comprise a consideration of the shape of each component part of the bony pelvis, for each of these affects the form of the unyielding bony birth canal. Roentgen pelvimetry may be defined as mensuration of the diameters of that pelvis from roentgenograms which adequately reproduce those diameters, usually by enlarged images. Because of the more or less irregular shape of the pelvic canal and the relatively large dimensions of the mature fetal head, it is apparent that any portion of the latter, chosen at random, cannot necessarily pass through every diameter of the former. It follows that some process of adaptation of suitable portions of the head to the various pelvic planes is necessary to insure successful labor and delivery and that variations in pelvic form will alter the definite movements or maneuvers of the presenting part which constitute what is termed the mechanism of labor. The size of the pelvis, on the other hand, has more to do with the possibility of passage of the fetus through the various transverse planes of the pelvis. Satisfactory clinical means of determining the adequacy of the pelvic inlet with relationship to fetal head size have long been available, so that methods of evaluating the relative adequacy of mid-pelvis and pelvic outlet needed to be more particularly developed. But both phases of pelvic study, shape and size, are essential to a scientific understanding of the mechanism of labor and the probability of spontaneous delivery in the individual patient.

These concepts of childbirth are not new. They have received consideration from time to time but exhaustive studies of the two phases have rarely been combined. Furthermore, until recently, studies of pelvic size had proceeded to a much more advanced state than had studies of pelvic morphology.

The latest classification of the obstetric pelvis has been relatively recently developed and deals primarily with a correlation of pelvic morphology with the complete mechanism of labor. To make such a correlation, it is necessary to view the obstetric pelvis in stereoscope and to possess more than average knowledge of the movements of labor. Previous to 1934, the most important roentgenologic contributions to clinical obstetrics were non-qualitative. However, a thoroughgoing qualitative and quantitative survey of the maternal pelvis is a complicated problem and requires some special equipment as well as a good working knowledge of all the maneuvers of labor. Consequently, most of this later work has been carried on along investigative lines and is not yet readily available to every pregnant patient who needs it. We do not agree with those who suggest that routine roentgen pelvimetry must be made available to at least every primigravida and will presently state some well known facts to substantiate the stand in this regard.

Although the art of obstetrics is as old as the human race and although there can have been no scientific understanding of the mechanics of labor until the shape of the bony birth canal was clearly understood, the advance in knowledge of pelvic size and shape has been spasmodic and the greatest developments have occurred within the past 90 years. Previous to the discovery of the X-ray, all knowledge of the bony pelvis was obtained from autopsy material, anatomical dissection, museum specimens, or from clinical mensuration of living obstetric patients.

The greatest single contribution dealing with the effect of pelvic size and shape upon the mechanism of labor was derived from the painstaking clinical observations of Michaelis. These were published by his successor, Litzmann, in 1851 and many of the resultant conclusions were astoundingly accurate and are not generally known even today. From the point of view of lasting effect upon obstetric thought, one need add to the above classic only the contributions of Smellie, Bandelocque, Breus and Kolisko, Williams, and Thoms.

With the introduction of the x-ray, considerable attention was focused upon mensuration of the obstetric pelvis and during the first two decades of this century almost all the currently employed methods were introduced. Interest in pelvic morphology, however, was not revived until early in the fourth decade. Practitioners of obstetrics have been slow to accept the latter advance, perhaps chiefly on account of its limited usefulness, especially in a locality such as the American northwest where contracted pelves are rare, but also because of its apparent complexities. To this may be added the uncertainty of its ultimate usefulness. The following case history exemplifies its desirability and usefulness, at least in certain selected cases.

., a 27 year old, white para 1-0-1-0, with a negative blood Wassermann was admitted to the University Hospitals on October 8, 1940 for study because of mild blood pressure elevation and because of her previous obstetric history.

The first pregnancy ended, in 1937, in spontaneous abortion at 18 weeks. The estimated date of confinement for the second pregnancy was October 16, 1939. She entered another hospital two days before that date complaining of labor pains. Soon after admission she was given a medical induction of labor plus pituitrin (M II), the latter undoubtedly given intramuscularly and repeated in one-half hour. She is said to have had irregular uterine contractions during the next 48 hours. Approximately 36 hours later, a difficult mid-forceps delivery was done and a 4000 gram, macerated fetus was delivered. The puerperium was complicated by an infection of the perineal repair which broke down and she was unable to void until 10 days after delivery. She was, however, discharged on the 14th puerperal day.

With the third and current pregnancy she was due, according to her menstrual history, on October 26, 1940. She was cared for by her family physician and the course of the pregnancy was said to have been normal. A few days before referring her to the University Hospital,

her physician had obtained x-ray pelvimetry studies with the Thoms technique. She was informed that her pelvis was small, necessitating a cesarean section.

On admission to the University Hospitals her blood pressure was 140/100 but she was without symptoms of toxemia. The fetus was thought to be of small term-size, presented by the vertex with the presenting pole floating high over the pelvic inlet. No cephalopelvic disproportion was present. The external pelvic measurements were within normal limits although the outlet measurements were near the lower limits of normal. The diagonal conjugate could not be reached at 12.5 cm. and the anteroposterior diameters of the inlet were, therefore, adequate. The vaginal outlet, vagina, and cervix bore evidence of previous obstetric trauma and there were only remnants of anal sphincter muscle imbedded in the thick scar tissue separating the rectum and vagina. From clinical examination, there was every reason to believe that this pelvis was adequate for safe delivery of an average term-size fetus though the pelvic outlet was less adequate than the inlet. Nevertheless, since she had been advised to have a cesarean section and because of the previous obstetric difficulty, roentgen pelvimetry was obtained.

The roentgenograms showed a definitely but only moderately contracted pelvis. The greatest transverse diameter of the inlet measured 11.66 cm. whereas 13.5 cm. is considered average normal. The anteroposterior diameters of the inlet were well within normal limits. The distance between the ischial spines was 9.8 cm. as compared with a normal of 10.5 cm. The outlet measurements were near the lower limits of normal. The pelvic type was found to be an undesirable obstetric one. It conformed most nearly to an android type with little lateral but considerable anteroposterior funneling. The bony pelvis was considered adequate for safe delivery of a fetus up to 3400 grams in weight provided its head diameters were consistent with the average measurements of fetuses weighing 3400 grams at birth. The un-

desirable features of the android type of pelvis will be pointed out on lantern slides in the discussion of the Caldwell-Moloy parent types.

Several unsuccessful attempts were made to induce labor by medicinal means, but since these failed, the fetus was estimated to weigh less than 3000 grams and the blood pressure had fallen to within normal limits, the patient was discharged to be followed in the out-patient department. She presented herself again four days before her estimated date of confinement and was immediately readmitted to the hospital on account of a blood pressure of 156/100. During the next three days, there was little change in the blood pressure determinations, functional changes were noted in the retinal vessels, and the blood chemistry readings were normal except for uric acid of 4.5 mgm % and CO₂ combining power of 38. Another medical induction of labor had failed. It was now believed that the fetus had attained the upper limit in size for safe vaginal delivery and since the use of intranasal pituitrin for induction of labor was contraindicated on account of the toxemia, the patient was delivered by elective cesarean section.

The puerperium was uneventful except for fever on the second, third, and fourth days and she was discharged in good condition on the fourteenth day after delivery with a diagnosis of unclassified toxemia.

While it is impossible to predict the ability of any fetal head to mold, the measurements of the unmolded fetal head immediately after delivery indicated that slight molding would have been essential to engagement, considerable molding would have been imperative with descent to the midpelvis and through the pelvic outlet, and anterior internal rotation would hardly have been possible with the amount of funneling that this pelvis exhibited. The newly-born child weighed 3375 grams and had an occipito-frontal diameter of 11.25 cm. but a biparietal of 10.25 cm. The child did well and was discharged with the mother.

There are several lessons which might

be learned from this case. No accurate information was available from the experiences of the first labor which might be applied in a subsequent labor. Careful clinical mensuration of her pelvis in the last pregnancy resulted in the diagnosis of a normal pelvis. The external inlet measurements did not give the slightest indication of transverse contraction of the true pelvic inlet. Moreover, there is as yet no clinical way of determining such contractions with certainty. They may be suspected at internal examination from the discovery of convergence of the side walls of the pelvis. Furthermore, though we may be able to develop a high degree of clinical accuracy in estimating fetal weights within the range of 2500 to 3500 grams, the fetal head measurements may vary widely and can be estimated with precision only with the aid of a reliable x-ray method and under certain ideal conditions, i.e., a good silhouette of the fetal head must be clearly visualized in each of a pair of stereoscopic films. The unmeasurable factor of malleability of the fetal head can not be overlooked. But these latter variable factors should not deter from obtaining the maximum information about the one factor which is constant and is measurable with precision, namely, the bony pelvis. Certainly this is true in doubtful or borderline contracted pelvises. Pelvic morphology in definite or borderline contractions is just as important as the actual or precise measurements of the bony birth canal, for a good obstetrical type may nullify the pelvic contraction and may well allow safe delivery of a term child.

The classification of pelvic morphology which we favor was developed by Caldwell, Moloy, and D'Esopo. Its superiority over any other classification lies in the fact that it is based upon the sum total of all pelvic characteristics and at all pelvic levels and is not based, as all other methods are, upon a comparison of the lengths of the anteroposterior and greatest transverse diameters of the inlet alone. In the following lantern slide presentation of these pelvic types, it must be remembered that the various names signi-

fy definite shapes of pelves and do not infer etiological factors which produced those shapes. For instance, while the gynecoid type is believed to be the true female pelvis and the android type the typical male pelvis, this does not mean that these represent the end results of female and male hormonal influences, respectively. Nor does the anthropoid type suggest simian characteristics in its possessor, but rather that this pelvic shape is similar to that found in the higher or man-like apes.

The typical female pelvis (gynecoid type) presents an inlet with circular outline and ample room in both anterior and posterior segments. The broad sacral promontory encroaches little upon the posterior segment and the sacrum is broad, short and directed backward and downward. The side walls are divergent with the interischial spinous diameter so broad that the spines may not show in the inlet view. The sacro-sciatic notch is shallow and broad. The subpubic arch is wide, the descending pubic rami spring from the lateral sides of the inferior surfaces of the pubic bones, and the ischiopubic rami curve outward to produce a Norman arch effect. Only about one-third of all female pelves will be essentially of this type. Unless they are small, they give rise to no dystocia and the mechanism of labor classically described for oblique occiput anterior and occiput posterior positions occurs in these.

In the typical male (android) pelvis, the inlet is blunt heart-shaped and there is little or no hindpelvis, i.e., the segment posterior to the greatest transverse diameter. The sacral promontory is large and bulges well into the posterior pelvic segment. The sacrum is narrow and long, and is directed forward and downward, to produce a convergent lateral bore. The sacro-sciatic notch is narrow and deep, the sacrum approaching the ischial spines. The side walls are convergent and the distance between the long ischial spines is decreased. The subpubic arch is more truly an angle, with long, heavy and straight ischio-

pubic rami that spring from the inner margins of the under surfaces of the pubic bones. Approximately one-third of the pelves found in obstetric patients show these characteristics. This pelvic type is associated with occiput-posterior positions which do not undergo anterior internal rotation, but become arrested as posteriors at the mid-pelvic level or outlet. The small android pelvis is the severe grade of funnel pelvis of clinical classifications.

The anthropoid type of pelvis is anteroposteriorly oval in shape, with the forepelvis pointed. The sacral promontory is not large and does not encroach materially upon the posterior segment of the pelvic inlet. The sacrum is long, narrow, usually made up of six segments, is dagger-shaped and directed slightly forward to produce a moderately convergent lateral bore. The inclination of the pelvis is so increased that when this patient stands, the plane of the pelvic inlet is almost perpendicular to the horizon. The side walls are convergent, but the ischial spines so rudimentary that the transverse diameter is no more decreased at the midpelvis than at the pelvic inlet. The sacro-sciatic notch is very broad and shallow and the sacrum set far back between the iliac bones. The subpubic angle is narrow and the ischio-pubic rami are large and long. This type of pelvis is found in approximately one-third of all obstetric women and appears to be most common in those of the upper brackets of social and economic life. It is not a bad obstetrical type, but engagement usually occurs in direct occiput-posterior or direct occiput-anterior positions. Anterior internal rotation usually does not or cannot take place from the posterior position, necessitating delivery of the fetal head in the posterior position.

The platypelloid (flat) pelvis is essentially a gynecoid pelvis, with its inlet transversely oval in shape and the anteroposterior diameters definitely decreased. The sacro-sciatic notch, too, is reduced in width. There is adequate compensatory space in all transverse dia-

meters of the pelvis and the fetal head invariably engages in the transverse, with anterior internal rotation taking place on the pelvic floor or with delivery. Caldwell and Moloy found less than 5% of their original cases falling into this classification.

The asymmetrical type of pelvis is not discussed in detail, since each asymmetrical pelvis is placed into this group, regardless of which true parent type its characteristics predominantly simulate.

There are many obstetrical pelvises which do not contain all the characteristics for any one of the true parent types and these are classified as mixed types. Since Caldwell and Moloy consider the hindpelvis as more important obstetrically than the forepelvis, mixed types are classified primarily according to the shape of the hindpelvis and the forepelvic shape is considered as a variation or a tendency. The midpelvic and pelvic outlet characteristics will coincide with the inlet type except for the subpubic angle which shows the greatest variations.

It must be clearly understood that any prediction of the mechanism of labor from pelvic morphology is possible only when some accommodation between fetal head and bony pelvis is essential to spontaneous labor. Obviously, if we are dealing with a pelvic canal that is essentially cylindrical in form or that is large as compared to fetal head size, soft tissue factors will determine the mechanisms of engagement and labor.

In the presentation of the Caldwell-Moloy pelvic types, no mention was made of pelvic size. Caldwell and his co-workers are primarily interested in pelvic morphology and they make no attempt to classify size beyond the relative terms of small, average, and large. The Moloy type of precision stereoscope is precise only to the extent of accurately reproducing the size of the phantom image of the pelvis. The actual measurement of this image is extremely difficult, does not depend upon one's stereoscopic sense, and even such three as Caldwell, Moloy, and D'Esopo who have had the greatest

experience with this apparatus, cannot regularly duplicate each other's measurements within a range of 10%. Since we consider precise measurements equally as important as pelvic morphology and do not believe it justifiable to evaluate the capacity of any obstetric pelvis on either one of these alone, it has become necessary to adopt or to devise some means of mensuration other than the precision stereoscope. Obviously, since stereoscopic roentgenograms must be utilized for the above described method of morphological study, some method of mensuration from these roentgenograms would avoid the necessity of obtaining more x-rays. It has been found convenient to add centering markers and a marker of known length to the stereoscopic views obtained for the study of pelvic morphology. The parallax shifts (the apparent displacements of the diameters as observed on the accurately superimposed stereoscopic films) are measured and Hodges' graphic method employed. By the original method a correction factor is calculated from the measured parallax shift and the known tube-film and tube-shift distances which were used in obtaining the particular pair of stereoscopic roentgenograms. This correction factor is applied to the average length of the images of the diameter in order to obtain the actual length of the pelvic diameter under consideration. Some modification of Hodges' method is dictated by the use of a non-precise x-ray machine. However, it has been possible to prove that a high degree of precision with mensuration is possible without a specially-built precise x-ray machine such as the one developed in Hodges' laboratory. Incidentally, the pelvic measurements obtained by the Thoms method on the patient whose history is here presented, are available for comparison. It can be shown that they underestimate the actual size of her pelvic inlet by 6% in one plane and almost 10% in the other.

By the methods employed in the above case, it is possible to obtain an exhaustive study on pelvic morphology as well as accurate measurements of pelvic size in the individual obstetric patient. They are not readily available

to every gravida but we do not consider them absolutely essential in every pregnancy, nor even in every primigravida, though such a routine might constitute ideal obstetric practice. Such studies in primigravidas would entail the x-raying of more than one-half million patients each year in the United States alone and the enormous expenditure, it can be shown, would not be justified. More than 90% of these patients are delivered spontaneously of living children without evidence of dystocia. Moreover, there are clinical methods of mensuration and impression which almost invariably prove the adequacy of these pelves for purposes of childbearing. By the use of such methods, the clinician can select those pelves which are obviously large and, therefore, adequate for childbearing. These pelves, incidentally, will make up the great majority. Furthermore, the clinician can, by the same clinical procedures, discover those pelves which are too small for safe delivery of average-size fetuses and these generally make up a very small group. There remains only those pelves which are at or near the borderline between contraction and normalcy. These do not make up a large group and the best interests of mother and child would be served by the use of roentgen pelvimetry.

If advanced x-ray studies are obtained in this group of borderline pelves, it will be found that many of them are actually adequate for safe delivery of average term-size fetuses, for compensatory space is often found to show pelvic adequacy in spite of some contraction of clinically measurable diameters. Equally as important, perhaps, will be the revelation of pelvic morphology which renders that pelvis of desirable obstetric form. The converse of these findings may also be true, but probably to a lesser extent. It must be definitely understood that these methods must be employed in connection with good clinical judgment and must not supplant the latter, for such factors as soft tissue dystocia and fetal weight, which are as yet unmeasurable, will have to be determined by clinical experience. It would seem that the ultimate utilization of roentgen pelvimetry and morphology must be in the

direction of a clearing house for those pelves which from careful clinical palpation and mensuration are doubtfully contracted or doubtfully of normal size and shape.

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V. GOSSIP

One day last August I spoke at summer school for the Benedictine Nuns at St. Benedict's College, St. Joseph, Minnesota. After dinner I walked through the grounds with some of the college officials. They took me through the gardens, farm, and finally, through the cemetery. As each nun dies, she is given a spot with a cross on which is printed the dates of her birth, death, and reception into the Order. As the burials go back to 1862, I mentioned casually that it would be interesting to know what age change in the time of death had occurred through the passing of the years. The sister who had been painting the crosses took her notebook along the next morning and did a little graveyard research. The other evening when I was at St. Benedict's again, I was handed her report which I found of great interest. The average age of death of the 38 sisters buried in the first square from 1862-1890 was 27.5 years, while the average age of the 38 sisters buried in the last plot from 1935 - 1940 was 65 years. Of the first group, 17 died before they completed three years of religious life, and only six of the 38 completed more than ten years. I suppose one might guess that it was tuberculosis or perhaps typhoid fever which was prevalent in those days....Minnesota Blue, the cheese which is being made at the Farm School, is rapidly achieving a national reputation. Although it is identical with the best brand of imported Roquefort cheese, the name "Roquefort" cannot be used because of trade restrictions. It is made of cow's milk and is aged in the caves along the Mississippi. It is becoming quite the thing for Minnesotans to remember their friends elsewhere with five-pound cakes wrapped in tinfoil. The attractive package includes the seal of the University of Minnesota... ..The special virus laboratory of the Minnesota Department of Health is a busy place these days with their studies on influenza virus continuing at a very satisfactory rate. The basis of the culture medium is minced chicken embryo, and growth is rapid. Two types, A and B, are known, and identification is made by neutralization and complement fixation. A handy gadget for extracting tissue fluids is the one invented by Fred Waring, the

orchestra leader, which was originally intended for use on fruits and vegetables. Although there are many methods of growing the virus, variations of the chick embryo technique are most commonly used. The attempts being made at the present time to immunize against influenza involve the use of inactive virus..... Paul Nicholas Leech, Secretary, Council on Pharmacy and Chemistry, American Medical Association, died this week at the age of 51. For many years he has been in charge of the chemistry laboratories at Association Headquarters. At one time he was also assigned to the Annual Convention in charge of the scientific exhibit. He deserves full credit for the development of this attractive feature, and he gave it up only when it began to interfere with his chemistry. Famed as a chemist and investigator, his loss to the Association is great.....In the movie entitled "When Bobbie Goes to School," developed by the American Academy of Pediatrics for parental education, there is one line which drew giggles from University students when they saw it. After the physician has completed the physical examination of the youngster and explained its purposes, the mother gushes, "My, you doctors have to know a lot!.". The picture, aside from a few minor slips, is a splendid educational achievement.....There will be a regional conference the first week in February of the Women's Field Army of the American Society for the Control of Cancer at Rochester, Minnesota. The Executive Staff from National Headquarters will be here for the meeting. Discussions will center around ways and means of furthering lay education in the field of cancer....Secretary Lillian Hunter, Chief of the Medical Unit of the Division of Social Welfare Herman E. Hilleboe, and Housewife Ruth McKelvey have all sustained fractures of the wrist in falling on the ice. The accidents occurred independently....There are 72 registrations for the continuation study course in Ophthalmology to be given January 20-25. Nearly half of those coming have been certified by the American Board, and all except six limit their practice to ophthalmology and otolaryngology. The 6 carry on in this field in connection with other types of practice..