

THE MECHANISM OF LABOR: SOME EXPERIMENTAL AND CLINICAL OBSERVATIONS.

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THE writer believes that an intelligent and intimate knowledge of the mechanism of labor is as essential for the management of normal and abnormal parturition as is an acquaintance with the anatomy and physiology of the heart for the treatment of functional and organic disease of that organ. It has been with the object of inquiring more definitely into certain more or less unsettled questions that the following experimental and clinical observations have been made by him during the past year.

What is the Cause of Internal and Forward Rotation of the Head in Vertex Presentations during Labor?

The ischial spine, forming as it does the commencement of the smooth anterior inclined plane of the ischium, may, it is true, prevent the posterior rotation of the occiput in the first (L.O.A.) and second (R.O.A.) positions of the vertex, and even favor anterior rotation; but that they have anything to do with anterior rotation of the vertex in originally posterior positions is difficult to understand.

All explanations of internal rotation, apart from the foetus, may be classed as (1) uterine and (2) pelvic.

The uterine theory attributes a rotation force to the uterus itself; the trunk and, secondarily, the head rotate to the front, because, after the escape of the liquor amnii, the uterus flattens and directs the dorsal plane of the foetus in that direction.

The pelvic explanation takes into account the shape of the pelvis—as determined by the ischial spines and planes and varying lengths of the pelvic diameters—and the shape, resistance, and action of the structures going to make up the perineal floor.

The anatomical investigations of J. Veit¹ and H. Varnier² deny to the shape of the pelvis, namely, the varying lengths of the various diameters, and even to the bones of the pelvic outlet every influence on the internal rotation of the head. The latter explains the rotation of the head exclusively, as due to the arrangement of the muscles of the pelvic floor and the perineum.

On the other hand, there is an interesting reported case³ of labor in a woman after Kraske's operation for cancer of the rectum, where in spite of the absence of the sacrum and of part of the ligaments and muscles making up the pelvic floor, in giving birth to a living child weighing nine pounds, forward rotation of the occiput was observed, and otherwise the mechanism of labor was normal.

In reply to the statement of Olshausen that internal rotation of the head is caused only by the the co-rotation of the child's trunk, Zweifel⁴ says: "We cannot agree with this doctrine . . . We shall only refer here to the first Braune Section (Plate C) where the rotation of the head is already far advanced, the body still remaining completely transverse."

Desiring to test for himself, experimentally, the part the pelvic floor plays in anterior rotation of the presenting part, the writer undertook the following experiments:

Fortunately a cadaver was secured from the Morgue in April, 1892, in the most favorable condition for the purpose. It was that of a German girl, twenty years of age, who one morning was found upon the floor of her employer's store dead from post-partum hemorrhage. The pregnancy had

¹ Die Anatomie des Beckens im Hinblick auf den Mech. d. Geb., 1837.

² Du dedroit intérieur musculaire du bassin obstétrical. Paris, 1833.

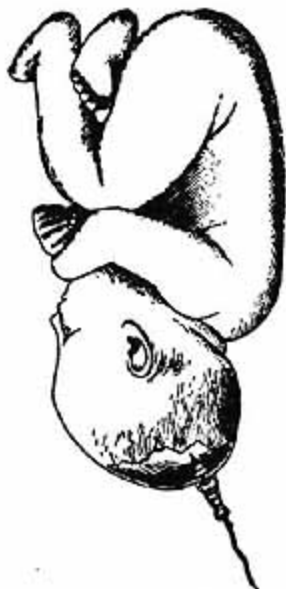
³ Lihotzky, Montreal Medical Journal, June, 1859.

⁴ Lehrbuch der Geburtshilfe, Stuttgart, 1892.

been a twin one, and when found, one twin, rather small even for a twin, was found between the girl's thighs, and the remaining one with the double placenta was still within the uterine cavity.

The cadaver was removed from the Morgue to the Operative Surgery Room of the University Medical College, and a careful examination failed to reveal any lacerations of the cervix, vagina, or perineum; hence one of the first conditions of success—a firm perineum—was obtained.

A foetal cadaver was selected of average size, the sagittal suture was opened, the occipital bone was incised for half an



Foetal cadaver used in the experiments cited.

inch, and, after firmly fixing the swivel and ring seen in the accompanying cut at a point one-half inch posterior to the small fontanelle, the scalp was closed by sutures. (See illustration.)

To the ring of the swivel was then tied a yard of whipcord.

In making use of the term complete rotation of either head or shoulders in these observations it is not meant that mathe-

matically complete rotation results, but only such as palpation or inspection determined, unaided by more exacting means of measurement. Leishman's researches, with a cord stretched from symphysis to coccyx, showed that exact coincidence of the sagittal suture and the antero-posterior diameter of the pelvic outlet failed in many instances.

The well-known experiments of Paul Dubois consisted in *pushing* foetal cadavers of various sizes through the birth-canal of a puerpera recently dead; the following experiments, as will be readily seen, differ somewhat from the above, in that *traction* was made directly on the occiput and the head was permitted to revolve at will on a swivel.

The abdomen and uterus of the cadaver being now opened, and the uterus held in as nearly a normal position as possible—including the usual right lateral obliquity and left to right torsion—the experiments were then made.

EXPERIMENT I. The whipcord, by means of a pair of uterine dressing forceps, was passed down through the cervix, vagina, and out at the vulva, and the foetal cadaver was placed in its normal attitude within the uterus in the L.O.A. position. Traction, intermittent in character, upon the cord in the vagina, and always in the axis of that part of the pelvis at which the vertex rested, caused descent of the head until the pelvic floor was reached or until the occiput reached a point just below the ischial spines, and then forward rotation of the occiput brought the sagittal suture exactly into the antero-posterior diameter of the pelvic outlet. The head was not delivered. The shoulders were now found just at the brim, with a bis-acromial diameter, as originally placed, corresponding to the left oblique diameter of that part of the pelvis.

EXPERIMENT II. Anterior rotation was secured in the R.O.A. position in the same manner, the shoulders coming to the brim in the right oblique diameter.

EXPERIMENTS III. and IV. I. and II. repeated with the same results.

EXPERIMENT V. Fœtus placed in normal attitude in the R.O.P. position, and anterior rotation about the right half of the pelvis occurred, the small fontanelle finally resting just below the sub-pubic ligament.

Now for the first time the head was drawn through the vulva, and the mechanism of shoulder delivery watched. The bis-acromial diameter entered the brim in the left oblique diameter, the left shoulder being lowest and to the front of the pelvis.

Upon the sagittal suture becoming transverse the shoulders began to rotate, and, finally, brought the bis-acromial diameter into the opposite or right oblique, the small fontanelle being now at the sub-pubic ligament.

EXPERIMENT VI. Vertex placed in the L.O.P. position in the lower uterine segment.

Anterior rotation of the occiput about the left side of the pelvis took place, as soon as the pelvic floor was reached, until the occiput came to the pubic arch; upon delivery of the head, internal rotation of the shoulders and, finally, of the buttocks was observed.

EXPERIMENT VII. The occiput was now placed directly in the median line of the body and just under the promontory of the sacrum. Traction on the cord, as before, readily brought the well-flexed head to the pelvic floor. Further progress now was arrested for a moment. Intermittent traction, however, being continued, finally, slowly and gradually, rotation of the head was observed to take place about the right half of the pelvis, until at last the small fontanelle appeared at the ligamentum arcuatum, the vertex having traversed a complete semicircle. Anterior rotation in this instance was only secured after persistent and repeated traction with the swivelled cord, and was only finally attained after considerable bulging of the tissue included between the coccyx and fourchette was produced by the advancing and rotating head.

The writer feels convinced that the preceding experiments were fair tests; that by using care to make traction on the

cord only in the axis of that part of the parturient canal in which the presenting part rested, the influence of the traction upon the vertex did not favor forward rotation, but only, by downward traction, brought the head in relation with influences favorable to such anterior rotation.

The shoulders being originally in the transverse diameter of the brim in this experiment, it was observed that during the tardy anterior movement of the occiput the shoulders moved from the transverse into the left oblique, and then into the conjugate, and, during the dragging of the head through the vulva into the right oblique diameter of the pelvis, and here shoulder rotation ceased and they passed obliquely through the vulval opening.

EXPERIMENT VIII. Once more the foetal head was placed well flexed in the L.O.A. position at the brim, and upon traction bringing the occiput into the lower half of the pelvis little if any rotation of the head could be detected; the head being dragged through the vulva slit obliquely, and no attempt at rotation on the part of the shoulders was noticed.

EXPERIMENT IX. R.O.A. position; result same as in Experiment VIII.

EXPERIMENT X. Head placed as before in R.O.P. position. The head was drawn to pelvic floor and through vulva in this position, the shoulders also preserving their original position in the left oblique diameter, and were so dragged through the outlet.

EXPERIMENT XI. L.O.P. position; result same as in Experiment X.

EXPERIMENT XII. Head placed flexed, as in Experiment VII. Not even the slightest change from the original position could be observed, the occiput still posteriorly being dragged over the perineum, and the shoulders remaining in their original transverse position.

Such experiments can, of course, determine nothing as to the influence of forward rotation of the foetal trunk upon anterior rotation of the occiput. In other words, they fail

entirely to show us what factor the rotary power attributed to the uterus plays in the production of movements of the occiput.

Undoubtedly during pregnancy and the early stages of labor the position, shape, and contractions of the uterus play an all-important part in the production of the normal attitude, presentation, and position of the foetus; but that these factors, with the exception of uterine contractions, are at all essential to the movements of the occiput the writer does believe.

Rotation of the head does, without question, occur independently of the body, as has been observed by many (Frommel, Schatz), and as can be seen by reference to Braune's frozen sections (Plate C).

The influence of trunk rotation over cephalic is shown in the well-known clinical fact that the lateral posture of the parturient, right or left, as the case may demand, does undoubtedly assist anterior occipital rotations in occipito-posterior positions and tardy rotation in original occipito-anterior positions. This the writer has, in a number of cases, been able to demonstrate to the pupil at the bedside.

What these experiments do show, however, is that the pelvic-floor explanation of rotation of the most dependent portion of the presenting part is a sufficient one.

Rotation is complete and is readily accomplished in the first of the above-mentioned trials; then as the muscles and tissues become more and more stretched and relaxed, as the result of repeated pressure upon them, we find rotation first incomplete and finally failing to occur altogether.

The subsequent clinical observations are in accord with the foregoing.

In the 47 primiparæ we see internal forward rotation of the occiput failing in only 7 instances; in the 43 multiparæ we observe failure in 30.

Given the normal attitude of the foetus (extreme flexion of the head) and good expulsive powers, and the most important

remaining condition for forward rotation and a normal mechanism is a *firm pelvic floor*.

Internal Rotation of the Head and Head Delivery.

Observations were made at the bedside upon 47 primiparæ and 43 multiparæ during spontaneous labor at term in various positions of the vertex.

The results show that internal rotation of the head was complete, before it entered the vulval slit, in 40 of the 47 observations in primiparæ, and in only 13 of the 43 of multiparæ, thus showing that complete internal rotation of the occiput in vertex presentations occurs 1:1.1 in primiparæ, as against 1:3.3 in multiparæ; or, in other words, the emergence of the sagittal suture at the ostium vaginæ in an oblique diameter of the pelvis is three times as common in multiparæ as in primiparæ. This fact, it seems to the writer, can only be due to the greater firmness and rigidity of the pelvic-floor tissues in the primipara over those of the multipara.

PRIMIPARÆ (47 observations).

Complete forward rotation of occiput	40 cases.
Incomplete " " " " " " " " " " " " " " " "	7 "
Total	47 cases.

Complete rotation once in 1.1 cases.

MULTIPARÆ (43 observations).

Complete forward rotation of occiput	13 cases.
Incomplete " " " " " " " " " " " " " " " "	30 "
Total	43 "

Complete rotation once in 3.3 cases.

One of the seven primiparæ in whom anterior rotation of the vertex failed was a Hungarian, aged twenty years; the position was L.O.A.; the dorsal posture was used during delivery; no chloroform or ether; duration of labor, twenty-five hours; duration of second stage, one hour and forty minutes. The birth of the head in an oblique diameter resulted in a bilateral laceration of the vagina; the perineum proper was not ruptured. Internal rotation of the shoulders occurred

spontaneously, the perineal shoulder appearing first and being first delivered by traction in the axilla.

In a second instance the woman was Irish, twenty-five years of age; the position was R.O.P.; the posture during second stage, dorsal; duration of labor, eight hours; duration of second stage, three hours; chloroform was used; forceps was finally applied, and the birth of the head obliquely caused deep vaginal and perineal laceration into the rectum. The true conjugate in this case was under four inches.

This was the only complete perineal laceration occurring among 72 primiparæ and 79 multiparæ of whom records were kept.

Not uncommonly in old multiparæ, with lax soft parts, one observes what may be termed a deep transverse position of the sagittal suture, namely, the head advances through the lower part of the pelvis and even up to the orifice of the vulva in a transverse or oblique position, and internal rotation only occurs at the very last moment in the vulval orifice, becomes incomplete or fails altogether, because the strength and rigidity of the primiparous pelvic floor is wanting in multiparæ.

On the other hand, we sometimes see excessive internal rotation of the head, by which we mean the sagittal suture rotates from one oblique pelvic diameter past the conjugate and into the opposite oblique. This is probably in consequence of excessive rotation of the trunk, due to strong uterine contractions compressing the foetal back and turning it toward the front and opposite side.

In 69 observations on primiparæ and 71 on multiparæ excessive rotation of the head from one oblique diameter to the other occurred in but one instance—a primipara.

The writer's observations show that in sixty-nine vertex presentations in primiparæ, including the various positions, in only one instance did a permanent occipito-posterior position obtain. This woman had a true conjugate of about four inches, and was finally delivered in the presence of the

writer by forceps, the sagittal suture being born in an oblique diameter, and with an entire loss of the perineal structures (case referred to above).

In seventy-one vertex presentations in multiparæ, including various positions, anterior rotation failed in three instances.

Head Delivery.

An attempt was made to test the truth of the statement of Dr. D. Berry Hart¹ that the term "extension of the head," as applied to the mechanism of head delivery in vertex anterior positions is a most misleading one, for it indicates that the chin leaves the sternum while the head is passing the perineum. He states:

"I deny *in toto* that the chin leaves the sternum, and I hold that this fixation of the occiput and descent of the sinciput is not the best or normal mechanism. The best mechanism to avoid tear is for the occiput to lead, for the head to be driven on by a steady movement of translation, any rotation upon a bi-parietal axis so taking place as to favor occipital dipping and never dipping of the sinciput. It is easy to see how the erroneous idea of extension arose. The attendant, while the patient lay on her left side, watched the passage of the foetal head from behind, saw more of the anterior portions of the head appear, and accounted for it by extension."

In a limited number of spontaneous vertex deliveries at term, by the administration of chloroform to control the rapidity of the passage of the head, and by repeated rectal and vaginal palpation, the latter more especially in multiparæ, the writer has been able to demonstrate to the satisfaction of those present that the chin does not, under the above conditions, leave the sternum until the bulk of the head, including what may be termed the sub-occipito frontal diameter, has escaped from the vulval orifice. The small number of observations, however, forbids any conclusions.

¹ Transaction Edinburgh Obstet. Soc., 1887, vol. xii.

Internal Rotation of the Shoulders and Shoulder Delivery.

Observations were made upon 67 primiparæ and 70 multiparæ as regards the internal rotation of the bis-acromial diameter, as follows :

PRIMIPARÆ (67 observations).

Complete rotation of shoulders into antero-posterior diameter of outlet, before delivery	51 cases
Incomplete delivery in oblique diameter	14 "
" " transverse "	2 "
Total	67 cases.

Complete rotation once in 1.3 cases.

MULTIPARÆ (70 observations).

Complete rotation	56 cases.
Incomplete "	14 "
Total	70 cases.

Complete rotation once in 1.2 cases.

It will be seen from the above that complete rotation occurs with about equal frequency in primiparæ and multiparæ.

Regarding shoulder delivery, the following was observed :

Shoulder First to Appear at Vulva.

PRIMIPARÆ (69 observations of spontaneous delivery).

The perineal or posterior shoulder appeared first in the vulval orifices in	33 cases
The pubic or anterior first in	33 "
Both shoulders simultaneous	3 "
Total	69 cases

MULTIPARÆ (68 observations of spontaneous delivery).

Perineal shoulder first in	48 cases.
Pubic " " "	25 "
Total	68 cases.

Shoulder First to be Delivered.

PRIMIPARÆ (15 observations of spontaneous delivery).

Perineal shoulder first born in	9 cases.
Pubic " " " "	3 "
Simultaneous delivery "	2 "
Transversely "	1 "
Total	15 cases.

MULTIPARÆ (28 observations of spontaneous delivery).

Perineal shoulder first born in	19 cases.
Pubic " " " "	8 "
Simultaneous delivery "	1 "
Total	28 cases.

From the foregoing it would appear that the posterior shoulder is born first three times as often as the anterior in primiparæ, and two and one-half times as often in multiparæ.

It must be remembered, however, that in almost every one of the above cases the head upon delivery was lightly supported with the hand, and this support results in favoring the birth of the posterior shoulder first.

R. Lefour believes the posterior shoulder, as a rule, is born first.

Auvard found, in 29 cases, that the posterior shoulder came first in 16 and the anterior in 9 cases. He recommends in all cases support of the head, in order to prevent its own weight interfering with natural progress of the expulsion of the body.

He states: "Before attempting to extract the shoulders they should have completely rotated, and, if possible, should be expelled by a *vis à tergo*, at the same time so assisting as to carry the anterior shoulder well up behind the symphysis. By so doing we facilitate delivery of the posterior arm, which is the safest and most natural method of delivery."

The same principle may be applied to the after-coming head. By it we secure at the outlet the "cervico-acromial" diameter in place of the longer bis-acromial. Leonet¹ asserts that the anterior shoulder first disengages in 90 out of 100 cases if the head be not supported. If the head be supported the posterior shoulder emerges in 90 out of 100 cases. The disengagement of the posterior shoulder is the critical moment as regards perineal rupture.

The posture of the woman does not appear to affect the mechanism of shoulder delivery. Thus:

¹ Thèse de Paris, 1889.

PRIMIPARÆ (15 observations of spontaneous delivery).

Dorsal posture (9 cases).

Posterior shoulder first delivered	4 cases.
Anterior " " "	2 "
Simultaneous delivery	2 "
" " , transverse	1 case.
Total	9 cases.

Lateral posture (6 cases).

Posterior shoulder first delivered	4 cases.
Anterior " " "	1 case.
Simultaneous delivery, transverse	1 "
Total	6 cases.

MULTIPARÆ (28 observations of spontaneous delivery.)

Dorsal posture (16 cases).

Posterior shoulder first delivered	9 cases.
Anterior " " "	6 "
Total	15 cases.

Lateral posture (13 cases).

Posterior shoulder first delivered	10 cases.
Anterior " " "	2 "
Simultaneous delivery	1 case.
Total	13 cases.

Injury to the Perineum.

Nineteen perineal lacerations in primiparæ, including all degrees of injury, but no complete laceration, and in cases where complete shoulder rotation occurred, were caused as follows :

By forecoming head	8
By shoulder	6
Cause unobserved	5
Total	19

Whether the lacerations attributed to the shoulders as a cause were originated by the head within the vulva and completed by the posterior shoulder does not appear.

The dorsal posture was used during the second stage in 16 cases, the lateral in 3 ; chloroform in 12 instances ; various means of perineal protection made use of.

The method of shoulder delivery giving by far the best results in the avoidance of injury to the soft parts is the one

already referred to, in which delivery of the posterior shoulder first is favored by pushing the anterior shoulder behind the symphysis, obtaining the "cervico-acromial" diameter and the *slow* delivery of the perineal shoulder.

Conclusions.

1. The chief factor in determining anterior rotation of the lowest portion of the presenting part is the shape and resistance of the pelvic floor.

2. Complete forward rotation of the occiput is the rule in primiparæ; it often fails in multiparæ.

3. Excessive rotation of the head is of rare occurrence.

4. A permanent occipito-posterior position is more common in multiparæ, other things being equal, than in primiparæ.

5. Complete shoulder rotation occurs with about equal frequency in primiparæ and multiparæ.

6. In the primiparæ, and spontaneous delivery, the anterior and posterior shoulders appear first at the outlet with about equal frequency.

7. In the multiparæ, and spontaneous delivery, the posterior shoulder appears first more frequently than the anterior.

8. In both primiparæ and multiparæ, and spontaneous delivery, the posterior shoulder is born first most frequently—three and one-half times as frequently as the anterior in primiparæ; two and one-half times in multiparæ.

9. The posture of the parturient does not appear to affect the mechanism of shoulder delivery.

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