OBSTETRICS

When does fetal head rotation occur in spontaneous labor at term: results of an ultrasound-based longitudinal study in nulliparous women

Hulda Hjartardóttir, MD; Sigrún H. Lund, PhD; Sigurlaug Benediktsdóttir, MD; Reynir T. Geirsson, MD, PhD; Torbjørn M. Eggebø, MD, PhD

BACKGROUND: Improved information about the evolution of fetal head rotation during labor is required. Ultrasound methods have the potential to provide reliable new knowledge about fetal head position.

OBJECTIVE: The aim of the study was to describe fetal head rotation in women in spontaneous labor at term using ultrasound longitudinally throughout the active phase.

STUDY DESIGN: This was a single center, prospective cohort study at Landspitali - The National University Hospital of Iceland, Reykjavík, Iceland, from January 2016 to April 2018. Nulliparous women with a single fetus in cephalic presentation and spontaneous labor onset at ≥37 weeks' gestation were eligible. Inclusion occurred when the active phase could be clinically established by labor ward staff. Cervical dilatation was clinically examined. Fetal head position and subsequent rotation were determined using both transabdominal and transperineal ultrasound. Occiput positions were marked on a clockface graph with 24 half-hour divisions and categorized into occiput anterior (≥10- and ≤2-o'clock positions), left occiput transverse (>2- and <4-o'clock positions), occiput posterior (≥4- and ≤8 o'clock positions), and right occiput transverse positions (>8- and <10-o'clock positions). Head descent was measured with ultrasound as head-perineum distance and angle of progression. Clinical vaginal and ultrasound examinations were performed by separate examiners not revealing the results to each other.

RESULTS: We followed the fetal head rotation relative to the initial position in the pelvis in 99 women, of whom 75 delivered spontaneously, 16 with instrumental assistance, and 8 needed cesarean delivery. At inclusion, the cervix was dilated 4 cm in 26 women, 5 cm in 30 women, and ≥6 cm in 43 women. Furthermore, 4 women were examined once, 93 women twice, 60 women 3 times, 47 women 4 times, 20 women 5 times, 15 women 6 times, and 3 women 8 times. Occiput posterior was the most frequent position at the first examination (52 of 99), but of those classified as posterior, most were at 4- or 8-o'clock position. Occiput posterior positions persisted in >50% of cases throughout the first stage of labor but were anterior in 53 of 80 women (66%) examined by and after full dilatation. The occiput position was anterior in 75% of cases at a head-perineum distance of ≤30 mm and in 73% of cases at an angle of progression of ≥125° (corresponding to a clinical station of +1). All initial occiput anterior (19), 77% of occiput posterior (40 of 52), and 93% of occiput transverse positions (26 of 28) were thereafter delivered in an occiput anterior position. In 6 cases, the fetal head had rotated over the 6-o'clock position from an occiput posterior or transverse position, resulting in a rotation of >180°. In addition, 6 of the 8 women ending with cesarean delivery had the fetus in occiput posterior position throughout the active phase of labor.

CONCLUSION: We investigated the rotation of the fetal head in the active phase of labor in nulliparous women in spontaneous labor at term, using ultrasound to provide accurate and objective results. The occiput posterior position was the most common fetal position throughout the active phase of the first stage of labor. Occiput anterior only became the most frequent position at full dilatation and after the head had descended below the midpelvic plane.

Key words: active phase, angle of progression, cesarean delivery, fetal head position, head-perineum distance, progress of labor, transabdominal ultrasound, transperineal ultrasound

Introduction

The position of the fetal head during labor is an important factor to consider when there are signs of labor protraction or arrest disorders. Occiput posterior (OP) and transverse positions have been associated with poorer outcomes of labor for both the mother and fetus.[1–3] At present, position is predominantly assessed clinically, and although some obstetricians become skilled at this examination,[4,5] many operators never acquire it fully. The use of ultrasound has been shown to be more accurate in determining fetal head position[6–11] and has a shorter learning curve than clinical examinations,[12] and the introduction of this skill has been encouraged. With this compelling evidence, ultrasound will probably become common practice, and it will be essential to have reliable data about what constitutes normal findings in labor in terms of occiput positions.

EDITORS' CHOICE

The study of fetal head rotation during labor has not been the subject of many studies since Calkins et al[13] published their results on internal rotation based on clinical examinations of women in labor in 1939. This has formed the basis of our knowledge and been quoted in textbook chapters on the mechanism of labor ever since.[14,15] Ultrasound can be applied repeatedly during labor to assess the fetal head position accurately with a combination of transabdominal and transperineal approaches.[7–9,16–22]

This offers the opportunity to study fetal head rotation in great detail and relates it to other factors, such as fetal station, cervical dilatation, labor phases,

Cite this article as: Hjartardóttir H, Lund SH, Benediktsdóttir S, et al. When does fetal head rotation occur in spontaneous labor at term: results of an ultrasound-based longitudinal study in nulliparous women. Am J Obstet Gynecol 2021;224:514.e1-9.

0002-9378/free
© 2020 Elsevier Inc. All rights reserved.
https://doi.org/10.1016/j.ajog.2020.10.054

Click Video under article title in Contents at **ajog.org**

Descargado para Anonymous User (n/a) en National Library of Health and Social Security de ClinicalKey.es por Elsevier en junio 17, 2021. Para uso personal exclusivamente. No se permiten otros usos sin autorización. Copyright ©2021. Elsevier Inc. Todos los derechos reservados.

AJOG at a Glance

Why was this study conducted?

Clinical examination of the fetal head position has limited accuracy. Ultrasound can reliably assess fetal head position. The study was conducted to describe the fetal head rotation using ultrasound in nulliparous women with spontaneous labor onset.

Key findings

More than 50% of fetuses were in the occiput posterior position throughout the first stage of labor. The occiput anterior (OA) position only became the most common position below the midpelvic plane. Of initial occiput positions, all anterior, 93% transverse, and 77% posterior positions were delivered in the OA position.

What does this add to what is known?

New and detailed information about fetal head rotation in nulliparous women is presented. Fetal head rotation most often occurs at full dilatation and below the midpelvic plane. Rotation could be >180° for some fetuses.

and mode of delivery. As labor progresses differently between nulliparous and parous women and between induced and spontaneous labors, it is important to study clearly defined groups of women.[23] The objective of this study was to describe fetal head rotation longitudinally with ultrasound throughout the active phase of labor in nulliparous women with spontaneous onset of labor at term.

Materials and Methods

This was a single center, prospective, cohort study at Landspitali - The National University Hospital of Iceland, Reykjavík, Iceland, during the period of January 2016 to April 2018. All women received oral and written information on admission to the labor ward and gave written consent before inclusion. Nulliparous women with a spontaneous start of labor at ≥37 weeks' gestation and with a single fetus in cephalic presentation were eligible, corresponding to group 1 in the 10-group classification system proposed by Michael Robson.[24] Inclusion was nonconsecutive and occurred on admission for women with an established active phase of labor or when that phase could be established in women admitted during the latent phase. The active phase was defined as a fully effaced cervix, dilated at least 4 cm, in the presence of regular contractions in accordance with the actual World Health Organization (WHO) recommendations.[25,26] Clinical and ultrasound examinations were paired throughout labor by 2 separate examiners, blinded to each other's results. The midwife caring for the woman performed a clinical examination at recruitment and then as clinically indicated, in accordance with the hospital guidelines recommending vaginal examinations at least every 4 hours, recording cervical dilatation in centimeters on a specially designed medical record. Whenever the fetal occiput position could be assessed clinically, it was marked on a clockface graph with 24 half-hour divisions.

All ultrasound examinations were performed within 15 minutes of the clinical examination by experienced ultrasound examiners (H.H. and S.B.) who were not involved in the clinical care of the laboring woman. A Voluson i ultrasound machine (GE Medical Systems, Zipf, Austria) with a 3.5- to 7.5-MHz 3-dimensional curved multifrequency transabdominal transducer was used for both transabdominal and transperineal scans.

Fetal head position was determined using both the transabdominal[27] and the transperineal[28] approaches. The transabdominal examination was preferred whenever reference structures could be visualized. The occiput position was marked on a similar clockface graph for the clinical examinations. Fetal head positions were categorized as occiput anterior (OA; ≥10- and ≤2-o'clock positions), left occiput transverse (LOT; >2- and <4-o'clock positions), OP (≥4- and ≤8-o'clock positions), and right occiput transverse positions (ROT; >8- and <10-o'clock positions).[29] The fetal spine, orbits, midline structures, and choroid plexus were used to determine the position by ultrasound.[22]

To assess fetal head station, transperineal ultrasound was used, and the measurements obtained were head-perineum distance (HPD) and angle of progression (AoP). HPD was measured in the frontal plane (transverse plane related to the perineum) as the shortest distance from the transducer to the fetal skull. The soft tissue was compressed with the transducer until it met with resistance against the pubic bone.[18,30] AoP was measured in the sagittal plane as the angle between the longitudinal axis of the pubic symphysis and a line from the inferior part of the symphysis tangentially to the fetal head contour.[31] The spinal plane is considered to be at an AoP level of 116° and at an HPD of 36 mm.[22]

All data were collected and managed using Research Electronic Data Capture tools hosted at the hospital.[32] The study was approved by the Landspitali Ethics Committee, reference number 26/2015.

Statistical analysis

To describe the association between fetal head station and fetal head position against time, the delivery time was used as a fixed reference point. From that point, time was calculated backward. The Shapiro-Wilk test for normality was used for the AoP and HPD measurements. As the AoP measurements were not normally distributed, the differences in median AoP and HPD measurements by occiput position at inclusion were estimated with the Kruskal-Wallis test. The Fisher exact test was used to compare proportions. Other results are presented descriptively, and data were analyzed using the statistical software package R Core Team (R Foundation for Statistical Computing, Vienna, Austria; URL: https://www.R-project.org/; R: a

Descargado para Anonymous User (n/a) en National Library of Health and Social Security de ClinicalKey.es por Elsevier en junio 17, 2021. Para uso personal exclusivamente. No se permiten otros usos sin autorización. Copyright ©2021. Elsevier Inc. Todos los derechos reservados.

TABLE 1
Characteristics of the study population stratified by occiput position on inclusion

Characteristics	OA n=19	LOT n=15	OP n=52	ROT n=13
Maternal characteristics				
Maternal age, y	31 (18–40)	27 (22–38)	26 (18–38)	26 (23–34)
Oxytocin augmentation	7 (37)	5 (33)	23 (44)	6 (46)
Epidural analgesia	10 (53)	6 (40)	37 (71)	8 (62)
Gestational age, wk	39 (37–42)	40 (39–42)	40 (37–42)	40 (37–42)
Newborn characteristics				
Birthweight	3530 (2480–5000)	3690 (2930–4480)	3530 (2750–4660)	3440 (2560–4330)
Apgar score at 1 min	9 (8–9)	9 (3–9)	9 (2–10)	7 (4–9)
Apgar score at 5 min	10 (9–10)	10 (5–10)	10 (8–10)	9 (8–10)
Labor characteristics				
Mode of delivery				
Cesarean delivery	1 (5)	0 (0)	6 (12)	1 (8)
Instrumental delivery	1 (5)	1 (7)	11 (21)	3 (23)
Spontaneous delivery	17 (90)	14 (93)	35 (67)	9 (69)
Length of labor, h	7.9 (1.4–17.3)	8.0 (3.1–17.6)	8.9 (2.6–26)	9.7 (2.2–24.3)

Data are presented as median (interquartile range) or number (percentage).

LOT, left occiput transverse; *OA*, occiput anterior; *OP*, occiput posterior; *ROT*, right occiput transverse.

Hjartardóttir et al. Fetal head rotation in nulliparous women at term. Am J Obstet Gynecol 2021.

language and environment for statistical computing, 2018).

Results

Study population

Of the 100 women initially included, 1 withdrew her consent and was excluded. Characteristics of the study population, differentiated by occiput position at the first examination, are presented in Table 1. At inclusion, the cervix was dilated 4 cm in 26 women, 5 cm in 30 women, and ≥6 cm in 43 women. A total of 340 paired clinical and ultrasound examinations were done, varying from 1 to 8 examinations for each woman, depending on the length of labor. Furthermore, 4 women were examined only once, 93 women at least twice, 60 women 3 times, 47 women 4 times, 20 women 5 times, 15 women 6 times, and 3 women 8 times.

Fetal head position throughout the active phase of labor

Figure 1 (left image) shows the frequency and detailed distribution of the position of the fetal head at the first ultrasound examination. The OP position was the most common position at the first examination (52 of 99). Of the other fetuses, 19 were OA, 15 LOT, and 13 ROT. Of those classified as OP, most were at the 4- or 8-o'clock positions. Fetal head position could only be clinically assessed in 31 of 99 cases at the time of the first paired examination, and only 14 of these examinations (45%; 95% confidence interval [CI], 28–89) agreed with the ultrasound examination.

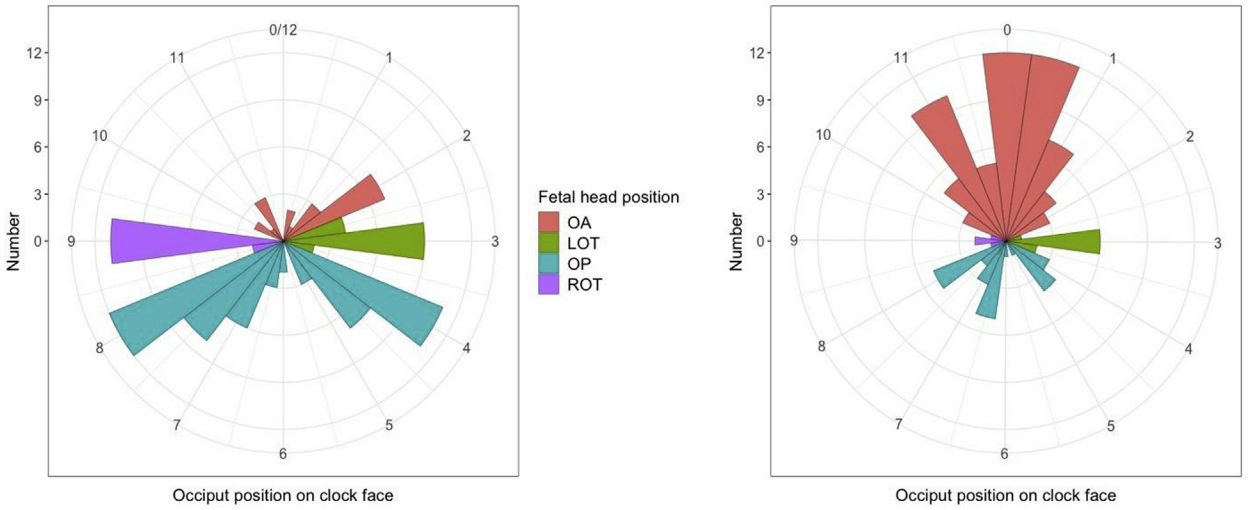
Fetal position at each examination is presented in Table 2. Individual rotation patterns showed that the occiput was either in the left or right side position throughout labor in most cases, but in 6 cases, the occiput was seen to rotate over the 6-o'clock position. In Figure 1 (right image), the detailed distribution and frequency of positions of the fetal head at the last ultrasound examination before birth are shown, when 61 of 99 fetuses were in the OA position, 9 in the LOT position, 25 in the OP position, and 4 in the ROT position. Fetal head position could be assessed clinically in 61 of 99 cases at the time of the last paired examination, and 52 of these examinations (85%; 95% CI, 73–93) agreed with the ultrasound-assessed position.

All fetuses in the OA position at the first examination were delivered in the OA position. From an initial OT position, 26 of 28 fetuses (93%; 95% CI, 75–99) rotated to the OA position, whereas 2 cases in the right-sided OT positions were in the OP position at delivery. Of the initial OP positions, 40 of 52 fetuses (77%; 95% CI, 63–87) were delivered in the OA position. All 61 fetuses in the OA position at the last examination and all 13 fetuses in the LOT position were delivered in the OA position. Of the 4 fetuses in the ROT positions at the last examination, 2 were delivered in the OA position, and 12 of the 25 fetuses in the OP position were delivered in the OA position.

All the 6 cases seen to rotate over the 6-o'clock position ended as spontaneous OA deliveries (rotating >180°). Furthermore, 2 cases rotated from the

Descargado para Anonymous User (n/a) en National Library of Health and Social Security de ClinicalKey.es por Elsevier en junio 17, 2021. Para uso personal exclusivamente. No se permiten otros usos sin autorización. Copyright ©2021. Elsevier Inc. Todos los derechos reservados.

FIGURE 1
Fetal head position at the first and last examinations



The circular bar graphs show the distribution and frequency of each occiput position at the first (left image) and at the last (right image) ultrasound examinations of nulliparous women in the active phase of labor with spontaneous onset at term. Each *bar* represents a marking on a clockface with half-hour intervals. The frequency at each position is counted from the center outward, the scale being represented on the y-axis. The *bars* are colored according to the classification of the occiput position.

LOT, left occiput transverse; *OA*, occiput anterior; *OP*, occiput posterior; *ROT*, right occiput transverse.

Hjartardóttir et al. Fetal head rotation in nulliparous women at term. Am J Obstet Gynecol 2021.

left side to the right side (initially at the 3:30 position and 4-o'clock position) and 4 cases from the right side to left side (initially at the 6:30 position and 7-, 8-, and 9-o'clock positions).

Occiput position and mode of delivery

Overall, 75 women had a spontaneous delivery, 15 fetuses were delivered with vacuum extraction, 1 fetus was delivered with forceps, and 8 fetuses were delivered by cesarean delivery. Furthermore, 6 of the fetuses that were delivered by means of cesarean delivery were in the OP position at the first examination, 1 was in the OA position, and 1 was in the ROT position. At the last examination before birth, all 6 fetuses at the OP position remained in the OP position, the one in the ROT position had rotated to the OP position, and the one in the OA position remained in the OA position.

Direct occiput posterior position and mode of delivery

Of note, 14 fetuses were in the direct or almost direct OP position (from a 5- to 7-o'clock position) at inclusion, and 10 of the 14 fetuses (71%; 95% CI, 42–90) rotated to the OA position at delivery. Of the 14 fetuses, 11 were delivered spontaneously (79%; 95% CI, 49–94), 2 were delivered with instrumental assistance (1 in the OA position and 1 in the OP position at delivery), and 1 was delivered via cesarean delivery (in the OP position at delivery).

Oxytocin augmentation and occiput position at delivery

Of the women needing oxytocin augmentation, 8 of 41 women delivered a fetus in the OP position vs 6 of 58 women who did not receive oxytocin.

TABLE 2
Fetal position at each examination

Position	First n=99	Second n=93	Third n=60	Fourth n=47	Fifth n=20	Sixth n=15	Seventh n=3	Eighth n=3	Last n=99
Occiput anterior	19	28	19	24	6	8	0	2	61
Left occiput transverse	15	13	6	2	1	0	0	0	9
Occiput posterior	52	42	28	19	10	6	1	1	25
Right occiput transverse	13	10	7	2	3	1	2	0	4

Data are presented as number.

Hjartardóttir et al. Fetal head rotation in nulliparous women at term. Am J Obstet Gynecol 2021.

Descargado para Anonymous User (n/a) en National Library of Health and Social Security de ClinicalKey.es por Elsevier en junio 17, 2021. Para uso personal exclusivamente. No se permiten otros usos sin autorización. Copyright ©2021. Elsevier Inc. Todos los derechos reservados.

The difference was not significant (P=.25).

Occiput position and fetal head station

Table 3 shows the ultrasound measurements of the fetal head station at the first and last examinations according to the occiput position at inclusion. OA position at inclusion was associated with lower stations (shorter HPD and wider AoP) at both the first and last examinations. Table 4 and Table 5 show the association between fetal position and station in all examinations. The occiput position was anterior in 75% of cases when HPD was ≤30 mm and in 73% of cases when AoP was ≥125° (corresponding to a clinical station of +1). The associations among fetal head station, occiput position, and time to delivery at each ultrasound examination are presented in Figure 2. The OA position did not become predominant until 2 hours before birth.

Occiput position and cervical dilatation

The relation between clinically assessed cervical dilatation and fetal head position is shown in Figure 3. OP positions persisted in >50% of cases throughout the first stage of labor but were anterior in 53 of 80 cases (66%) examined by full dilatation.

Comment

Principal findings

Determining the fetal head position with ultrasound during labor was easy and could always be done. We found that the OP position was the most common position at the first examination, but most of the OP positions were at the 4- or 8-o'clock position (Figure 1). The OP position remained the most common one until the cervix was fully dilated and the fetal head had descended below the midpelvic plane. All fetuses starting in the OA position were delivered in the OA position, 93% of fetuses starting in transverse positions rotated to the OA position, and 77% of fetuses starting in the OP position rotated and were delivered in the OA position.

TABLE 3
Ultrasound measuring fetal head station at first and last examinations according to fetal head position at the first measurement

	OA (n=19)	LOT (n=15)	OP (n=52)	ROT (n=13)	*P* value
First examination					
AoP	107 (82–123)	98 (87–117)	98 (73–128)	103 (88–114)	.02
HPD	40 (24–56)	43 (37–56)	46 (29–66)	44 (31–54)	.05
Last examination					
AoP	128 (95–161)	110 (98–124)	106 (76–142)	116 (106–138)	<.01
HPD	27 (9–49)	40 (21–51)	41 (20–62)	33 (26–39)	<.01

Data are presented as median (interquartile range). The differences in median AoP and HPD measurements by fetal head position at inclusion were estimated with the Kruskal-Wallis test.

AoP, angle of progression; *HPD*, head-perineum distance; *LOT*, left occiput transverse; *OA*, occiput anterior; *OP*, occiput posterior; *ROT*, right occiput transverse.

Hjartardóttir et al. Fetal head rotation in nulliparous women at term. Am J Obstet Gynecol 2021.

Clinical significance

As ultrasound is being used increasingly during labor, accurate knowledge on fetal head position and rotation is needed. It is one of the factors observed in assessing labor progress, and deviations from the normal should guide the obstetrician and midwife to timely and correct interventions. Ultrasound could conceivably lead to an increased frequency of interventions if these mechanics are not well described.[33] We observed that the fetal head position could only be correctly identified in a minority of cases at inclusion, but even at the last examination, only around two-thirds of the clinical staff felt they could determine the position but with increasing accuracy. This is very much in agreement with other studies,[6–8,34,35] but Iversen et al[4] have shown that this can be improved with structured clinical assessment.

As shown in this study, at the start of the active phase of spontaneous labor, the OP position was common. This is important knowledge when estimating progress in established labor. In accordance with clinical knowledge, it is only persistent OP position that is likely to lead to delayed and difficult labor.[36] The OP position should not by itself be considered a negative sign. The fetal head should not be expected to rotate to the OA position until toward the end of labor, when the cervix is fully dilated and the head has descended below the midpelvic plane.

TABLE 4
Fetal head position at the level of the head-perineum distance

Position	>50 mm (n=51)	41–50 mm (n=116)	31–40 mm (n=112)	≤30 mm (n=57)
Occiput anterior	2 (4)	19 (16)	41 (37)	43 (75)
Left occiput transverse	6 (12)	18 (16)	11 (10)	2 (4)
Occiput posterior	33 (65)	64 (55)	49 (44)	10 (18)
Right occiput transverse	10 (20)	15 (13)	11 (10)	2 (4)

Data are presented as number (percentage).

Hjartardóttir et al. Fetal head rotation in nulliparous women at term. Am J Obstet Gynecol 2021.

Descargado para Anonymous User (n/a) en National Library of Health and Social Security de ClinicalKey.es por Elsevier en junio 17, 2021. Para uso personal exclusivamente. No se permiten otros usos sin autorización. Copyright ©2021. Elsevier Inc. Todos los derechos reservados.

TABLE 5
Fetal head position at the level of the angle of progression

Position	<95° (n=68)	95°–109° (n=129)	110°–124° (n=95)	≥125° (n=45)
Occiput anterior	4 (6)	27 (21)	39 (41)	33 (73)
Left occiput transverse	10 (15)	17 (13)	10 (11)	0 (0)
Occiput posterior	46 (68)	67 (52)	37 (39)	9 (20)
Right occiput transverse	8 (12)	18 (14)	9 (10)	3 (7)

Data are presented as number (percentage).

Hjartardóttir et al. Fetal head rotation in nulliparous women at term. Am J Obstet Gynecol 2021.

Research implications

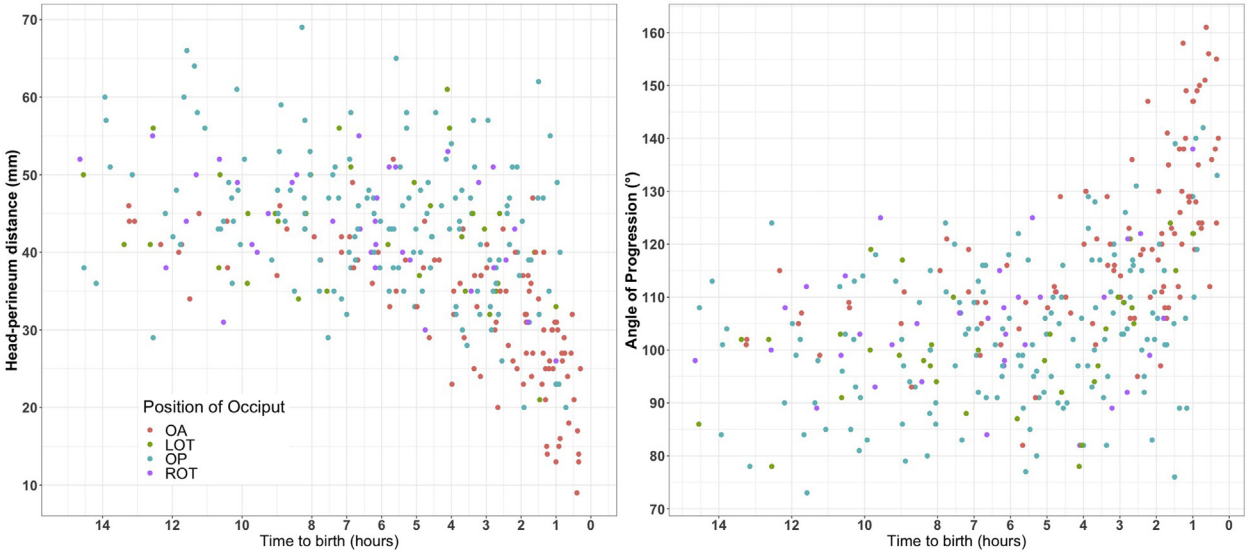
Occiput position at the first examination

Our findings of the high frequency of the OP position early in the active phase of labor differ from previous studies. The results from the original radiological studies by Caldwell et al[37] suggested that approximately 20% of fetuses were in the OP position; the results had the same frequency as the OA position, but OT positions were considered predominant. Steele and Javert,[38] also using radiology, found the fetus to be in OT position in over 60% of cases. The populations examined in these studies were, however, not very clearly defined or timed in relation to labor stages, and the technique used may not have given exact positions other than classifying them as OA, OP, or OT positions. Any degree of deviation from those positions may be open to interpretation because the landmarks inside the fetal skull could not be identified as accurately as now with ultrasound. The clinical study of Calkins[13] from 1939 showed the occiput to be posterior or in the direct transverse position in 50% of nulliparous women in early labor.

Several ultrasound studies have described the occiput position at induction or admission in spontaneous labor with frequencies of OP position varying from 15% to 38%.[7,20,39–45] The most obvious explanations for such percentage discrepancies are differences in how the OP position was defined. Some authors divided the pelvis into 4 parts,[44] some into 8 equal parts where the OP position would extend from the 5:15 position to the 6:45 position[7,20] or into 2 parts, anterior or posterior.[39] We used the definition proposed by Akmal et al[29,43,46] in which the OP position extends from 4- to 8-o'clock position. In the aforementioned studies, only transabdominal ultrasound examinations were used to determine the position, which can be inaccurate when the head is deeply engaged. We therefore combined transabdominal and transperineal scanning to improve accuracy.

Some variation may also be explained by different timing of the examinations. If examined before labor onset, the head is

FIGURE 2
Fetal head station and position in relation to time to delivery



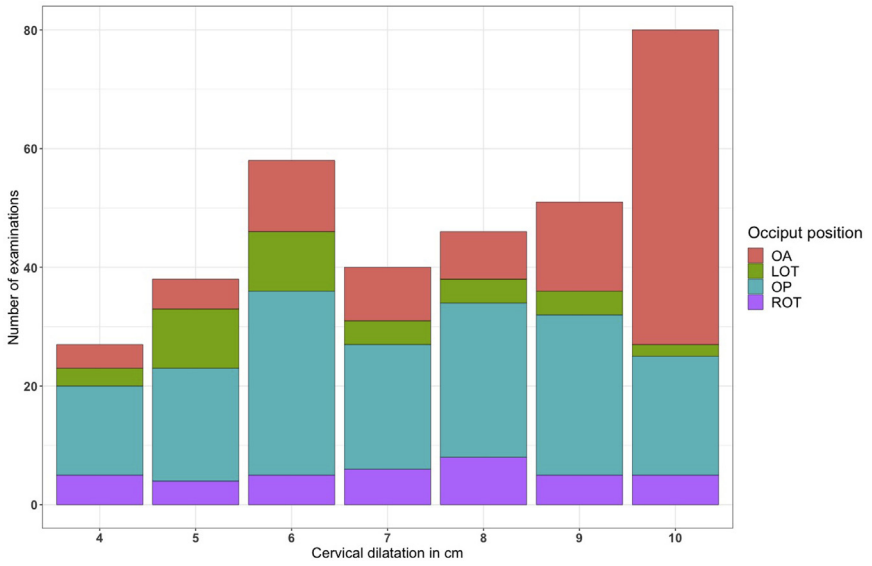
The dot plot shows the fetal head station measured as head-perineum distance in millimeter (left image) and angle of progression in degrees (right image) on the y-axis in relation to time to delivery on the x-axis. The women examined were nulliparous in the active phase of labor with spontaneous onset at term. Delivery is at point 0, and the time to delivery is calculated backward. The dots are colored according to the classification of the occiput position.

LOT, left occiput transverse; *OA*, occiput anterior; *OP*, occiput posterior; *ROT*, right occiput transverse.

Hjartardóttir et al. Fetal head rotation in nulliparous women at term. Am J Obstet Gynecol 2021.

Descargado para Anonymous User (n/a) en National Library of Health and Social Security de ClinicalKey.es por Elsevier en junio 17, 2021. Para uso personal exclusivamente. No se permiten otros usos sin autorización. Copyright ©2021. Elsevier Inc. Todos los derechos reservados.

FIGURE 3
Fetal head position in relation to cervical dilatation



The bar graph shows the number of ultrasound examination at each cervical dilatation in centimeters. The women examined were nulliparous in the active phase of labor with spontaneous onset at term. The *bars* are colored according to the classification of the occiput position.

LOT, left occiput transverse; *OA*, occiput anterior; *OP*, occiput posterior; *ROT*, right occiput transverse.

Hjartardóttir et al. Fetal head rotation in nulliparous women at term. Am J Obstet Gynecol 2021.

most often in the transverse position at the inlet, but during the negotiation of the pelvic cavity, the occiput may have to fit into the hollow posterior aspect at each side of the sacral promontory, which may explain the higher frequency in our study conducted in established labor.

Occiput rotation during labor

Of note, 3 longitudinal ultrasound studies have examined fetal rotation.[20,45,47] The populations studied in 2 of them were a mixed group of nulliparous and multiparous women, and all included women in both spontaneous and induced labors with a limited number of repeated examinations being reported or a large dropout owing to uninterpretable ultrasound scans so it is not possible to form a full picture of when the rotation occurs from these studies. To avoid this, we included only nulliparous women with spontaneous labor onset and combined abdominal and perineal ultrasound approaches. This allowed the presentation of more detailed information about the exact fetal position and when the rotation occurs during labor. Our results agree with those of Adam et al[47] and Souka et al[20] in that a fetus in the anterior fetal head position at admission in labor does not malrotate to an OP position and the results of Lieberman et al[45] that fetal head rotation is a late occurrence during labor.

Our findings that 77% of OP positions during labor rotated to be delivered in the OA position confirm the results of other studies of mixed groups of nulliparous and multiparous women in various stages of active labor.[20,44,46,47] This was similar for the group that were near to direct OP at inclusion (from the 5- to 7-o'clock position) where 71% of cases rotated to the OA position.

Oxytocin use could possibly have an effect on the rotational forces during labor, but we did not observe a difference in the frequency of persistent OP position in connection with oxytocin use.

Only 2 of 12 OP deliveries were in the OT position on admission, whereas all the others had an original OP position. This confirms the view of several authors that an OP position at delivery results from failed rotation from an original OP position at the pelvic inlet[20,46–48] rather than being a malrotation from an OT or OA position as suggested by Gardberg et al.[39]

The frequency of rotation of more than 180° has not been described before but was seen in 5% (95% CI, 2–12) of our study population.

Occiput position and head descent

We have demonstrated the higher station of the fetal head in the OP and OT positions in early labor. The rotation from the common OP position to the OA position did not occur until the head began to descend, and the OA position was not predominant until below the midpelvic plane. It is not clear whether the descent precedes the rotation, but it is likely that this happens simultaneously.

Occiput position and cervical dilatation

We also confirmed the association between fetal head rotation and cervical dilatation ascertained during the clinical examinations. The OP position was the most common position up to the point when cervical dilatation had been completed (Figure 3). Only then could the OA position be demonstrated in >50% of cases. This is a further confirmation of the late occurrence of fetal head rotation to the OA position, which only becomes the most common position within approximately 2 hours before birth. In a cross-sectional study by Akmal et al,[46] the frequency of OP, OA, and OT positions was very similar during the first stage of labor, but the OA position predominated with 64% of cases at full dilatation. Similar results were obtained by Souka et al[20] (74% of cases in the OA position at full dilatation).

Strengths and limitations

The main strength of our study was the prospective, longitudinal design examining a well-defined group of nulliparous women in spontaneous labor throughout the active phase. We used objective and reliable methodology and combined transabdominal and transperineal

Descargado para Anonymous User (n/a) en National Library of Health and Social Security de ClinicalKey.es por Elsevier en junio 17, 2021. Para uso personal exclusivamente. No se permiten otros usos sin autorización. Copyright ©2021. Elsevier Inc. Todos los derechos reservados.

ultrasound examinations for defining the exact fetal position. The definition of the active phase at 4 cm dilatation was according to the WHO criteria recommended during the recruitment period. We are aware of recent suggestions of changing the definition to 5[49] or 6 cm,[50] but because we use delivery as the fixed reference point, the definition of active labor will not have had an important impact. The relatively limited sample size was a weakness, especially regarding the operative delivery numbers. The external validity needs to be confirmed by further studies in similarly well-defined groups of parous women and women in induced labor. The experience of the 2 ultrasound operators in fetal medicine was a strength for validating the results but might be considered a weak point for external validation. It has, however, been demonstrated that the skills needed for examining women in labor with ultrasound are easily obtained[51] and have a shorter learning curve than vaginal examination skills.[12] The varying degree of experience in clinical vaginal examinations by the labor ward staff might likewise be considered a weakness. This does, however, represent the situation in most labor wards, and this is likely to be improved with the ultrasound methods described in the study. A further weakness was our inability to examine the active phase from the start by some women who were admitted late in labor. This came from the way women were recruited into the study, but it also represents the reality among spontaneously laboring women. Excluding those women would have created a selection bias. Although we included fetal station and rotation in our study, fetal attitude and flexion of the fetal head were not considered as a possible and additional variable for labor progress. The occiput-spine angle is easy to measure in OA positions, but more challenging in OP positions.[52]

Conclusions

We have followed and given a detailed description of the rotation of the fetal head throughout the active phase of labor in nulliparous women in spontaneous labor, using accurate, objective ultrasound methods. The OP position was the most common position throughout the first stage, and the OA position only became most frequent at full dilatation and after the head had descended below the midpelvic plane. No fetus was seen to rotate from the OA position to the OP position, and most of the initial OT and OP positions rotated to the OA position, but commonly late in labor.

Highlights

- Ultrasound was used to examine fetal head rotation longitudinally during the active phase of labor.
- More than 50% of fetuses were in the OP position throughout the first stage of labor.
- The OA position only became the most common position below the midpelvic plane.
- All initially anterior, 93% transverse, and 77% posterior positions were delivered in the OA position.
- Fetal head rotation most often occurs at full dilatation and below the midpelvic plane.
- Rotation could be >180° for some fetuses.

Acknowledgments

The authors thank the midwives at the labor ward in Landspitali - The National University Hospital of Iceland for their help with the recruitment, clinical examinations, and data collection. We also thank Helga Birna Gunnarsdottir for her help with setting up the database.

References

1. Ponkey SE, Cohen AP, Heffner LJ, Lieberman E. Persistent fetal occiput posterior position: obstetric outcomes. Obstet Gynecol 2003;101:915–20.
2. Cheng YW, Shaffer BL, Caughey AB. The association between persistent occiput posterior position and neonatal outcomes. Obstet Gynecol 2006;107:837–44.
3. Fitzpatrick M, McQuillan K, O'Herlihy C. Influence of persistent occiput posterior position on delivery outcome. Obstet Gynecol 2001;98:1027–31.
4. Iversen JK, Jacobsen AF, Mikkelsen TF, Eggebø TM. Structured clinical examinations in labor: rekindling the craft of obstetrics. J Matern Fetal Neonatal Med 2019 [Epub ahead of print].
5. Bergsjø P, Koss KS. Interindividual variation in vaginal examination findings during labor. Acta Obstet Gynecol Scand 1982;61:509–10.
6. Sherer DM, Miodovnik M, Bradley KS, Langer O. Intrapartum fetal head position II: comparison between transvaginal digital examination and transabdominal ultrasound assessment during the second stage of labor. Ultrasound Obstet Gynecol 2002;19:264–8.
7. Sherer DM, Miodovnik M, Bradley KS, Langer O. Intrapartum fetal head position I: comparison between transvaginal digital examination and transabdominal ultrasound assessment during the active stage of labor. Ultrasound Obstet Gynecol 2002;19:258–63.
8. Akmal S, Kametas N, Tsoi E, Hargreaves C, Nicolaides KH. Comparison of transvaginal digital examination with intrapartum sonography to determine fetal head position before instrumental delivery. Ultrasound Obstet Gynecol 2003;21:437–40.
9. Ramphul M, Ooi PV, Burke G, et al. Instrumental delivery and ultrasound: a multicentre randomised controlled trial of ultrasound assessment of the fetal head position versus standard care as an approach to prevent morbidity at instrumental delivery. BJOG 2014;121:1029–38.
10. Kreiser D, Schiff E, Lipitz S, Kayam Z, Avraham A, Achiron R. Determination of fetal occiput position by ultrasound during the second stage of labor. J Matern Fetal Med 2001;10:283–6.
11. Chou MR, Kreiser D, Taslimi MM, Druzin ML, El-Sayed YY. Vaginal versus ultrasound examination of fetal occiput position during the second stage of labor. Am J Obstet Gynecol 2004;191:521–4.
12. Rozenberg P, Porcher R, Salomon LJ, Boirot F, Morin C, Ville Y. Comparison of the learning curves of digital examination and transabdominal sonography for the determination of fetal head position during labor. Ultrasound Obstet Gynecol 2008;31:332–7.
13. Calkins LA. Occiput posterior. Am J Obstet Gynecol 1939;38:993–1001.
14. Eastman NJ, Williams JW, eds. Williams obstetrics. New York, New York: Appleton-Century-Crofts; 1950. p. 354–72.
15. Cunningham FG, Leveno KJ, Bloom SL, et al. Williams obstetrics. New York, New York: McGraw-Hill Education; 2018. p.429.
16. Chan YT, Ng VK, Yung WK, Lo TK, Leung WC, Lau WL. Relationship between intrapartum transperineal ultrasound measurement of angle of progression and head-perineum distance with correlation to conventional clinical parameters of labor progress and time to delivery. J Matern Fetal Neonatal Med 2015;28:1476–81.
17. Eggebø TM, Wilhelm-Benartzi C, Hassan WA, Usman S, Salvesen KA, Lees CC. A model to predict vaginal delivery in nulliparous women based on maternal characteristics and intrapartum ultrasound. Am J Obstet Gynecol 2015;213:362.e1–6.
18. Kahrs BH, Usman S, Ghi T, et al. Sonographic prediction of outcome of vacuum deliveries: a multicenter, prospective cohort study. Am J Obstet Gynecol 2017;217:69.e1–10.

Descargado para Anonymous User (n/a) en National Library of Health and Social Security de ClinicalKey.es por Elsevier en junio 17, 2021. Para uso personal exclusivamente. No se permiten otros usos sin autorización. Copyright ©2021. Elsevier Inc. Todos los derechos reservados.

19. Bellussi F, Ghi T, Youssef A, et al. The use of intrapartum ultrasound to diagnose malpositions and cephalic malpresentations. Am J Obstet Gynecol 2017;217:633–41.
20. Souka AP, Haritos T, Basayiannis K, Noikokyri N, Antsaklis A. Intrapartum ultrasound for the examination of the fetal head position in normal and obstructed labor. J Matern Fetal Neonatal Med 2003;13:59–63.
21. Malvasi A, Tinelli A, Barbera A, et al. Occiput posterior position diagnosis: vaginal examination or intrapartum sonography? A clinical review. J Matern Fetal Neonatal Med 2014;27:520–6.
22. Ghi T, Eggebø T, Lees C, et al. ISUOG Practice Guidelines: intrapartum ultrasound. Ultrasound Obstet Gynecol 2018;52:128–39.
23. Østborg TB, Romundstad PR, Eggebø TM. Duration of the active phase of labor in spontaneous and induced labors. Acta Obstet Gynecol Scand 2017;96:120–7.
24. Robson MS. Classification of caesarean sections. Fetal Matern Med Rev 2001;12:23–39.
25. World Health Organization partograph in management of labour. World Health Organization Maternal Health and Safe Motherhood Programme. Lancet 1994;343:1399–404.
26. World Health Organization. WHO recommendations for augmentation of labour. Geneva, Switzerland: World Health Organization; 2014.
27. Youssef A, Ghi T, Pilu G. How to perform ultrasound in labor: assessment of fetal occiput position. Ultrasound Obstet Gynecol 2013;41:476–8.
28. Ghi T, Farina A, Pedrazzi A, Rizzo N, Pelusi G, Pilu G. Diagnosis of station and rotation of the fetal head in the second stage of labor with intrapartum translabial ultrasound. Ultrasound Obstet Gynecol 2009;33:331–6.
29. Akmal S, Tsoi E, Kametas N, Howard R, Nicolaides KH. Intrapartum sonography to determine fetal head position. J Matern Fetal Neonatal Med 2002;12:172–7.
30. Eggebø TM, Gjessing LK, Heien C, et al. Prediction of labor and delivery by transperineal ultrasound in pregnancies with prelabor rupture of membranes at term. Ultrasound Obstet Gynecol 2006;27:387–91.
31. Barbera AF, Pombar X, Perugino G, Lezotte DC, Hobbins JC. A new method to assess fetal head descent in labor with transperineal ultrasound. Ultrasound Obstet Gynecol 2009;33:313–9.
32. Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research Electronic Data Capture (REDCap)—a metadata-driven methodology and workflow process for providing translational research informatics support. J Biomed Inform 2009;42:377–81.
33. Popowski T, Porcher R, Fort J, Javoise S, Rozenberg P. Influence of ultrasound determination of fetal head position on mode of delivery: a pragmatic randomized trial. Ultrasound Obstet Gynecol 2015;46:520–5.
34. Dupuis O, Silveira R, Zentner A, et al. Birth simulator: reliability of transvaginal assessment of fetal head station as defined by the American College of Obstetricians and Gynecologists classification. Am J Obstet Gynecol 2005;192:868–74.
35. Zahalka N, Sadan O, Malinger G, et al. Comparison of transvaginal sonography with digital examination and transabdominal sonography for the determination of fetal head position in the second stage of labor. Am J Obstet Gynecol 2005;193:381–6.
36. Abalos E, Oladapo OT, Chamillard M, et al. Duration of spontaneous labour in 'low-risk' women with 'normal' perinatal outcomes: a systematic review. Eur J Obstet Gynecol Reprod Biol 2018;223:123–32.
37. Caldwell WE, Moloy HC, Anthony D'esopo D. A roentgenologic study of the mechanism of engagement of the fetal head. Am J Obstet Gynecol 1934;28:824–41.
38. Steele KB, Javert CT. The mechanism of labor for transverse positions of the vertex. Surg Gynaecol Obstet 1942;75:477–84.
39. Gardberg M, Laakkonen E, Sälevaara M. Intrapartum sonography and persistent occiput posterior position: a study of 408 deliveries. Obstet Gynecol 1998;91:746–9.
40. Eggebø TM, Heien C, Økland I, Gjessing LK, Romundstad P, Salvesen KA. Ultrasound assessment of fetal head-perineum distance before induction of labor. Ultrasound Obstet Gynecol 2008;32:199–204.
41. Rane SM, Pandis GK, Guirgis RR, Higgins B, Nicolaides KH. Pre-induction sonographic measurement of cervical length in prolonged pregnancy: the effect of parity in the prediction of induction-to-delivery interval. Ultrasound Obstet Gynecol 2003;22:40–4.
42. Rane SM, Guirgis RR, Higgins B, Nicolaides KH. The value of ultrasound in the prediction of successful induction of labor. Ultrasound Obstet Gynecol 2004;24:538–49.
43. Akmal S, Kametas N, Tsoi E, Howard R, Nicolaides KH. Ultrasonographic occiput position in early labour in the prediction of caesarean section. BJOG 2004;111:532–6.
44. Vitner D, Paltieli Y, Haberman S, Gonen R, Ville Y, Nizard J. Prospective multicenter study of ultrasound-based measurements of fetal head station and position throughout labor. Ultrasound Obstet Gynecol 2015;46:611–5.
45. Lieberman E, Davidson K, Lee-Parritz A, Shearer E. Changes in fetal position during labor and their association with epidural analgesia. Obstet Gynecol 2005;105:974–82.
46. Akmal S, Tsoi E, Howard R, Osei E, Nicolaides KH. Investigation of occiput posterior delivery by intrapartum sonography. Ultrasound Obstet Gynecol 2004;24:425–8.
47. Adam G, Sirbu O, Voicu C, Dominic D, Tudorache S, Cernea N. Intrapartum ultrasound assessment of fetal head position, tip the scale: natural or instrumental delivery? Curr Health Sci J 2014;40:18–22.
48. Blasi I, D'Amico R, Fenu V, et al. Sonographic assessment of fetal spine and head position during the first and second stages of labor for the diagnosis of persistent occiput posterior position: a pilot study. Ultrasound Obstet Gynecol 2010;35:210–5.
49. World Health Organization. WHO recommendation on definitions of the latent and active first stages of labour. 2018. Available at: https://apps.who.int/iris/bitstream/handle/10665/272447/WHO-RHR-18.12-eng.pdf. Accessed April 15, 2021.
50. Zhang J, Landy HJ, Branch DW, et al. Contemporary patterns of spontaneous labor with normal neonatal outcomes. Obstet Gynecol 2010;116:1281–7.
51. Bamberg C, Scheuermann S, Fotopoulou C, et al. Angle of progression measurements of fetal head at term: a systematic comparison between open magnetic resonance imaging and transperineal ultrasound. Am J Obstet Gynecol 2012;206:161.e1–5.
52. Ghi T, Bellussi F, Azzarone C, et al. The "occiput-spine angle": a new sonographic index of fetal head deflexion during the first stage of labor. Am J Obstet Gynecol 2016;215:84.e1–7.

Author and article information

From the Department of Obstetrics and Gynecology, Landspitali - The National University Hospital of Iceland, Reykjavík, Iceland (Drs Hjartardóttir, Benediktsdóttir, and Geirsson); Faculty of Medicine, University of Iceland, Reykjavík, Iceland (Drs Hjartardóttir, Benediktsdóttir, and Geirsson); deCODE genetics, Reykjavík, Iceland (Dr Lund); National Center for Fetal Medicine, St. Olav's Hospital, Trondheim University Hospital, Trondheim, Norway (Dr Eggebø); Department of Obstetrics and Gynecology, Stavanger University Hospital, Stavanger, Norway (Dr Eggebø); and Institute of Clinical and Molecular Medicine, Norwegian University of Science and Technology, Trondheim, Norway (Dr Eggebø).

Received Sept. 4, 2020; revised Oct. 29, 2020; accepted Oct. 30, 2020.

The authors report no conflict of interest.

This study was supported by grant number 185435-052 from the Icelandic Centre for Research.

Corresponding author: Hulda Hjartardóttir, MD. huldahja@landspitali.is

Descargado para Anonymous User (n/a) en National Library of Health and Social Security de ClinicalKey.es por Elsevier en junio 17, 2021. Para uso personal exclusivamente. No se permiten otros usos sin autorización. Copyright ©2021. Elsevier Inc. Todos los derechos reservados.