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# Angle of progression with trans-perineal ultrasound and delivery type in labor's second stage; a cross-sectional study in Isfahan, Iran

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Dr.msmiri@gmail.com**Received:** 31 Aug. 2021**Accepted:** 12 Oct. 2021**ePublished:** 25 Oct. 2021**Keywords:** Angle of progression,  
Trans-perineal sonography, Labor**Abstract****Introduction:** Numerous studies have shown that clinical evaluation in labor is not very accurate, therefore ultrasound is one of the instruments that can give us a more objective assessment than the clinical evaluation.**Objectives:** In this study, we investigate the magnitude of the angle of progression (AoP) at the second stage of labor in fetuses with cephalic presentation and its relation to spontaneous vaginal delivery.**Patients and Methods:** In this cross-sectional study, we measured the AoP using trans-perineal sonography in the 2nd stage of the labor and compared AoP in normal vaginal delivery (NVD), cesarean and NVD with vacuum groups on 80 pregnant women. We also investigated the correlation between AoP and induction time and duration of the second stage of labor.**Results:** In 80 study patients, 54 (67.5 %) had normal vaginal deliveries, 21 (26.2 %) had cesarean section and 5 (6.2%) had NVD with a vacuum. There was a statistically significant difference between NVD, cesarean section, and NVD with vacuum in terms of the AoP ( $P < 0.01$ ). There was a statistically significant correlation between AoP and induction time, duration of 2nd stage of labor and Apgar scores ( $P < 0.05$ ).**Conclusion:** Higher progression angle is associated with shorter induction time and 2nd stage of labor, higher neonatal Apgar scores and a higher chance of spontaneous vaginal delivery which makes it an appropriate index for predicting pregnancy outcomes.**Citation:** Zarean E ,  
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jpe.2022.05.**Introduction**

First, "Normal Birth" was described in 1942 as "a condition in which mother is fearless and the baby is in a good position and passes freely and without problems through the pelvic canal" (1). In recent studies, there is a fertility rate of 1.7 per 1 in American women in childbearing ages and most of women will experience the labor, so evaluating and studying the labor and childbirth complications and conditions seems necessary (2).

One of the most essential components of women's treatment during labor is assessing their childbirth progress (3). Focusing on the extent of childbirth progress is critical for selecting whether or not to intervene in natural childbirth (4). Approximately 41%-45% of births are natural and do not require medical assistance (5). Labor dystocia, also known as aberrant delivery progression, is defined as a lack of progress in effacement, cervical dilatation, or presentation descent (6). It is also defined by abnormally slow dilation of the cervix or descent of the fetus in an active delivery (7), which

**Key point**

In this cross-sectional study, we investigated the magnitude of the angle of progression (AoP) at the second stage of labor and its relation to spontaneous vaginal delivery. Higher progression angle is associated with shorter induction time and 2nd stage of labor, higher neonatal Apgar scores and a higher chance of spontaneous vaginal delivery.

accounts for 8% of maternal mortality in developing countries (8). It affects between 25% and 30% of primiparous women and 15% of multiparous women. According to surveys, the incidence of hard labor varies significantly around the globe, ranging from 4.8% to 21% (9,10).

Labor progression is linked to more cesarean deliveries, delivery enhancement, and vaginal inspections (11), resulting in severe difficulties for the mother and fetus if not detected and treated promptly (12). The gold standard approach for measuring labor progress is now vaginal examination (13). The device used to measure the development of childbirth should detect a natural condition of birthing that is becoming



abnormal in a timely way, allowing for appropriate referral to more advanced centers or timely intervention (14).

Some women do not progress to the 2<sup>nd</sup> stage of labor and must have an instrumental delivery. Primary cesarean surgery, instrumental vaginal delivery (with forceps and suction), and secondary cesarean surgery after instrumental vaginal birth failure are all options for managing this situation. The fetus is safer after a successful instrumental vaginal delivery than after a cesarean section (secondary to instrumental failure).

In addition, in the 2<sup>nd</sup> stage of labor, maternal hazards of cesarean delivery are present, including significant bleeding, a higher chance of bladder trauma, and uterine rupture leading to large ligament hematoma (17, 18). As a result, making the proper and timely choice on when to delay delivery in the 2<sup>nd</sup> phase is critical.

Recent research on trans-perineal ultrasonography assessment of fetal head descent in labor showed no explicit values for the angle of advancement were supplied, the scientists projected that the ultrasonography technique would provide a more intuitive assessment of the placement of the baby's head because of the tiny variations in taste (20).

### Objectives

Several studies have shown that clinical evaluation in labor is not very reliable; thus, ultrasonography is one of the tools that can help us make better judgments by providing a more objective assessment than clinical evaluation. The size of the angle of progression (AoP) in the 2<sup>nd</sup> stage of labor in fetuses with cephalic presentation and its relationship to spontaneous normal delivery are investigated in this study.

### Patients and Methods

#### Study design

This cross-sectional study was set to take place between May 2020 and June 2021 on 80 pregnant women referred to Shahid Beheshti and Al-Zahra hospitals. Women who had a gestational age of more than 37 weeks and a singleton pregnancy were included in the study. Fetal distress, labor disruption, and any adverse fetal and maternal issues or disorders other than occiput anterior, all were ruled out. Patients who were less than 37 weeks pregnant, had twins, had a previous cesarean delivery, had any uterine surgery, had a non-cephalic presentation, or were receiving APR were excluded. The necessity of implementing the plan and its benefits to patients was fully explained and written informed consent was obtained from them.

A transducer was positioned between the labia under the symphysis pubis and a sagittal view was taken from the longitudinal axis of the symphysis pubis to measure the AoP after complete cervical dilation and in the 2<sup>nd</sup> stage of labor. The image was then frozen, and the angle between the symphysis pubis line and the line between the inferior apex of the symphysis pubis and the fetal head was

measured, and the time and technique of delivery were assessed. SIUI (CTS 8800) was the ultrasound equipment used in this study.

#### Data analysis

SPSS software version 26 was used to analyze the data. Quantitative data were stated as a mean  $\pm$  SD, whereas qualitative data were expressed as a frequency (percent). The Kolmogorov-Smirnov test was utilized to determine whether quantitative variables were normal (such as angle size). For statistical analysis, Spearman's and multivariate tests were applied. In all tests, a significance level of less than 0.05 was used.

### Results

In the 80 samples studied, 54 (67.5%) had normal vaginal deliveries, 21 (26.2%) had cesarean section and five (6.2%) had normal vaginal delivery (NVD) with a vacuum. The mean body mass index (BMI) of the samples was  $24.61 \pm 2.44$  (kg/m<sup>2</sup>) and the maximum and minimum were 28 and 19, respectively. The mean gestational age at referral was 40 weeks with a standard deviation of 6. Around 43.8% (35 cases) of pregnant women referred with a complaint of labor pain, 28.8% (23 cases) with rupture of membranes, 17.5% (14 cases) with reduced fetal movements, 5% (4 cases) with vaginal bleeding, 3.8% (3 cases) with hypertension and 1.2% (1 case) with a decrease in amniotic fluid. The mean progression angle is  $142.09^\circ$  with a standard deviation of  $12.19^\circ$ . Other descriptive data for the study variables are presented in [Table 1](#).

Kolmogorov-Smirnov test was used to investigate the normal distribution of quantitative data. The results showed that the variables of induction duration, birth weight, BMI, neonate blood pH, and stretch of stay in the neonatal intensive care unit (NICU) had a normal distribution. As a result, nonparametric tests were used to analyze other study variables.

Investigation of the relationship between the AoP and gravid showed no significant correlation between these two variables ( $P=0.268$ ). There was no statistically significant relationship between gestational age and the progression angle ( $P=0.271$ ). Examination of the relationship between Apgar score one and five and the AoP showed that there was a significant correlation between these variables ( $P<0.05$  and correlation coefficient = 0.485,  $P<0.05$ , and correlation coefficient = 0.431, respectively) ([Figures 1A and 1B](#)).

There was no statistically significant relationship between birth weight and the AoP ( $P=0.338$ ). Examination of the relationship between the stretch of stay in NICU and the AoP presented no significant correlation between these two variables ( $P=0.112$ ). The relationship between neonate blood pH and the AoP showed no significant correlation ( $P=0.419$ ). There was no significant correlation between BMI and AoP ( $P=0.881$ ).

Investigation of the relationship between the duration

**Table 1.** Descriptive data of study variables

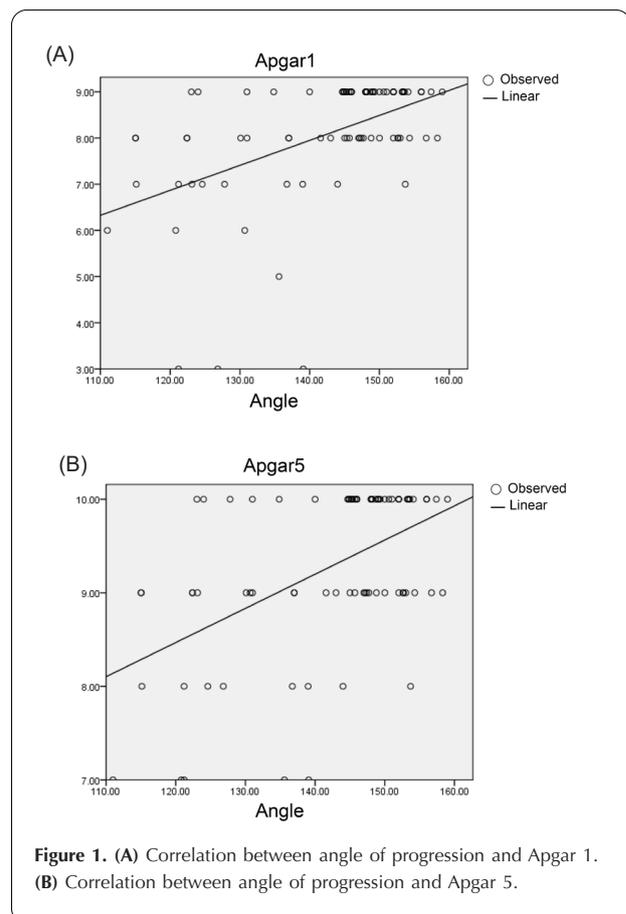
Variables	No.	%
<b>Delivery method</b>		
NVD	54	67.5
C/S	21	26.2
Vacuum	5	6.2
<b>Gravid</b>		
1	44	55
2	23	28.8
3	9	11.2
4 and more	4	4.9
<b>Station</b>		
-3	53	66.2
-2	18	22.5
-1	9	11.2
<b>Chief complaint</b>		
Labor	35	43.8
Rupture of membrane	23	28.8
Reduction of fetal movements	14	17.5
Vaginal bleeding	4	5
HTN	3	3.8
Decrease of amniotic fluid	1	1.2
	<b>Mean</b>	<b>Standard deviation</b>
Effacement (cm)	1.97	0.98
Stage 2 length (min)	50.44	57.75
Induction time (min)	573	343.53
Birth weight (g)	3401.93	383.19
BMI (kg/m <sup>2</sup> )	24.61	2.44
APGAR 1	8.06	1.34
APGAR 5	9.27	0.88
Neonate blood pH	7.24	0.11
NICU admission (h)	45	24.06
Angle of progression (°)	142.09	12.19
Gestational age (wk)	40.09	6.18

of 2<sup>nd</sup> stage of labor and the AoP showed that there was a statistically significant correlation between these two variables ( $P < 0.05$ , correlation coefficient = -0.642). There was a statistically significant relationship between the duration of induction and the AoP ( $P < 0.05$ , correlation coefficient = -0.683; **Figures 2a** and **2B**).

The relationship between the duration of the 2<sup>nd</sup> stage of labor and the AoP was statistically significant in the two groups of primigravida and multigravida women ( $P < 0.05$  and correlation coefficient = -0.817,  $P < 0.05$ , and correlation coefficient = -0.597, respectively; **Figures 3A** and **3B**).

Investigation of the relationship between duration of induction and the AoP between two groups of primigravida and multigravida showed a statistically significant correlation ( $P < 0.05$  and correlation coefficient = -0.799,  $P < 0.05$ , and correlation coefficient = -0.377, respectively; **Figures 4A** and **4B**).

Comparison of the AoP by delivery method showed



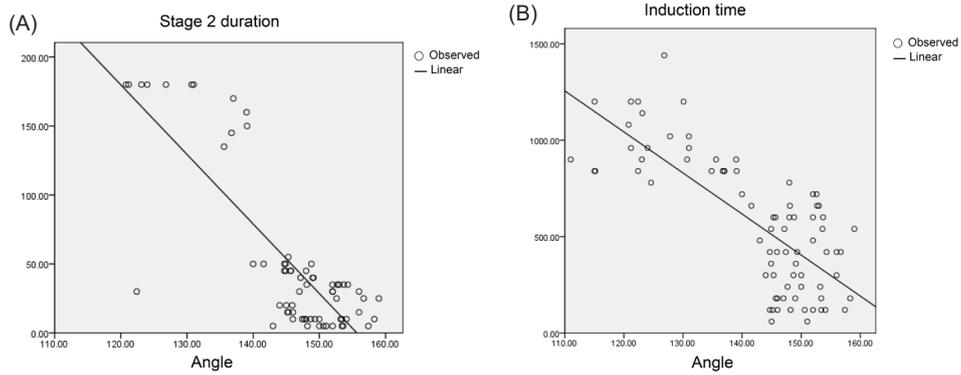
**Figure 1.** (A) Correlation between angle of progression and Apgar 1. (B) Correlation between angle of progression and Apgar 5.

that there was a statistically significant difference between NVD, cesarean section, and NVD with vacuum in terms of mean AoP ( $149.47^\circ \pm 4.47^\circ$ ,  $124.20^\circ \pm 6.81^\circ$ ,  $137.48^\circ \pm 1.51^\circ$ , respectively;  $P < 0.01$ ).

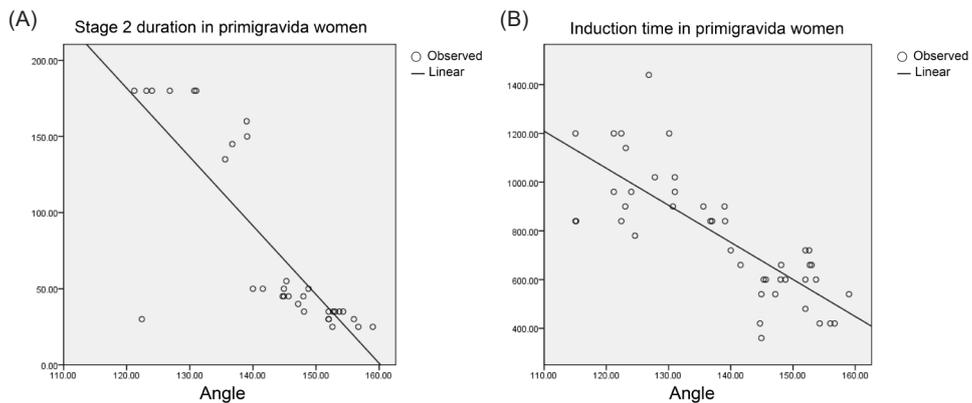
## Discussion

The size of the AoP at the 2<sup>nd</sup> stage of labor in fetuses with cephalic presentation and its relationship to spontaneous standard delivery was studied in this cross-sectional study. The overall findings of this investigation revealed that the progression angle directly impacted the manner of delivery. This study demonstrated that the greater the AoP, the higher the likelihood of an NVD delivery and that decreasing the progression angle raised the probability of a cesarean section delivery. The researchers also discovered no link between progression angle and gravidity, BMI, gestational age, or birth weight. As a result, these characteristics cannot forecast the degree of advancement and the delivery outcome. On the other hand, there was no link between the neonate blood pH and the angle of promotion and admittance to the NICU. This suggests that the length of stay in the ICU and hypoxic problems were not significantly different in infants with a lower angle of advancement.

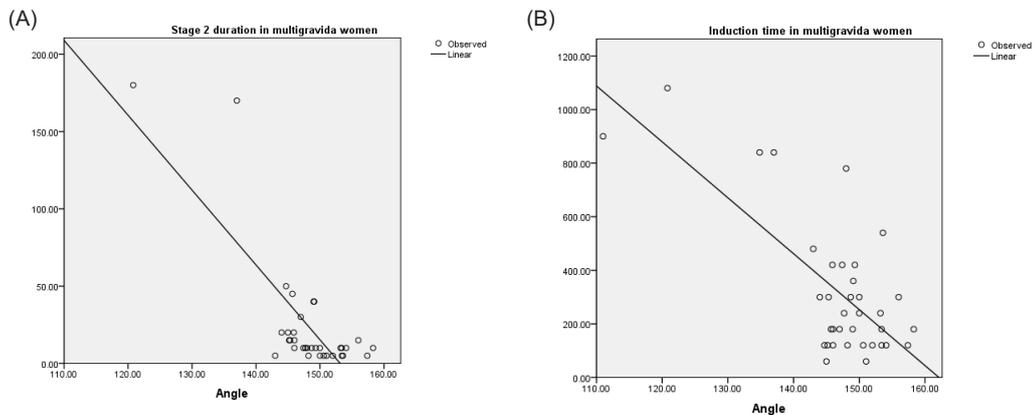
Several studies (22-25) have evaluated the clinical application of ultrasound in detecting progression angle



**Figure 2.** (A) Correlation between angle of progression and stage 2 duration. (B) Correlation between angle of progression and induction time.



**Figure 3.** (A) Correlation between angle of progression and stage 2 duration in primigravida women. (B) Correlation between angle of progression and stage 2 duration in primigravida women.



**Figure 4.** (A) Correlation between angle of progression and induction time in multigravida women. (B) Correlation between angle of progression and induction time in multigravida women.

and predicting labor outcome, and it has been discovered that the AoP has a strong relationship with the type of delivery and that the difference in vaginal progression between vaginal delivery and cesarean section has been objectively demonstrated by ultrasound evaluation of the fetus (19-27). Chan et al (28), for example, found that out of 143 women, 116 had a successful instrumental birth and 27 had a cesarean surgery. Due to the extension of

the 2nd stage of labor, the AoP predicted roughly 80% of successful device-assisted births, according to the findings of this study. The optimum AoP cut-offs for predicting successful instrument delivery in this investigation were 138.7 degrees at rest (86.2% sensitivity, 51.9% specificity) and 160.9 degrees in contraction (86.2% sensitivity, 51.9% specificity) (87.1% sensitivity, 74.1% specificity).

In nulliparous women, a wider AoP at rest and under

the Valsalva technique was linked with vaginal birth, shorter interval to delivery, and shorter labor length (29). The AoP's accuracy in predicting cesarean section was moderate in this study, and it is unlikely to be clinically meaningful for predicting labor status alone. According to the findings of Kameyama et al (30), trans-perineal ultrasonography examination shortly after complete cervical dilation was a useful predictor for predicting birth type. Bibbo et al (31) looked at the link between the angle of advancement determined by trans-peritoneal ultrasonography, the route of delivery, and the duration of the 2<sup>nd</sup> stage in 137 patients. This study revealed that a progression angle of fewer than 153 degrees is linked to a higher risk of a prolonged pregnancy culminating in cesarean delivery. In addition, the angle of advancement may be used to indicate spontaneous vaginal birth.

All of the studies above looked at the AoP during labor. Still, only a handful looked at it before labor started and its function in determining the pregnancy's outcome. The progression angle was measured at admission and the commencement of the 2<sup>nd</sup> stage of labor in the study by Marsoosi et al (32) on 70 pregnant women. The findings revealed a substantial direct association between progression angle and cervical dilatation in the first stage of labor and a solid indirect link between progression angle at the start of the 2<sup>nd</sup> stage and labor duration.

Previous research that investigates 100 nulliparous and 71 multiparous pregnant women that in their gestational age was equal and more than 39 weeks showed that nulliparous women with a narrow AOP less than 95 degrees have a higher chance of cesarean birth. Before the start of labor, multiparous women had a narrower AOP than nulliparous women. Though unlike nulliparous women, limited AOP in multiparous women does not seem to be linked to cesarean delivery, and most multiparous women deliver vaginally. In contrast to the findings of this study, our results showed that lower AOP was related to an extended induction time and 2<sup>nd</sup> stage of labor in both multigravida and primigravida women (33).

This is the first study in Iran to examine the association between trans-perineal sonography angle of advancement and delivery outcomes. However, there were certain limits to this study's implementation. First, the number of samples analyzed in this study is not very large due to a lack of funds and time, making some statistical analyses of some of the indicators examined unimportantly. The study was conducted in a cross-sectional manner. It is worth noting that interventional studies with control and study groups will produce more reliable results regarding the impact of the angle of improvement in predicting delivery type. Furthermore, this research focused solely on the angle of advancement during the 2<sup>nd</sup> stage of labor. It is only natural that a review of this index at other times and stages of pregnancy yields broader and more accurate results. Therefore more significant sample numbers and more precise techniques are recommended for planning studies.

## Conclusion

It can be concluded that the AoP by itself is not a good predictor of labor problems and should be used in conjunction with other indicators. However, according to the data, the Apgar scores of minutes 1 and 5 did have a direct association with the angle of advancement. Thus, the angle of improvement appears to directly affect immediate labor difficulties, such as the baby's Apgar score at birth, but this is not true for more severe and persistent challenges. Furthermore, this study revealed that the greater the AoP in ultrasound examination, the shorter the duration of the 2<sup>nd</sup> stage of labor and the less they need for induction of labor, which was observed in both primigravida and multigravida groups.

As a result, using trans-perineal ultrasound during birth in conjunction with clinical examination improves diagnostic accuracy in predicting the type of birth, which reduces delivery problems and the cost burden on the health system. According to the findings of this study, trans-perineal ultrasonography should be used to diagnose the AoP to determine the type of delivery.

## Limitations of the study

This study was conducted at two different hospitals in Isfahan, Iran. We could gain more accurate results by increasing the sample size and incorporating more cities and provinces in a more extensive study.

## Authors' contribution

EZ and FM were the principal investigators of the study. MSM was included in preparing the concept and design. EZ revisited the manuscript and critically evaluated the intellectual contents. All authors participated in preparing the final draft of the manuscript, revised the manuscript and critically evaluated the intellectual contents. All authors have read and approved the content of the manuscript and confirmed the accuracy or integrity of any part of the work.

## Conflicts of interest

The authors decline any kind of conflict of interest.

## Ethical issues

The research followed the tenets of the Declaration of Helsinki. The Ethics Committee of Isfahan University of Medical Sciences approved this study (Ethical code#IR.MUI.MED.REC.1398.081). Accordingly, written informed consent was taken from all participants before any intervention. This study was extracted from obstetrics and gynecology residency thesis of Mahsa Sadat Miri at this university. Additionally, ethical issues (including plagiarism, data fabrication and double publication) were completely observed by the authors.

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