



Measurement of Angle of Descent (AOD) by Transperineal Ultrasound in Labour to Predict Successful Vaginal Delivery

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Abstract

Introduction Non-progress of labour forms the largest indication caesarean section. The diagnosis of failure of descent using serial digital examination is objective, poor reproducibility, carries the risk of infection and is painful to the labouring patient. There is a need if not an alternative, adjunctive to digital vaginal examination. Measuring angle of descent (AOD) to predict vaginal birth in late labour by transperineal ultrasound provides an alternative without any of the above-mentioned drawbacks.

Materials and Methods A prospective observational study in 64 patients in the late first stage and second stage of labour with cephalic presentation was carried out, from September 2017 to December 2018, in PGIMER and DR. RML Hospital. Angle of descent was measured by transperineal ultrasound. Angle of descent is the angle between the longitudinal axis of pubic bone and a line joining the lowest edge of the pubis to the lowest convexity of the foetal skull. Time of assessment of AOD₁ was noted, and if patient did not deliver within 2 h, another AOD₂ was recorded. Eighty-five readings were obtained, and AOD predicting successful vaginal delivery was calculated.

Results and Discussion AOD of 116° and more resulted in vaginal delivery, spontaneous or instrumental. As the angle of descent increased, there was a decrease in time interval to vaginal delivery with correlation coefficient of -0.939 .

Conclusion The use of intrapartum transperineal ultrasound and measurement of angle of descent can prove to be a valuable adjunct in management of labour, especially in cases of prolonged first and second stages of labour in predicting successful vaginal delivery. AOD of 116° or more can predict successful vaginal delivery within 2 h. AOD can be used in centres having facilities of intrapartum ultrasound. The authors recommend the use of ultrasound in labour room as it is non-invasive and can provide a lot of information. This method is currently useful for tertiary centres or medical colleges.

Keywords Transperineal ultrasound · Angle of descent · Progress of labour

Introduction

Traditionally, the assessment of progress of labour in a woman is based upon dilatation and descent of presenting part by periodic vaginal examination. However, clinical examination of head station and position is inaccurate

and subjective, especially when caput succedaneum impairs palpation of sutures and fontanelles. Assessment of descent as well as dilatation on digital vaginal examination has a drawback of being highly subjective, uncertain reproducibility and operator dependent. These methods involve an unrealistic expectation of clinicians to possess an uncanny perception of three-dimensional relationships. Assessment of station of descent of foetal head is dependent upon an imaginary line drawn between the often inaccessible ischial spines. Nevertheless, this is the sole criterion used in clinical practice today.

Ultrasound imaging has already been reported as an adjunctive method for evaluating the level of the foetal presenting part within the maternal pelvis [1, 2]. Intrapartum transperineal ultrasound has the advantage of being objective and highly reproducible as compared to digital examination [3–6].

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The recent years have seen a change in many trends—the importance of non-invasive techniques, reliability, reproducibility of documentation, trends in minimising infection, change in criteria for non-progress of labour (NPL) and steps to reduce the alarming rise of caesarean delivery (ACOG 2014). NPL forms the largest indication for primary caesarean section. The diagnosis of failure of descent using serial digital examination is objective, poor reproducibility, carries the risk of infection and is painful to the labouring patient. There is a need if not an alternative, adjunctive to digital vaginal examination.

Measuring angle of descent to predict vaginal birth in late labour by transperineal ultrasound provides an alternative without any of the above-mentioned drawbacks.

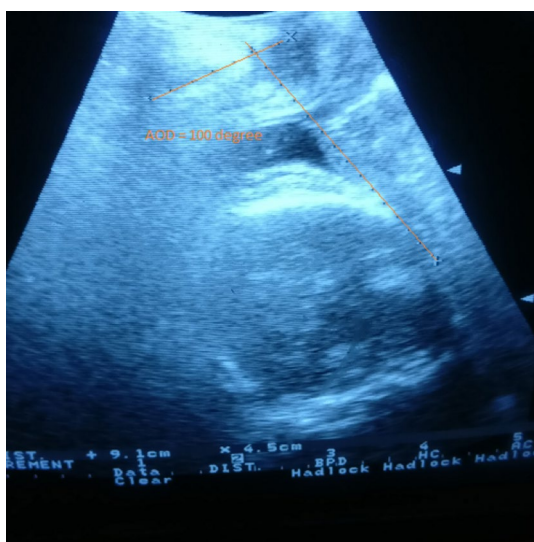
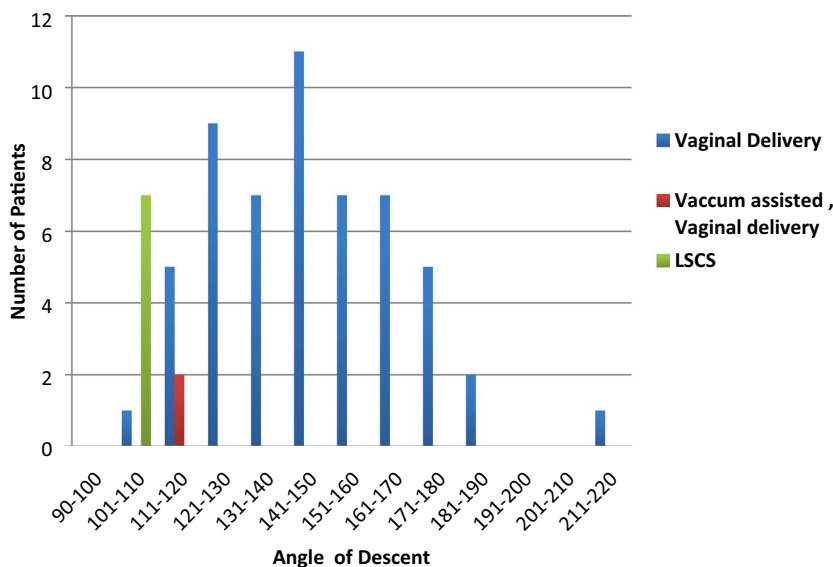


Fig. 1 Angle of descent (AOD) measured as 116°

Fig. 2 Angle of descent and mode of delivery



Materials and Methods

This study was a prospective observational study in 64 patients in the late first stage and second stage of labour with cephalic presentation from September 2017 to December 2018 in labour room of Department of Obstetrics and Gynaecology, PGIMER and DR. RML Hospital. After ensuring empty bladder of patient, transperineal ultrasound was performed using a 2D model SSD-900 Aloka with 3.5 MHz transducer. The probe was enclosed in a latex glove covered with ultrasound gel and then placed between the labia below the pubic symphysis, and the sagittal view, in the long axis of the pubic symphysis, was taken by gently rocking the transducer upward (Fig. 1). The recording was done during the resting phase between contractions. The image was frozen and hardcopy obtained for later analysis of angle of descent. The angle between the constructed lines was measured with a goniometer applied to a hard copy image recorded as AOD₁. Angle of descent is the angle between the longitudinal axis of pubic bone and a line joining the lowest edge of the pubis to the lowest convexity of the foetal skull (Fig. 2). Time of assessment of AOD₁ was noted, and if patient did not deliver within 2 h, another AOD₂ was recorded. Outcome was measured in terms of mode of delivery—spontaneous vaginal delivery, instrumental vaginal delivery or caesarean delivery. Results were analysed as degree of angle needed to predict successful vaginal birth. Degree of AOD was correlated with duration between time of estimation of AOD and vaginal birth.

Sample Size Calculation

On the basis of previous study “A new method to assess fetal head descent in labor with Transperineal ultrasound” by Barbera et al. in 2009 (– 0.8 to – 0.95) and taking this value as reference, the minimum required sample size with 10% margin of error and 5% level of significance is 60 patients. So total sample size taken is 64. Formula used is:

$$ME = Z_{\alpha} \sqrt{\frac{p(p-1)}{N}}$$

where Z_{α} is the value of Z at two sided alpha error of 5%, ME is margin of error and p is prevalence rate.

Statistical Analysis

Categorical variables were presented as number and percentage (%), and continuous variables were presented as mean \pm SD and median. Normality of data was tested by the Kolmogorov–Smirnov test. If the normality was rejected, then nonparametric test was used. Quantitative variables were compared using Mann–Whitney test (as the datasets were not normally distributed) between the two groups and Kruskal–Wallis test between more than two groups. Qualitative variables were correlated using Chi-square test. Spearman’s rank correlation coefficient was used to assess the correlation of quantitative parameters with each other. Receiver operating characteristic curve was used to find out cut-off point of angle of descent for predicting vaginal delivery. Kaplan–Meier survival analysis curve was used to find out time of vaginal delivery. The data analysis was performed using Statistical Package for Social Sciences (SPSS), version 21.0.

Results and Discussion

Descriptive Characteristics of Study Population

Among the total of 64 study subjects, labouring patients were in the age group of 20–40 years. Maximum patients were present in the age group of 20–30 years. 79.69% patients were in the age group of 20–30 years, and 20.31% were in the age group of 30–40 years. 54.69% patients were primigravida and 45.31% patients were multigravida. Among the total of 64 study subjects, 57 (89.2%) females had vaginal delivery and 7 (10.94%) patients had LSCS. Two patients (3.13%) had instrumental (vacuum-assisted) vaginal delivery.

Table 1 Angle of descent (AOD) and mode of delivery

Angle of descent (°)	Vaginal delivery	Instrumental delivery	LSCS
90–100	0	0	0
101–110	1	0	7
111–120	5	2	0
121–130	9	0	0
131–140	7	0	0
141–150	11	0	0
151–160	7	0	0
161–170	7	0	0
171–180	5	0	0
181–190	2	0	0
191–200	0	0	0
201–210	0	0	0
211–220	1	0	0

Table 2 Comparison between AOD and mode of delivery

Angle of descent	Vaginal delivery	Vacuum-assisted vaginal delivery	LSCS	<i>P</i> value
No. of patients	55	2	7	0.00002
Mean \pm SD	150.84 \pm 22.02	120 \pm 0	110 \pm 0	
Median	150	120	110	
Range	110–220	120–120	110–110	

Correlation Between AOD and Mode of Delivery

In our study population, it was found that with angle of descent reading of more than 116° all the patients delivered vaginally. None of the patients delivered when angle of descent was $<90^{\circ}$. All patients who had LSCS had angle of descent less than 110° . Between 101° and 110° , seven patients had LSCS and one patient had vaginal delivery. Seven patients had caesarean for non-progress of labour, five were in the first stage and two were in the second stage. There was no foetal distress in any of the seven patients, undergoing LSCS. When angle of descent was between 111° and 120° , five patients had spontaneous vaginal delivery and two patients had vacuum-assisted vaginal delivery (Table 1). The average angle of descent in vaginal deliveries was 150° (SD 22.02) compared to 110° in caesarean sections and 120° in vacuum-assisted vaginal delivery ($P < 0.00002$) (Table 2, Fig. 3).

The ROC curve for angle of descent for vaginal delivery showed an area under the curve (AUC) of 0.989. The value of the angle of descent that optimises the curve is 116° . There was no caesarean section with angle of descent more than 116° , that is, all patients delivered vaginally.

Fig. 3 Correlation between angle of descent and mode of delivery

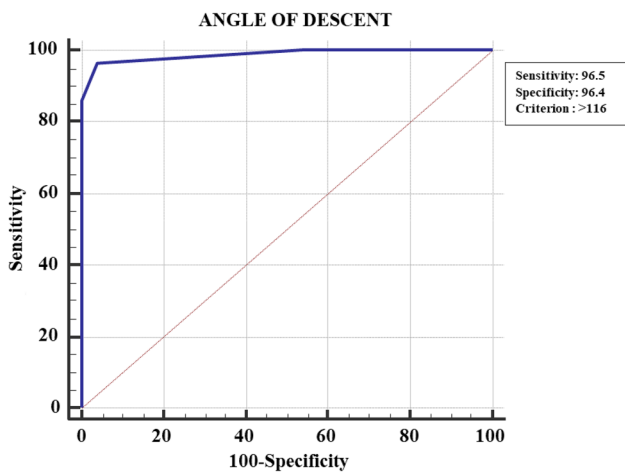
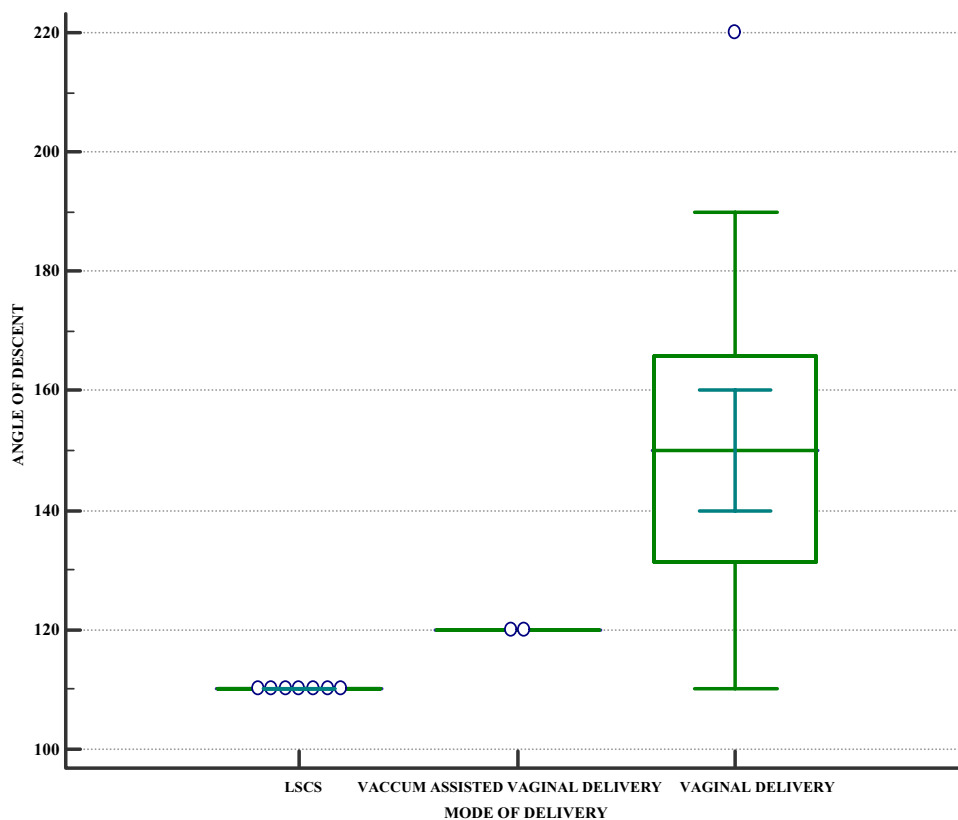


Fig. 4 ROC curve for angle of descent for vaginal delivery

116° AOD showed sensitivity of 96.49% and specificity of 96.43% for cut-off value of 116° in cases who delivered vaginally, value higher than that found in cases delivered by caesarean section. This difference was of high statistical significance AUC of 0.989 (Fig. 4).

Correlation Between AOD and Time of Vaginal Delivery

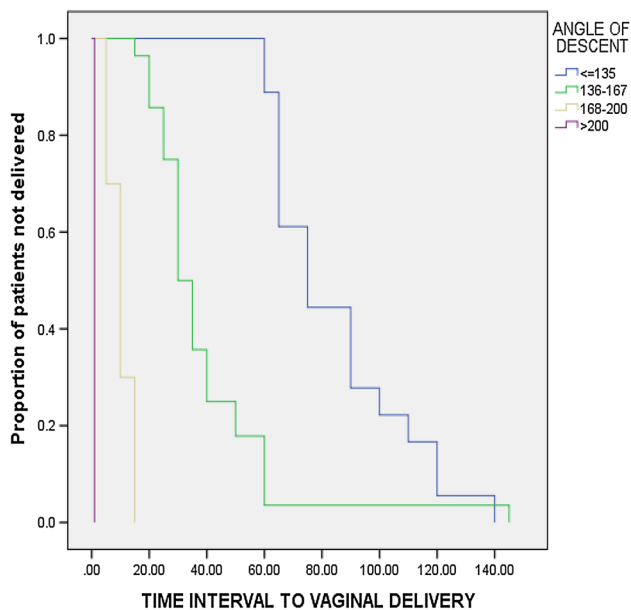
We noticed an inverse and significant relationship between the AOD and the duration of the second stage of labour, so at a greater angle of descent, a shorter duration of the second stage was found ($P < 0.0001$). Mean time interval to vaginal delivery when measurement of angle of descent was between 90° and 120° was found to be 107 min, for angle of descent between 121° and 150° was 54 min, for angle of descent between 151° and 180° was 20 min and for angle of descent > 180° was 3.6 min (Table 3).

Eighty-five sets of measurements, consisting of transperineal ultrasound angle and time until delivery, were obtained from 64 women during the active stage of labour. Out of 21 patients who required a second measurement of AOD (AOD₂), 15 patients had vaginal delivery (13 normal vaginal delivery and 2 instrumental delivery) with AOD₂ more than 116° and 6 patients had LSCS with AOD₂ less than 116° (Fig. 5).

In order to determine whether the time to delivery was associated with the magnitude of the transperineal angle, transperineal angles were divided into four groups ≤ 135°, 136°–167°, 168°–200° and > 200°. Table 4 lists the descriptive statistics for the mean time to delivery for each group based on Kaplan–Meier analyses. It is observed that larger transperineal ultrasound angles during the second stage of

Table 3 Relationship between angle of descent and time to vaginal delivery

					<i>P</i> value
Angle of descent (°)	90–120	121–150	151–180	> 180	
No. of patients	8	27	19	3	< 0.0001
Mean ± SD (min) (time to vaginal delivery)	107.5 ± 18.32	54.44 ± 24.7	20.79 ± 10.31	3.67 ± 2.31	
Median (min) (time to vaginal delivery)	105	60	20	5	
Range (min)	90–140	25–145	5–35	1–5	

**Fig. 5** Kaplan–Meier plot of time to vaginal delivery by angle of head descent measured on transperineal ultrasound

labour were associated with significantly decreased time to delivery. The group with smallest angles ($< 135^\circ$) had had markedly greater time of delivery (mean 85 min) than the other groups (136–167°) with mean 39 min, 168–200° with mean time 10 min and > 200 with mean time 1 min. The decrease in time to delivery became relatively smaller as the magnitude of the angle increased (Fig. 6). In our study, it was found that as the angle of descent increases there is a

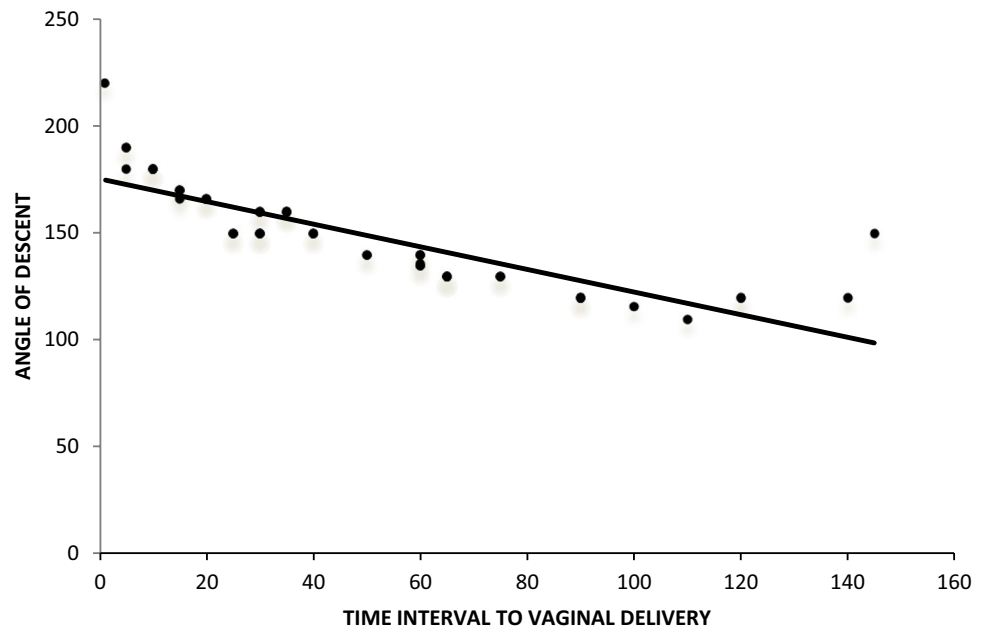
decrease in time interval to vaginal delivery with correlation coefficient of -0.939 . This is of high statistical significance $P < 0.0001$ (Table 4, Fig. 6).

Along with angle of descent, several other parameters that reflect foetal head descent in mid sagittal section have been proposed, including progression distance (the distance between leading edge of the foetal skull and the line perpendicular to the inferior edge of the pubis), head direction (the angle between the major longitudinal axis of foetal head and the line perpendicular to the inferior edge of pubis), head–symphysis distance and head–perineum distance. Among them, angle of descent was one of the most reliable parameters because of the minimal inter- and intra-observer errors [1, 7]. To summarise, in our study it was found that with angle of descent reading of more than 116° all the patients delivered vaginally ($P < 0.00002$). There was an inverse and significant relationship between the angle of descent and the duration of the second stage of labour, so at a greater angle of descent, a shorter duration of the second stage was found ($P < 0.0001$). As the angle of descent increased, there was a decrease in time interval to vaginal delivery with correlation coefficient of -0.939 , which was of statistical significance $P < 0.0001$. Similar studies in past have also predicted a cut-off value as 120° . In 2009, Barbera et al. studied the similar angle and described intra- and inter-observer variability of less than 3° . Their data in 88 term labouring patients showed that an angle of at least 120° was always associated with subsequent vaginal delivery. A similar study was conducted by Silvia Pina Perez et al. in 2017 who found that the value of angle of descent of 125° had 85% probability of vaginal delivery [8–11].

Table 4 Groups of angle of descent formed by Kaplan–Meier analysis and time interval to vaginal delivery

					<i>P</i> value
Angle of descent (°)	≤ 135	136–167	168–200	> 200	
Time intervals to vaginal delivery					
Sample size	18	28	10	1	< 0.0001
Mean ± SD (min)	85 ± 24.19	39.46 ± 24.43	10 ± 4.08	1 ± 0	
Median (min)	75	32.5	10	1	
Min–Max (min)	60–140	15–145	5–15	1–1	
Inter-quartile range (min)	65–100	27.500–45	5–15	1–1	

Fig. 6 Correlation between AOD and time to vaginal delivery



The strength of our study was that it was non-invasive technique, easy, reliable and gave a reproducible documentation of findings which can help in decision making in terms of leaving the patient for vaginal delivery as opposed to termination by caesarean in cases of prolonged second stage.

The weakness of our study was small size of the study and the absence of occipito-posterior position in our study group. A large number of patients and a computerised measurement of angle of descent are required in future studies.

Measurement of AOD is an easy method and has been successfully used even by midwives with good reproducibility [12]. Measuring AOD has an edge over traditional per vaginal examination which has person-to-person variability [13]. However, at present, due to a limited number of studies it is recommended as an ancillary tool to tradition per vaginal digital examination used to assess progress of labour. AOD can be used in centres having facilities of intrapartum ultrasound. Authors recommend the use of ultrasound in labour room as it is non-invasive and can provide a lot of information. This method is currently useful for tertiary centres or medical colleges. More studies are required to validate the degree of AOD to predict successful vaginal delivery in Indian pregnant women.

Conclusion

The use of intrapartum transperineal ultrasound and measurement of angle of descent can prove to be a valuable adjunct in management of labour, especially in cases of prolonged first and second stages of labour in predicting successful vaginal delivery. An angle measurement of 116°

or more can predict successful vaginal delivery within 2 h, spontaneous or instrumental. This method of measurement of AOD by intrapartum transperineal ultrasound is currently useful for tertiary centres or medical colleges.

Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical Approval Hospital ethical committee clearance for study was taken (file no-1776/17 dated 30.10.17).

Informed Consent Written and informed consent was obtained from patients for publication of data.

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About the Author



Dr. Renuka Malik is working as a Professor and Consultant in Obstetrics and Gynecology in PGIMER and DR. RML Hospital, a CGHS Hospital, New Delhi, for more than 25 years. She has a keen interest in laparoscopy and high-risk obstetrics.