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## Measurement of the Fetal Occiput-Spine Angle as a Predictor of Labor Outcomes During the First Stage of Labor

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### ABSTRACT

**Background:** In the first stage of labor, the attitude of the fetal head (relationship of the fetal head to the spine) may have a significant effect on the outcome of labor. Traditionally, diagnosis of deflexion in the fetal head is focused on digital labor examining, even though ultrasound use has recently been reported to support clinical diagnosis.

**Aim of the work:** To measure the degree of deflection of the head of the fetus during the first labor stage by the use of ultrasound. To determine whether an ultrasound-derived parameter (the occiput-spine angle) has a relation to the course and the result of the labor.

**Patients and Methods:** This was a possible future research performed from July 2019 to January 2020 at Alhussin Hospital. During the first stage of labor, Trans-abdominal ultrasound was observed in a non-consecutive series of women with simplified singleton pregnancy at gestation time (37 weeks or more). The fetal position was the anterior occiput and, on the sagittal plane, sonographically, an angle was obtained between the fetal occiput and the cervical spine (occiput-spine angle).

**Results:** The mean value of the occiput-spine angle measured during the first stage's active phase was  $126^{\circ} \pm 2.79^{\circ}$  (SD). In women who underwent CS, the occiput-spine angle was substantially narrower due to labor arrest. A larger occiput-spine angle (i.e.,  $>126^{\circ}$ ) has been shown to be significantly linked to a shorter duration of labor.

**Conclusion:** Fetuses with a smaller occiput-spine angle ( $<126^{\circ}$ ) have a higher risk of operative delivery.

**Keywords:** Occiput-Spine Angle; Labor Outcome; First Stage; 2D Dimensional ultrasound.

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### INTRODUCTION

The World Health Organization (WHO) describes normal birth as "spontaneous in onset, low risk in the beginning of labor, and remaining so during labor and delivery." In the vertex position the infant is born spontaneously, between 37 and 42 weeks of pregnancy. At birth, mum and baby are in good health.<sup>1</sup>

The favorable outcome for most pregnancies is spontaneous vaginal delivery, without obstetric intervention. Nonetheless, in the second stage of labor, some women fail to make progress and thus require operative delivery. Management strategies involve primary Cesarean section, instrumental delivery (forceps or vacuum).<sup>2</sup>

In the vertex presentation, the vertex is flexed in such a way that the chin rests on the fetal chest, causing

the suboccipito-bregmatic diameter of around 9.5 cm across the maternal pelvis to be the widest diameter.

This is the smallest of the diameters used to negotiate maternal pelvis.<sup>3</sup>

Deflexed cephalic presentation is an important cause of obstructed labor as a result of labor arrest, accounting for one third of cesarean deliveries.<sup>4</sup>

Traditionally, three types of deflexed cephalic malpresentations, including sinciput, brow, and face, are defined by the degree of head extension.<sup>5</sup>

The accurate determination of the position of the fetal head and the required application of the instrument are an important determinant of the effective and secure use of vacuum and forceps in instrumental delivery. In a high proportion of cases, the correct fetal position is not identified by the digital examination prior to instrumental delivery.<sup>6</sup>

In a recent study, several ultrasound parameters including progression angle, head-symphysis distance and head-perineum distance, showing strong correlations and moderate correlations with each other with the fetal head-station evaluation digital inspection.<sup>7</sup>

Measuring the angle of progression over time can be a predictor of the initiation of spontaneous labor. Women who witnessed spontaneous labor onset

within seven days had a substantially greater angle of progression than those who have undergone labor after seven days. In the next 7 days, a greater angle of progression is an indication of spontaneous labor. The angle of progression is also negatively associated with the length of the cervix and positively associated with the gestational age.<sup>8</sup>

At the first stage of labor, the fetal head attitude (fetal head-to-spin relationship) may have a significant effect on the outcome of labor. Traditionally, the prognosis of deflection of the fetal head is based on the examination of digital labor, even though; ultrasound was recently reported to be used to support clinical diagnosis.<sup>9</sup>

The aim of this research was to measure the degree of fetal head deflexion by the use of ultrasonography during the first labor stage and to quantify whether an ultrasound-derived parameter (the occiput-spine angle) has a relation to the course and the result of the labor. To decrease hazards of obstructed labor which carry risk on both mother and fetus.

### PATIENTS AND METHODS

After ethical committee approval, a total of 200 women of 37 weeks or more with gestational age and one vaginal delivery history were assessed in this study in Alhussin Hospital University by 2 dimensional ultrasound. Examinations were performed after a verbal consent from the patient with the patient lying in the dorsal supine position.

All patients selected for our study were subjected to the following: Verbal informed consent. Full history taking (age, parity, LMP, medical and surgical history). General examination including BMI, vital signs, abdominal and pelvic examination. In the first stage of labor, 2D trans-abdominal ultrasound was performed.

When the anterior occiput is the fetal position and the vertex is the fetal presentation, in the ultrasound machine, the bi-dimensional sagittal image of the fetal head and the upper spine was acquired and processed. The offline angle calculation of the tangential line to the occipital bone and the tangential line to the cervical spine of the first vertebral body (occiput-spine angle) will be performed in this image to determine the degree of flexion of the fetal head relative to the trunk. The sonographer did not engage

in the patient's treatment and was blinded to the ultrasound findings and the occiput-spine angle by the obstetrician in charge. Progress of labor with partogram (cervical dilation, effacement, consistency, position and station) and mode of delivery were evaluated retrospectively for each patient in the study group.

In multipara, extended first stage of labor is characterized as cervical dilatation < 1.5 cm / h for 2 hours while the first stage arrest is characterized as non-progress of cervical dilatation for > 4 hours despite sufficient uterine activity (3-5 contractions per 10 minutes). In multipara, extended second stage of labor is characterized as fetal head descent < 2 cm / h, while the second stage arrest is characterized as no of fetal head fall after one hour, or two hours with epidural analgesia in multipara. Neonatal assessment: Follow up the neonate for Apgar score at 5 min.

Criteria for inclusion: between the ages of 18 and 35 years. BMI is under 30. About 37-42 weeks of gestational age (calculated using LMP or 1<sup>st</sup> trimesteric U/S). Singleton pregnancy. A history of one vaginal deliveries. Occiputo anterior position. Active first stage of labor phase.

Criteria for exclusion: age (under 18 or over 35). Primigravida. Occiputo posterior position. Cesarean section signs such as malpresentations, macrosomia, placenta previa, previous cesarean section. A lot of gestation. Disorders of health, such as hypertension, DM, liver or kidney disease.

Statistical analysis: Statistically the data were described as mean  $\pm$  standard deviation ( $\pm$  SD), median and range, or frequency (number of cases) and, where appropriate, percentage. Numerical variables were compared using the Student t test for independent samples between study groups. For the comparison of categorical data, the Chi-square ( $\chi^2$ ) test was performed. Where the predicted frequency is less than 5, the exact test was used instead. Using the terms sensitivity and specificity, accuracy was represented. The receptor operator characteristic (ROC) analysis was used to determine the optimum cut-off value to be tested for the diagnostic markers. P values below 0.05 were referred to as being statistically significant. All statistical analyses were carried out with SPSS (Statistical Package for the Social Science; SPSS Inc., Chicago, IL, USA) release 15 for Microsoft Windows (2006).

### RESULTS

Labor progress	Angle Group				Total		Chi-square test	
	<126		126 or more		No.	%	$\chi^2$	P
	No.	%	No.	%				
Normal	8	24.2%	148	88.6%	156	78%	68.916	<0.001
Abnormal	25	75.8%	19	11.4%	44	22%		
Total	33	100.0%	167	100.0%	200	100%		

**Table 1:** Comparison between OSA <126 and 126 or more according to labor progress.

This table shows highly statistically significant difference between OSA <126 and 126 or more according to labor progress.

Fetal Complications	Angle Group				Total		Chi-square test	
	<126		126 or more				x2	p
	No.	%	No.	%	No.	%		
No	27	81.8 %	164	98.2 %	192	96.3%	27.316	<0.001
Yes	6	18.2 %	3	1.8%	8	3.8%		
Total	33	100.0%	167	100.0%	200	100.0%		

**Table 2:** Comparison between OSA<126 and 126 or more according to Fetal complications

This table shows highly statistically significant difference between OSA<126 and 126 or more according to fetal complications.

Maternal complications	Angle Group				Total		Chi-square test	
	<126		126 or more				x2	p-value
	No.	%	No.	%	No.	%		
No	18	54.5 %	158	94.6 %	176	88 %	43.781	<0.001
Yes	15	45.5 %	9	5.4 %	24	12 %		
Total	33	100.0%	167	100.0%	200	100%		

**Table 3:** Comparison between OSA<126 and 126 or more according to maternal complications

This table shows highly statistically significant difference between OSA<126 and 126 or more according to maternal complications.

Overall complications	Angle Group				Total		Chi-square test	
	<126		126 or more				x2	p
	No.	%	No.	%	No.	%		
No	14	42.4 %	157	94 %	171	86.0%	60.985	<0.001
Yes	19	57.6 %	10	6 %	29	14.0%		
Total	33	100.0%	167	100%	200	100.0%		

**Table 4:** Comparison between OSA<126 and 126 or more according to Overall

This table shows highly statistically significant difference between OSA<126 and 126 or more according to overall comp.

Complications Type	Angle Group				Total		Chi-square test	
	<126		126 or more				x2	P
	No.	%	No.	%	No.	%		
Cervical tear	1	5.3%	1	10 %	2	6.9 %	.89	0.915
Perineal tear	6	31.5%	4	40 %	10	34.5 %		
Vaginal tear	12	63.2%	5	50 %	17	58.6 %		
Total	19	100.0%	10	100%	29	100.0%		

**Table 5:** Comparison between OSA<126 and 126 or more according to Complication type.

This table shows highly statistically significant difference between OSA<126 and 126 or more according to complication Type.

### DISCUSSION

Diagnosis of the degree of deflexion is generally focused on digital inspection during labor, although the use of ultrasound has recently been documented to support clinical diagnosis.<sup>9</sup>

Arresting development of labor is the leading cause of obstetric involvement, including cesarean delivery and vaginal instrumental delivery.<sup>10</sup>

Maternal hazards of the second-stage cesarean section involve severe hemorrhage, increased risk of

trauma to the bladder, and extension tears at uterine angle contributing to broad ligament hematoma.<sup>1</sup>

Complications of obstructed labor include not getting enough oxygen for the baby that can lead to death. This raises the mother's risk of infection, uterine rupture, or postpartum bleeding.<sup>12</sup>

An Ultrasound-derived parameter (the occiput-spine angle) has a relationship to the path and the labor result.<sup>9</sup>

The objective of this study was to quantify the degree of fetal head deflection by using Ultrasound during the first stage of labor and to determine whether an

ultrasound-derived parameter (the occiput-spine angle) has a relation with the course and outcome of labor.

In the first stage of labor 2D transabdominal ultrasound was performed.

When the anterior occiput is the fetal position and the vertex is the fetal position, the bi-dimensional sagittal image of the fetal head and upper spine is obtained and processed in the ultrasound machine. The offline angle measurement generated in this picture by the tangential line to the occipital bone and the tangential line to the first vertebral body of the cervical spine (occiput-spine angle) shall be used to measure the degree of flexion of the fetal head toward the trunk.

The sonographer did not participate in treatment for the patient and ultrasound findings and occiput-spine angle were blinded by the directing obstetrician. For every study group patient, labor progress that used a partogram (cervical dilation, effacement, consistency, position and station) and delivery mode was retrospectively evaluated.

Our study was done over 200 women aged 18-35 years to correlate between the Occiput- spine angle (OSA) and the outcome of labor regarding the progress of labor, incidence of cesarean section, maternal and fetal complications. We found with decrease Occiput- spine angle there is increase the rate of CS, abnormal progress of labor and increase both maternal and fetal complications. We found that the cutoff value of Occiput- spine angle for safe vaginal delivery was 126.

Regarding labor progress, we found abnormal progress in 75.8% when the OSA was less than 126 while it was 11.4% when the angle was 126 or more which means that with decreasing the angle there is increase the probability of abnormal labor.

Regarding maternal complications, we found that incidence of complication 45.5% when the OSA was less than 126 while it was 5.4% when the angle was 126 or more which means that with decreasing the angle there is increase the probability of maternal complications.

The maternal complications are further specified in to cervical, vaginal and perineal tears which all increased with decrease the OSA angle with special concern to vaginal tear which was found in more than 60% with the angle group <126.

Regarding fetal complication, we found incidence of complication 18.2% when the angle was less than 126 and was 1.2% when the angle was 126 or more which means that with decreasing the angle there is increase the probability of fetal complications especially respiratory distress.

Regarding overall complications, we found its incidence 57.6% when the angle was less than 126 while it was 6% when the angle was 126 or more

which means that with decreasing the angle there is increase the probability of overall complications.

Regarding mode of delivery, we found incidence of Cesarean section 45.5% when the angle was less than 126 while it was 6% when the angle was 126 or more which means that with decreasing the angle there is increase the probability of Cesarean section.

Ghi et al.<sup>9</sup> conducted a study involving a total of 108 pregnant women, 79 subject to unexpected vaginal delivery and 29 due to obstetrical interference (19 cesarean deliveries and 10 vaginal instrumental deliveries).

The mean value was 126 + 9.8 (SD) for the occiput-spine angle measured during the active first stage phase. The occiput-spine angle calculation showed a very good intra-observer ( $r = 0.86$ ; 95% confidence interval [95% CI] (0.80-0.90) and a reasonable-to-good inter observer ( $r = 0.64$ ; 95% CI (0.51-0.74) agreement. Because of labor arrest, the occiput-spine angle in women that have had obstetric interference was much narrower (cesarean or vacuum delivery) (121 + 10.5 vs 127+9.4,  $P = .03$ ). A greater occiput-spine angle width (i.e. > 125) has been shown to be substantially linked to a shorter period of labor (hazard ratio = 1.62; 95% CI 1.07\_2.45;  $P = .02$ ).

The "occiput-spine angle" was defined as a new parameter for sonography to evaluate the deflection of the head of a fetus during labor. Fetuses with a smaller occiput-spine angle (<125\_) have a higher chance of surgical delivery.

There are a lot of studies preceding Ghi et al.<sup>9</sup> trying to correlate between the degree of fetal head deflexion and rate of CS based on clinical finding not ultrasound findings, but they have not been proved to be clinically effective in predicting the occurrence of CS.

This study has limitation regarding occiput posterior presentation which found in more than 25% of case during the first stage of labor.

To sum up we can associate OSA with the abnormal progress of labor which needs obstetric intervention. In fetuses, the degree of deflection of the fetal head in the first stage of labor can be accurately quantified with occiput anterior position by trans abdominal ultrasound. It appears that the occiput-spine angle is substantially related to the hazard of obstetric intervention.

## CONCLUSION

In this study we try to correlate between the OSA and progress of labor, subsequent effect on maternal, fetal complications and rate of cesarean delivery. We found that the best OSA is 126 and below this angle there is increase the incidence of maternal and fetal complication with significant increase in rate of cesarean delivery.

We have seen that, in the first stage of labor, the occiput-spine angle is substantially associated with the risk of obstructed labor compared with spontaneous vaginal delivery, at a similar station, cases requiring obstetric intervention showed a smaller occiput-spine angle, suggesting diminished fetal head flexion. The higher the degree of fetal head deflexion for occiput anterior fetuses, the higher the risk of operative delivery as a result of labor arrest.

It appears from our data that the idea of obstetrics that deflexed fetal behavior could interfere with the descent of the fetal head due to an improvement of the presenting diameter and a relative cephalo pelvic disproportion and in the end; this could raise the risk of arrest at labor and obstetric intervention.

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