

# MEASUREMENT OF FETAL OCCIPUT-SPINE ANGLE DURING THE FIRST STAGE OF LABOR IN PRIMIGRAVIDA AS A PREDICTOR OF THE MODE OF LABOR

By

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## ABSTRACT

**Background:** Fetal head “attitude” (relationship of fetal head to spine) in the first stage of labor may have a substantial impact on labor outcome. The diagnosis of fetal head deflexion traditionally is based on digital examination in labor.

**Objectives:** To quantify the degree of fetal head deflection via the use of Ultrasound during the first stage of labor, and the relationship with the course and outcome of labor.

**Patients and methods:** This was a prospective study conducted at Sayed Galal Hospital, Al-Azhar University from June 2019 to December 2019. Nonconsecutive series of women with uncomplicated singleton pregnancies at term gestation (37 weeks or more) were submitted to trans-abdominal ultrasound during the first stage of labor. Fetal position was occipito-anterior, and the angle between the fetal occiput and the cervical spine (the occiput-spine angle) was sonographically obtained on the sagittal plane. The measurements of the occipito-spine-angle were performed offline by an operator who was blinded to the labor outcome. The intra- and inter observer reproducibility and the correlation between the occipito-spine angle and the mode of delivery were evaluated.

**Results:** A total of 400 pregnant women were recruited, 350 of which underwent a spontaneous vaginal delivery, and 50 were submitted to cesarean delivery. The mean value of the occipito-spine angle measured in the active phase of the first stage was  $126^{\circ} \pm 2.79^{\circ}$  (SD). The occipito-spine angle was significantly narrower in women who underwent CS delivery due to labor arrest. A larger occipito-spine angle (i.e.  $>126^{\circ}$ ) showed to be significantly associated with a shorter duration of labor.

**Conclusion:** Fetuses with smaller occipito-spine angle ( $<126^{\circ}$ ) were at increased risk for operative delivery.

**Keywords:** Fetal Occipito-Spine Angle, First Stage of Labor Primigravida, Ultrasound.

## INTRODUCTION

Worldwide, cesarean section is the most common major procedure done by surgeons (Madsen *et al.*, 2013). Spontaneous vaginal birth without intervention is the ideal route for most pregnancies. Failure of progression in

some women may need some interventions including cesarean or instrumental delivery (Towner *et al.*, 2010).

In the vertex presentation, the vertex is flexed such that the chin rests on the fetal chest, allowing the suboccipito-bregmatic

diameter of approximately 9.5 cm to be the widest diameter through the maternal pelvis. This is the smallest of the diameters to negotiate the maternal pelvis (*Laughon et al., 2012*).

The arrest of labor progression is the leading cause of obstetric interventions, including cesarean delivery and instrumental vaginal delivery (*ACOG, 2012*).

Deflexed head can cause arrest of labor and accounts for 1/3 of cesarean sections performed for that arrest (*Laughon et al., 2012*).

Three varieties of deflexed cephalic mal-presentations traditionally are described according to the degree of head extension, including sinciput, brow, and face (*Kish and Joseph, 2013*).

Failed labor cannot be explained by fetal size only as most cases that experience disproportion have normal range of fetal birth weights. Thus, other factors as head mal-positions and mal-presentations may cause obstruction. These include asynclitism, occiput posterior position, and face and brow presentations (*Cunningham et al., 2014*).

Normally, late in pregnancy, a characteristic attitude is assumed by the fetus. It becomes folded upon itself so that it makes its back markedly convex with a sharply flexed head sharply making the chin in contact with the chest. Abnormalities to that attitude may occur. The fetal head may become progressively extended changing its position from the vertex to face. This results in changing of the vertebral column contour from convex to concave (*Cunningham et al., 2014*).

Apart from major degrees of head deflexion, there are minor degrees that cannot be detected clinically. The use of trans-abdominal ultrasound at the supra-pubic area can detect these minor degrees which may be responsible for abnormal progress of labor (*Ghi et al., 2016*).

**The aim of this study was to** quantify the degree of fetal head deflexion via the use of ultrasonography during the first stage of labor, and to determine whether a parameter derived from ultrasound examination (the occiput-spine angle) has a relationship with the course and outcome of labor.

## PATIENTS AND METHODS

This was a prospective study conducted on total of 400 women with gestational age 37 weeks or more and in primigravida were assessed in this study at Sayed Galal Hospital, Al-Azhar University between June 2019 till December 2019 by 2 dimensional ultrasound. Examinations were performed after a verbal consent from every patient.

These patients were divided into 2 groups: Group I: 333 pregnant women with OSA 126 or more, and Group II: 67 pregnant women with OSA less than 126.

### Inclusion criteria:

1. Age between 18 - 30 years old.
2. BMI was less than 30.
3. The gestational age between 37- 42 weeks (calculated by LMP or 1st trimesteric U/S).
4. Singleton pregnancy.
5. Primigravida.
6. Occipito-anterior position.

7. Active phase of first stage of labor.

**Exclusion criteria:**

1. Age (<18 years old or > 30 years old).
2. Occipito-posterior position.
3. Indications of cesarean section like malpresentations, macrosomia, placenta previa, previous cesarean section.
4. Multiple gestations.
5. Medical disorders like hypertension, DM, liver or renal diseases.

**All patients selected for our study were subjected to the following:**

1. Verbal informed consent.
2. Full history taking (age, parity, LMP, medical and surgical history).
3. General examination including BMI, vital signs, abdominal and pelvic examination.
4. GE E6 Abdominal ultrasound with a probe of 2-5 MHz will be done during the first stage of labor.
5. Ultrasonographic examination was performed transabdominally with the patient in the supine position. The ultrasound transducer was first placed transversely in the suprapubic region of the maternal abdomen. The landmarks depicting fetal position were the fetal orbits for occipito-posterior position, the mid-line cerebral echo for occipito-transverse positions and cerebellum or occiput for occipito-anterior position. For the latter, the fetal spine was demonstrated in its sagittal plane and traced from the fetal thorax to the occiput.

6. The occiput-spine angle was measured three times through the latent and the active stage of labor. A sagittal plane showing both the fetal head and spine was obtained. Three images were taken by one investigator. The angle between two tangential lines to occipital bone and the vertebral body of the first cervical spine was measured three times and the mean was taken.

7. The sonographer was not involved in the patient's care, and the managing obstetrician was blinded to the ultrasound findings and the occiput-spine angle. For each patient of the study group, the progress of labor using a partogram (cervical dilation, effacement, consistency, position and station) and the mode of delivery were assessed retrospectively.
8. Prolonged first stage of labor was defined as cervical dilation <1.2 cm/h in primigravida for 3 hours while arrest of the first stage was defined as non-progression of cervical dilation for > 4 hours despite adequate uterine activity (3-5 contractions every 10 minutes).
9. Prolonged second stage of labor was defined as fetal head descent <1 cm/h in nullipara while arrest of the second stage was defined as lack of fetal head descent after two hour, or three hours with epidural analgesia in nullipara.
10. Neonatal assessment: Follow up the neonate for Apgar score at 5 min.

**Statistical Analysis:**

All statistical calculations were done using computer program SPSS (Statistical Package for the Social Sciences; SPSS

Inc., Chicago, IL, USA) release 22 for Microsoft Windows (2000). Data were statistically described in terms of frequencies (number of cases) and percentages. For comparing data, Chi-square (X<sup>2</sup>) test was performed. Accuracy was represented using the terms

sensitivity, and specificity. Receiver operator characteristic (ROC) analysis was used to determine the optimum cut off value for the studied diagnostic markers. p values less than 0.05 was considered statistically significant.

## RESULTS

A total of 400 women participated in the study, whose age ranged between 18-30 years old 90% of our cases were  $\leq$  25 years old and 10% were over 25 years old. All patients were with history of vaginal delivery (100%). Those patients were divided into 2 groups: Group I was: 333 pregnant women with OSA 126 or more,

and Group II: 67 pregnant women with OSA less than 126.

The influence of OSA on progress of labor was compared between the 2 groups regarding the incidence of maternal, fetal complications and mode of delivery (**Table 1**).

**Table (1): Demographic characteristics of pregnant women in this study**

Characteristics		Percentage (%)
BMI	18-24.9 kg/m <sup>2</sup>	30%
	25-30 kg/m <sup>2</sup>	70%
Age	18-25 years	90%
	> 25-30 years	10%
Parity	Primigravida	100%

There were statistically significant differences between OSA<126 and 126 or more according to labor progress, mode of

delivery, and fetal complications (**Table 2**).

**Table (2): Comparison between OSA <126 and 126 or more according to labor progress, mode of delivery and fetal complications**

Parameters		Angle Group				Total		P
		<126		126 or more		No.	%	
		No.	%	No.	%			
Labor progress	Normal	15	22.4%	294	88.3%	309	77.3%	<0.001
	Abnormal	52	77.6%	39	11.7%	91	22.8%	
Mode of delivery	CS	31	46.3%	19	5.7%	50	12.5%	<0.001
	VD	36	53.7%	314	94.3%	350	87.5%	
Fetal Complications	No	54	80.6%	331	99.4%	385	96.3%	<0.001
	Yes	13	19.4%	2	0.6%	15	3.8%	
Total		67	100.0%	333	100.0%	400	100.0%	

There were statistically significant difference between OSA<126 and 126 or more according to maternal complications, overall complications and complication types (Table 3).

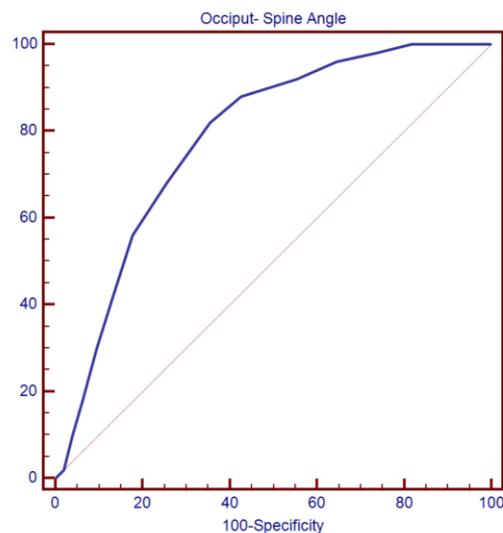
**Table (3): Comparison between OSA<126 and 126 or more according to maternal complications, overall complications and complication type.**

Angle Group		<126		126 or more		Total		p-value
		No.	%	No.	%	No.	%	
Maternal complications	No	37	55.2%	317	95.2%	354	88.5%	<0.001
	Yes	30	44.8%	16	4.8%	46	11.5%	
Overall complications	No	24	35.8%	315	94.6%	344	86.0%	<0.001
	Yes	43	64.2%	18	5.4%	56	14.0%	
Complications Type	Cervical tear	2	6.7%	1	6.3%	3	6.5%	0.874
	Perineal tear	9	30.0%	6	37.5%	15	32.6%	
	Vaginal tear	19	63.3%	9	56.2%	28	60.9%	

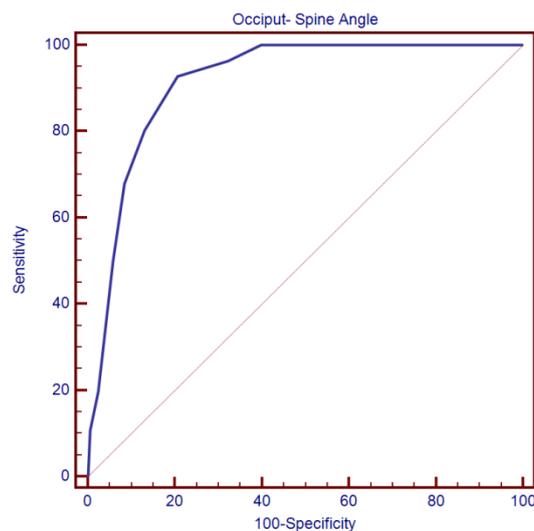
Receiver operating characteristics (ROC) curve was used to define the best cut off value of occiput-spine angle which was  $\leq 126$ , with sensitivity of 93% specificity of 79% positive predictive value of 52%, and negative predictive value of 98.6% with diagnostic accuracy of 92% (Table 4 & Figures 1, 2).

**Table (4): Diagnostic Performance of occiput-spine angle in Discrimination of CS & NVD and overall complications**

	Cut-off	Sen.	Sp.	PPV	NPV	Accuracy
CS & NVD	<126	82%	64.6%	45%	96.2%	78.4%
Overall complications	<126	93%	79%	52%	98.6%	92%



**Figure (1): ROC curve “sensitivity and specificity” diagnostic Performance of occiput-spine angle in Discrimination of CS and NVD**



**Figure (2): ROC curve “sensitivity and specificity” diagnostic Performance of occiput-spine angle in discrimination of overall complications**

## DISCUSSION

The diagnosis of the degree of deflexion is traditionally based on digital examination during labor, although the use of ultrasound to support clinical diagnosis has been reported (*Ghi et al., 2012*). The arrest of labor progression is the leading cause of obstetric interventions, including cesarean delivery

and instrumental vaginal delivery (*Cahill and Caughey, 2014*).

The maternal risks of second-stage cesarean section include major hemorrhage, greater risk of bladder trauma, and extension tears of the uterine angle leading to broad ligament hematoma (*Rane et al., 2010*). Complications of obstructed labor for the baby include not getting enough oxygen which may result

in death. It increases the risk of the mother getting an infection, having uterine rupture, or having post-partum bleeding (Neilson *et al.*, 2010).

A parameter derived from ultrasound examination (the occiput-spine angle) has a relationship with the course and outcome of labor (Ghi *et al.*, 2016).

The aims of this study were to quantify the degree of fetal head deflection via the use of ultrasound during the first stage of labor and to determine whether a parameter derived from ultrasound examination (the occiput-spine angle) has a relationship with the course and outcome of labor. 2D transabdominal ultrasound was done during the first stage of labor.

If fetal position was occipito-anterior and fetal presentation was vertex, two-dimensional sagittal picture of the fetal head and upper spine was acquired and stored in the ultrasound machine. On this image, the offline measurement of the angle formed by a line tangential to the occipital bone and a line tangential to the first vertebral body of the cervical spine (occipito-spine angle) was performed to quantify the degree of fetal head flexion in respect to the trunk.

The sonographer was not involved in the patient's care and the managing obstetrician was blinded to the ultrasound findings and the occiput-spine angle. For each patient of the study group, the progress of labor using a partogram (cervical dilation, effacement, consistency, position and station) and the mode of delivery were assessed retrospectively.

We found with decrease occiput- spine angle, there was an increase in the rate of CS, abnormal progress of labor and increase both maternal and fetal complications. The cutoff value of Occiput- spine angle for safe vaginal delivery was 126.

Regarding labor progress, we found abnormal progress in 77.6% when the OSA was less than 126, while it was 11.6% 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 44.8% when the OSA was less than 126 while it was 4.8% 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 19.4% when the angle was less than 126 and was 0.6% 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 56.7% when the angle 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 overall complications.

Regarding mode of delivery, we found incidence of cesarean section 46.3% when the angle was less than 126 while it was 5.7% 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. (2016)* found that the mean value of the occiput-spine angle measured in the active phase of the first stage was  $126 \pm 9.8$  (SD). The occiput-spine angle measurement showed a very good intraobserver, and a fair-to-good inter observer agreement. The occiput-spine angle was significantly narrower in women who underwent obstetric intervention (cesarean or vacuum delivery) due to labor arrest. A larger occiput-spine angle width (i.e.,  $>125^\circ$ ) showed to be significantly associated with a shorter duration of labor.

There are a lot of studies preceding *Ghi et al. (2016)* trying to correlate between the degree of fetal head deflexion and rate of CS based on clinical finding not ultrasound findings but They were not proven to be clinically useful in predicting the occurrence of CS.

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

## CONCLUSION

The best OSA was 126 and below this angle there was an increase on the incidence of maternal and fetal complication with significant increase in rate of cesarean delivery. The occiput-spine angle in the first stage of labor

correlated significantly with the risk of obstructed labor Compared with spontaneous vaginal deliveries. Cases that required obstetric intervention demonstrated a smaller occiput-spine angle at a similar station, suggesting diminished flexion of the fetal head. For occiput anterior fetuses, the greater the degree of fetal head deflexion, the greater risk of operative delivery due to labor arrest.

Our data supported the obstetric notion that a deflexed fetal attitude may interfere with the fetal head descent because of an increase of the presenting diameter and a relative cephalo-pelvic disproportion, and this may ultimately increase the risk of arrested labor and obstetric intervention.

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## قياس زاوية مؤخرة الرأس والعمود الفقري للجنين خلال المرحلة الأولى من الولادة في الحامل أول مرة وعلاقتها بطريقة الولادة

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**خلفية البحث:** تعتبر عملية الولادة عملية فسيولوجية يتم خلالها طرد منتجات الحمل (أي الجنين والأغشية والحبلى السري والمشيمة) خارج الرحم. ويحدث المخاض من خلال تغيرات في الأنسجة الضامة البيوكيميائية ومع التوسع التدريجي لعنق الرحم نتيجة لانقباضات الرحم الإيقاعية المتزايدة في التردد والكثافة والمدة.

**الهدف من البحث:** تحديد درجة إنحراف رأس الجنين عن طريق استخدام الموجات فوق الصوتية خلال المرحلة الأولى من الولادة وتحديد ما إذا كانت النتائج المشتقة من فحص الموجات فوق الصوتية (زاوية العمود الفقري) لها علاقة بتقدم المخاض، والأثر اللاحق على مضاعفات الأم والجنين ومعدل الولادة القيصرية.

**المريضات و طرق البحث:** إشتملت هذه الدراسة على 400 سيدة حامل يتراوح عمرها ما بين 18 سنة و 30 سنة لدراسة زاوية مؤخر الرأس والعمود الفقري للجنين خلال المرحلة الأولى من الولادة باستخدام الموجات فوق الصوتية وتأثيرها على المضاعفات التي تحدث للأم و الطفل ومعدلات الولادة القيصرية.

**نتائج البحث:** وجد مع زيادة هذه الزاوية قلة معدلات الولادة القيصرية و ثقل مضاعفات الأم والجنين بينما عندما تقل هذه الزاوية تتزايد معدلات الولادة القيصرية وتتزايد المضاعفات التي قد تحدث للأم والجنين، حيث وجد مع زيادة هذه الزاوية عن 126 أن معدل القيصرات كان 5.7%. وكانت المضاعفات التي تحدث للأم بنسبة 4.8%. وكانت نتيجة المضاعفات التي تحدث للجنين 0.6%. وقد وجد مع نقص هذه الزاوية عن 126 أن معدل القيصرات كان 46.3% وكانت المضاعفات التي تحدث للأم بنسبة أكثر من 60%. وكانت المضاعفات التي تحدث للجنين 19.4%.

**الاستنتاج:** دراسة زاوية مؤخر الرأس والعمود الفقري للجنين باستخدام الموجات فوق الصوتية قد يكون فعال في تقليل المضاعفات الناتجة عن الولادة.

**الكلمات الدالة:** زاوية مؤخر الرأس والعمود الفقري للجنين، المرحلة الأولى من الولادة الأولية.