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Association between fetal occiput position and fetal spine following induction of labour (IOL) and birth outcomes : a prospective study

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Abstract

Objective: This study aims to clarify whether the sonographic assessment of the fetal occipital and spine positions before a labour induction and during labour are related to delivery outcomes.

Methods: This prospective study involved 350 women carrying singleton normal fetuses in cephalic presentation, wherein fetal occiput and fetal spine positions were initially assessed via transabdominal ultrasound before induction of labour. Subsequently, these positions were reevaluated during the first stage of labour, while monitoring labour progress conventionally. Delivery mode and both maternal and fetal outcomes were then carefully documented and analysed.

Results: Induction was conducted using dinoprostone (prostin E2) or Pitocin, chosen based on cervical favourability. Before the induction of labour, 24.3% of fetuses were observed in the occiput posterior position, while 16.3% were noted to be in the posterior spine position. During the first stage of labour, fetal occipital posterior and fetal spine posterior positions were documented at 16.1% and 10.3%, respectively. A significant association was found between fetal occiput and spine positions during the first stage of labour and various obstetric outcomes, including mode of delivery, duration of labour, the incidence of postpartum hemorrhage, and admission to neonatal intensive care. ($p< 0.05$).

Conclusion: The presence of fetal occipitoposterior position and fetal spine posterior during the first stage of labour after induction of labour is linked to an increased likelihood of caesarean section. Moreover, a significant correlation was found between the fetal occiput and spine positions during the first stage of labour and the duration of labour, as well as the occurrence of postpartum haemorrhage and admission to the neonatal intensive care unit.

Keywords: Induction of labour, occipitopoterior position, fetal spine position

Introduction

Induction of labour (IOL) occurs in approximately 20 to 25% of births, making it one of the most common interventions in obstetrics.[1,2] With each instance of labour induction, clinicians endeavour to predict the likelihood of successful vaginal delivery. While fetal occiput position and its relationship with the fetal spine before IOL have been considered for such predictions, studies have shown inconsistent correlations with the mode of delivery [3-5], leading to their non-recommendation.

The position of the fetal occiput during labour is regarded as a crucial factor in determining the feasibility of vaginal delivery. Malposition of the presenting head during early labour can significantly impact the progression of labour. A persistent occiput posterior position during labour often necessitates instrumental or caesarean delivery, increasing the risks of maternal and fetal complications.[5-10] Conversely, some studies have suggested that malrotation during labour, transitioning from an occiput anterior (OA) or occiput transverse (OT) position to occiput posterior (OP), may occur.[4,11]

The positioning of the fetal head at the pelvic brim and its alignment with the corresponding fetal spine before the onset of labour can undergo variations that may persist or change as labour progresses through its stages. The occurrence of occipital positional changes before labour is often attributed to fetal heads that have not yet engaged.[3] Particularly in primiparous and multiparous individuals, non-engaged fetal heads may eventually as-

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sume various occiput positions, predominantly in the OT position, upon the onset of contractions as they gradually descend into the pelvic inlet. Depending on the initial occiput position within the pelvic cavity and the strength of contractions, along with the associated fetal spine position, further rotation of the occiput will occur until delivery. Achieving rotation to the OA position is crucial for facilitating a successful and uncomplicated vaginal delivery.

Ultrasound is an essential and reliable tool for determining the position of the fetal occiput and spine before IOL and both during the first and second stages of labour, as demonstrated by numerous studies.[3–6,9,10,13,14]

The fetal spine position during labour serves as an additional predictor of successful vaginal delivery and offers valuable insights for obstetrical management and counselling.[12] Specifically, the presence of a posterior fetal spine position during the second stage of labour is recognised as a diagnostic indicator for predicting OP position at birth.[9] Thus, this study aims to clarify whether the sonographic assessment of the fetal occipital and spine positions before labour induction and during labour correlates to delivery outcomes.

Methods

Between September 2017 and September 2018, we conducted a prospective study at Hospital Universiti Sains Malaysia (USM), Malaysia. All eligible women in the antenatal ward, scheduled for IOL due to various medical indications were invited to take part in the study. Out of the total invited, 350 women chose to participate. Inclusion criteria comprised the presence of a live, singleton fetus at term without known abnormalities, with labour induced using Dinoprostone (Prostin E2 3mg) or Oxytocin synthetic (Pitocin). Exclusion criteria encompassed multiple pregnancies, preterm delivery, nuchal cord, intrauterine fetal demise, planned elective caesarean section, previous uterine scar, antepartum haemorrhage and non-reassuring CTG. This study was ethically approved by the Human Research Ethics Committee (JEPeM Code: USM/JEPeM/ 17050260)

Eligible participants who consented to participate were provided with verbal explanations regarding their role as subjects and the study's objective. A demographic and biophysical profile, including maternal parity, age, ethnicity, height, weight and body mass index, was documented during the initial pregnancy booking stage. Participants were furnished with information and allowed to seek clarification on any queries. Those who agreed to participate were then asked to sign a triplicate consent form. Participants were informed that they might be deemed ineligible later if abnormalities were detected in the fetus or if a non-cephalic presentation was identified.

Before IOL, a transabdominal ultrasound examination was conducted to ascertain the fetal head and spine positions. The same operator performed both ultrasound assessments using a portable Mindray with a 3.5 MHz probe.

For patients with an unfavourable cervix, IOL is initiated using dinoprostone administered vaginally, and inserted at the posterior fornix. An hour after dinoprostone insertion, a cardiotocography (CTG) examination is performed to assess fetal well-being, and the findings are reviewed by the respective ward doctor. The patient is then scheduled for review after the onset of regular uterine contractions or 6 hours post dinoprostone insertion, whichever comes first. If, upon review, the cervix is found to be favourable, the patient is transferred to a labour room for artificial rupture of membrane. However, if at the 6-hour mark, the cervix remains unfavourable, a second dinoprostone insertion is carried out. The total cumulative dose of dinoprostone allowed does not exceed 6 mg. Patients with favourable cervix but inadequate or absent contractions underwent artificial rupture of the membrane in conjunction with a titrated infusion of pitocin to induce labour. The dosage of Pitocin infusion was according to the hospital protocol. The aim is to achieve satisfactory, strong, regular contractions of the uterus.

The second ultrasound was performed on the patient upon admission to the labour room and during the first stage of labour. The fetal head and spine positions obtained from the initial ultrasound examinations before IOL and during the first stage of labour were documented on the study form. Labour progression was monitored until the delivery of the baby. There was no manual rotation of the fetal head involved during the first or second stage of labour. Additionally, there was no preference for maternal position following the ultrasound assessment during the first stage of labour. The mode of delivery and associated outcomes were then recorded.

Data on the mode of delivery, pitocin augmentation, analgesia, duration of the first stage of labour, analgesic use, retained placenta, postpartum haemorrhage, Apgar score, birth weight and neonatal intensive care unit (NICU) admission were meticulously recorded. Subsequently, all data were entered into an Excel Spreadsheet and transferred to SPSS for comparative statistical analysis.

The fetal occiput position was determined using a transabdominal ultrasound examination. The ultrasound transducer is positioned in the transverse plane over the maternal abdomen. A transverse view of the fetal trunk is obtained at the level of the fetal upper abdomen or the four-chamber view of the heart. Subsequently, the ultrasound transducer is moved downwards until the suprapubic region is reached, allowing visualisation of the fetal head. The intracranial structures, such as the paired thalami, cranial midline and cerebellum, were identified. The midline of the fetal brain is indicated by the arrowhead on the transverse view, pointing from the occiput to the sinciput.[13,15] The position of the fetal occiput is categorised according to the orientation of the skull shape and its midline relative to the patient's pelvis. The presence of fetal orbit on ultrasound indicates an occiput posterior position.[13] Eight fetal occiput positions were categorised as follows: direct occipito-anterior (DOA), left occipito-anterior (LOA), right occipito-anterior (ROA), left occipito-transverse (LOT), direct occipito-posterior (DOP), left occipito-posterior (LOP), right occipito-posterior (ROP), right occipito-transverse (ROT).[10]

Following the identification of the fetal occiput position using ultrasound, the operator marked this position on a diagram located on the ultrasound examination study form. An example of this process, including an ultrasound finding a completed diagram, is depicted below (Figures 1 & 2). It's important to note that the diagram considers the maternal pelvis as a constant reference point, facilitating the operator's marking of the cranial midline and enabling precise identification of the fetal occipital position. Once the occiput was accurately defined, the operator proceeded to identify the spine position.

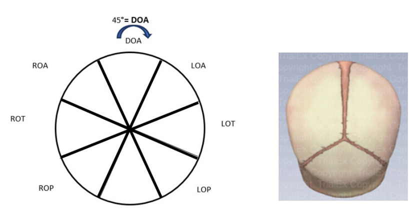

Fig 1. Classification of fetal occiput position within the 360° pelvic cavity

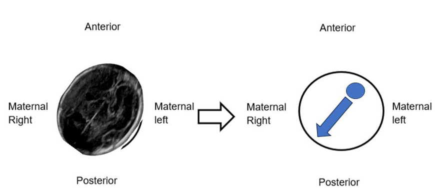

Fig 2. Recording the fetal occiput position

To determine the fetal spine position, the ultrasound transducer is positioned horizontally on the maternal abdomen to obtain a transverse view of the fetal trunk, typically at the level of the upper fetal abdomen or the four-chamber view of the heart.[6,13] The fetal spine position is then categorised according to its orientation relative to the patient's abdomen and recorded as follows: direct spine anterior (DspA), left spine anterior (LspA), left spine lateral (LspL), left spine posterior (LspP), direct spine posterior (DspP), right spine posterior (RspP), right spine lateral (RspL), right spine anterior (RspA). The position of the fetal spine is determined and marked on the ultrasound examination study form diagram based on the 360-degree relations of the abdominal cavity, as illustrated in Figures 3 & 4. Specifically, when the spine is visualised beneath the scanning transducer, It is designated as direct spine anterior. The fetal spine position is marked with an X on the ultrasound examination study form diagram.

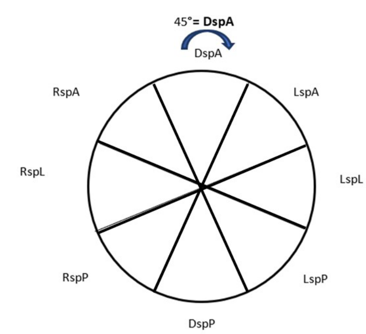

Fig 3. Classification of fetal spine position within the 360° abdominal cavity

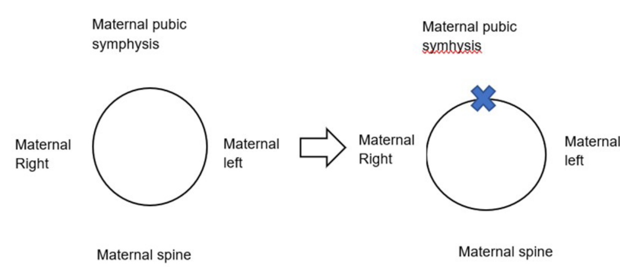

Fig 4. Recording the fetal spine position

The primary outcome of the study was the mode of delivery. Before commencement, a power calculation for chi-square analysis was conducted using PS-Power and Sample Size software. Based on this calculation, a total sample size of 334 (considering a 10% dropout rate) was determined to detect an incidence of caesarean section of

19% in the posterior fetal occiput position group and an estimated 8% in the other group, with 80% power and a 95% confidence level.[6]

All data analysis and entry were performed using Social Science and Statistical Package (SPSS) version 24.0 software licensed to Universiti Sains Malaysia. Descriptive statistical procedures were employed to analyse the data. Means with standard deviation (SD) and frequency (%) were utilised to describe the distribution of variables regarding maternal characteristics before labour induction. The chi-square test was employed to investigate the association between occiput position and spine position with birth outcomes among pregnant women during induction and each stage of labour at Hospital USM. Additionally, factors such as patient age, Body Mass Index (BMI), parity, birth weight and duration of the first stage of labour were included in the analysis.

Results

In this study, a total of 350 patients were enrolled, with primigravida mothers, also known nulliparous women (pregnant for the first time and have never given birth before) comprising almost half (49.4%) of the IOL cases, followed by multiparous (women who have given vaginal birth to two or more children) (32.0%) and Gravida2 Para1 (G2P1; women who are in second pregnancy and have given vaginal birth to a child before) (18.6%) individuals. Approximately 66.6% of the patients in this study delivered at 39 to 40+6 weeks of gestation (Table 1).

Table 2 illustrates that before IOL, the most prevalent fetal occiput position was OT at 44.3%, OA at 31.4%, and OP at 24.3%. During the first stage of labour, the most common fetal occiput position remained OT position at 49.0% or 161 fetuses, 92 fetuses (28.0%) with LOT position, and 69 fetuses (21.0%) with ROT position. OA position was observed in 35.0% of cases, while OP position was identified in 16.0%.

Before IOL, the most prevalent fetal spine position was lateral with 156 (44.6%) out of 350 fetuses. During the first stage of labour, the most common fetal spine position was anterior in 156 out of 329 fetuses (47.4%), with fetal spine position left anterior (LspA) in 68 fetuses or 20.7%. Fetal spine lateral was seen in 139 (42.2%) and spine posterior in 34 (10.3%) fetuses respectively.

A significant association was found between fetal occiput positions and the mode of delivery during the first stage of labour ($p<0.001$)(Table 3). Table 3 shows that 77.3% of OA positions during the first stage of labour gave spontaneous vaginal birth, in 85 out of 110 patients. The number of fetal OP positions during the first stage of labour was lower compared to before IOL (85 vs 53 cases), indicating that several OP positions transitioned to other positions during the first stage of labour. Furthermore, 15.1% of total fetal OP positions during the first stage of labour were delivered via emergency lower segment cesarean section, in 8 out of 53 patients. It is the highest percentage compared to the other positions. In comparison, 7.5% of total fetal OP positions were delivered via instrumental vaginal delivery, in 4 out of 53 patients.

Table 1. Maternal characteristics prior the induction of labour (n=350)

Socio-demographic characteristics	Frequency n (%)
Parity	
Primigravida	173 (49.4)
Gravida 2 Para 1 (G2P1)	65(18.6)
Multiparous	112 (32.0)
Age group (years)	
≤ 20	5 (1.4)
21 – 25	75 (21.4)
26 – 30	161 (46.0)
31 – 35	71 (20.3)
>36	38 (10.9)
BMI	
Underweight (<18.0 kg/m2)	13 (3.7)
Normal (18.0-24.9 kg/m2)	139 (39.7)
Overweight (25-29.9 kg/m2)	115 (32.9)
Obesity Class 1 (30.0-34.9kg/m2)	61 (17.4)
Obesity Class 2 (35.0-39.9kg/m2)	14 (4.0)
Obesity Class 3 (>40kg/m2)	8 (2.3)
Gestational age on delivery (weeks)	
37-38 + 6	85 (23.3)
39-40 + 6	243 (66.6)
41-41+6	22 (6.0)
≥42	0

Table 2. Fetal occiput and spine position on ultrasound examination prior to induction of labour and during first stage of labour

Fetal occiput position on ultrasound n(%)	Fetal spine position on ultrasound n (%)								TOTAL n(%)
	Spine anterior			Spine lateral		Spine posterior			
Prior to induction of labour	DspA	RspA	LspA	RspL	LspL	DspP	RspP	LspP	
Occiput anterior		79(22.5)		29(8.3)			2(0.6)		110 (31.4)
DOA	2(0.6)	3(0.9)	1(0.3)	0	0	0	0	0	
ROA	9(2.6)	13(3.7)	5(1.4)	12(3.4)	0	0	2(0.6)	0	
LOA	12(3.4)	1(0.3)	33(9.4)	1(0.3)	16(4.6)	0	0	0	
Occiput transverse		47(13.4)		94(26.9)			14(4.0)		155(44.3)
ROT	3(0.9)	10(2.8)	2(0.6)	31(8.8)	3(0.9)	0	6(1.7)	1(0.3)	
LOT	3(0.9)	1(0.3)	28(8.0)	1(0.3)	59(16.9)	0	2(0.6)	5(1.4)	
Occiput posterior		11(3.1)		33(9.4)			41(11.7)		85(24.3)
DOP	0	0	0	1(0.3)	0	4(1.1)	0	0	
ROP	0	4(1.1)	0	15(4.3)	1(0.3)	5(1.4)	19(5.4)	2(0.6)	
LOP	0	0	7(2.0)	1(0.3)	15(4.3)	2(0.6)	0	9(2.6)	
TOTAL		137(39.1)		156(44.6)			57(16.3)		100%
During first stage of labour									
Occiput anterior		84(25.5)		30(9.1)			1(0.3)		115(35.0)
DOA	10(3.0)	4(1.2)	4(1.2)	0	2(0.6)	0	0	0	
ROA	8(2.4)	14(4.2)	2(0.6)	9(2.7)	2(0.6)	0	0	0	
LOA	15(4.5)	3(0.9)	24(7.3)	0	17(5.2)	0	0	1(0.3)	
Occiput transverse		63(19.1)		83(25.2)			15(4.6)		161(49.0)
ROT	5(1.5)	15(4.6)	1(0.3)	31(9.4)	5(1.5)	0	12(3.6)	0	
LOT	11(3.3)	0	31(9.4)	1(0.3)	46(14.0)	0	1(0.3)	2(0.6)	
Occiput posterior		9(2.7)		26(7.9)			18(5.4)		53(16.0)
DOP	0	0	0	0	0	1(0.3)	0	1(0.3)	
ROP	0	3(0.9)	0	12(3.6)	1(0.3)	0	10(3.0)	0	
LOP	0	0	6(1.8)	0	13(3.9)	1(0.3)	0	5(1.5)	
TOTAL		**156(47.4)**		**139(42.3)**			**34(10.3)**		100%
Not Related									21

Table 3. Mode of delivery with fetal occiput position on ultrasound examination prior to induction of labour and during first stage of labour

Fetal occiput position	Mode Of Delivery, n(%)				TOTAL (n)%	p-value
	SVD	IVD		EMLSCS		
		VD	FD			
Prior To Induction Of Labour						0.393[a]
Occiput anterior	85(24.3)	9(2.5)		16(4.6)	110(31.4)	
DOA	5(1.4)	1(0.3)	0	0	6	
ROA	31(8.9)	4(1.1)	0	6(1.7)	41	
LOA	49(14.0)	1(0.3)	3(0.9)	10(2.8)	63	
Occiput transverse	127(36.3)	5(1.4)		23(6.6)	155(44.3)	
ROT	42(12.0)	3(0.9)	0	11(3.1)	56	
LOT	85(24.3)	2(0.6)	0	12(3.4)	99	
Occiput posterior	67(19.1)	3(0.9)		15(4.3)	85(24.3)	
DOP	3(0.9)	0	0	2(0.6)	5	
ROP	37(10.6)	4(1.1)	0	5(1.4)	46	
LOP	27(7.7)	1(0.3)	0	7(2.0)	34	
	279(79.7)	17(4.9)		54(15.4)	350 (100)	
During First Stage Of Labour						<0.001[b]
Occiput anterior	106(32.2%)	6(1.8)		3(0.9)	115(34.9)	
DOA	19(5.8)	1(0.3)	0	0	20	
ROA	32(9.7)	2(0.6)	0	1(0.3)	35	
LOA	55(16.7)	2(0.6)	1(0.3)	2(0.6)	60	
Occiput transverse	132(40.1)	7(2.1)		22(6.7)	161(48.9)	
ROT	52(15.8)	4(1.2)	0	13(4.0)	69	
LOT	80(24.3)	1(0.3)	2(0.6)	9(2.7)	92	
Occiput posterior	41(12.5)		4(1.2)	8(2.4)	53(16.1)	
DOP	1(0.3)	1 (0.3)	0	0	2	
ROP	19(5.8)	2(0.6)	0	5(1.5)	26	
LOP	21(6.4)	1(0.3)	0	3(0.9)	25	
	279(84.8)	17(5.2)		33(10.0)	329(100)	
Not related					21	

*LSCS for failed induction

The incidence of caesarean delivery and instrumental vaginal delivery was highest among cases with a posterior spine position during the first stage of labour, accounting for 29.4% of EMLSCS (10 out of 34 patients) and 5.9% of instrumental vaginal delivery (2 out of 34 patients). (Table 4). Furthermore, there was a significant association between the fetal occiput and spine positions during the first stage of labour and the incidence of EMLSCS with a p-value <0.001.

Table 4. Mode of delivery in relation to fetal spine position on ultrasound examination prior to induction of labour and during first stage of labour

Fetal Spine Position	Mode Of Delivery, n(%)				TOTAL n(%)	p-value
	SVD	IVD		EMLSCS		
		VD	FD			
Prior To IOL						0.250[b]
Spine anterior	117(33.4)	6(1.7)		14(4.0)	137(39.1)	
DspA	25(7.1)	1(0.3)	0	3(0.9)	29	
RspA	28(8.0)	1(0.3)	0	3(0.9)	32	
LspA	64(18.3)	2(0.3)	2(0.6)	8(2.3)	76	
Spine lateral	117(33.4)	8(2.3)		31(8.9)	156(44.6)	
RspL	39(11.1)	5(1.4)	0	18(5.1)	62	
LspL	78(22.3)	2(0.6)	1(0.3)	13(3.7)	94	
Spine posterior	45(12.9)	3(0.9)		9(2.6)	57(16.3)	
DspP	9(2.6)	0	0	2(0.6)	11	
RspP	21(6.0)	3(0.9)	0	5(1.4)	29	
LspP	15(4.3)	0	0	2(0.6)	17	
	279 (79.7)	**17(4.9)**		**54(15.4)**	**350(100)**	
During First Stage Of Labour						<0.001[b]
Spine anterior	140(42.6)	8(2.4)		8(2.4)	156(47.4)	
DspA	45(12.9)	2(0.6)	0	2(0.6)	49	
RspA	33(9.4)	3(0.9)	0	3(0.9)	39	
LspA	62(17.7)	1(0.3)	2(0.6)	3(0.9)	68	
Spine lateral	117(35.6)	7(5.0)		15(10.8)	139(42.2)	
RspL	43(13.1)	3(0.9)	0	7(2.1)	53	
LspL	74(22.5)	3(0.9)	1(0.3)	8(2.4)	86	
Spine posterior	22(6.3)	2(0.6)		10(3.0)	34(10.3)	
DspP	1(0.3)	1(0.3)	0	0	2	
RspP	14(4.3)	1(0.3)	0	8(2.4)	23	
LspP	7(2.1)	0	0	2(0.6)	9	
	279(84.8)	**17(5.2)**		**33(10.0)**	**329(100)**	
Not related					21	

During the first stage of labour, the vast majority of OA positions,112 out of 115 patients (97.4%) were delivered via vaginal delivery (VagD), followed by 139 out of 161 patients (86.3%) of OT positions and 45 out of 53 patients (84.9%) of OP positions (Table 5). Notably, the incidence of EMLSCS was highest among cases with posterior spine position at 29.4%, in 10 out of 34 patients, whereas only 5.1%, in148 out of 156 patients of anterior spine positions were delivered via EMLSCS.

Table 5. The associations between fetal occiput and spine positions and birth outcomes based on ultrasound examination prior to IOL and during first stage of labour

Variable	Birth Outcomes, n (%)			P-Value
	$V_{ag}D$	NON-$V_{ag}D$	TOTAL	
Prior To IOL				
Occiput				0.807[a]
Anterior	94(26.8)	16(4.6)	110(31.4)	
Transverse	132(37.7)	23(6.6)	155(44.3)	
Posterior	70(20.0)	15(4.3)	85(24.3)	
		Total:	350(100%)	
Spine				0.074[a]
Anterior	123(35.1)	14(4.0)	137(39.1)	
Lateral	125(35.7)	31(8.9)	156(44.6)	
Posterior	48(13.7)	9(2.6)	57(16.3)	
		Total:	350(100%)	
During First Stage Of Labour				
Occiput				<0.001[a]
Anterior	112(34.0)	3(0.9)	115(35.0)	
Transverse	139(42.2)	22(6.7)	161(48.9)	
Posterior	45(13.7)	8(2.4)	53(16.1)	
		Total:	329(100%)	
Spine				<0.001[a]
Anterior	148(45.0)	8(2.4)	156(47.4)	
Lateral	124(37.7)	15(4.6)	139(42.3)	
Posterior	24(7.3)	10(3.0)	34(10.3)	
		Total:	329(100%)	
Not related			21	-

Note:- * Mean with SD, all values are in frequency and percentage. a: Pearson Chi- Square, b: Fisher exact test

Spontaneous vaginal delivery and instrumental vaginal delivery were categorized as vaginal delivery ($V_{ag}D$). Non-$V_{ag}D$ represents EMLSCS.

Significant associations were observed between the fetal occiput positions during the first stage of labour and several delivery-related factors, including mode of delivery (p<0.001), use of Pitocin during labour (p=0.02), duration of the first stage of labour (p<0.001), and the postpartum haemorrhage (PPH) (p<0.05). However, no significant difference was found in the occurrence of perineal tears among the study groups (Table 6).

Similarly, significant associations were found between fetal spine positions and various delivery-related factors, including mode of delivery (p<0.001), use of Pitocin during labour (p=0.018), duration of the first stage of labour (p<0.001), and PPH (p<0.001) (Table 7). The rates of EMLSCS were highest among cases with posterior spine position with 29.4%, in 10 out of 33 patients, compared to lateral and anterior spine positions with 10.8% (in 15 patients) and 5.1% (in 8 patients), respectively. Moreover, the use of Pitocin during labour was most prevalent in cases with a posterior spine position, 38.2% (in 13 out of 34 patients) as opposed to those with lateral, 20.9% (in 29 out of 139 patients) and anterior, 18.6% (29 out of 157 patients) spine positions.

Occiput posterior position during the first stage of labour demonstrated a significant association with the risk of caesarean and instrumental delivery. Among the study population, all infants delivered via SVD or operative vaginal delivery achieved Apgar scores of 7-10 at 5 minutes of life (Table 8). Significant associations were observed between fetal spine position during the first stage of labour and NICU admission (p=0.021). Neonates with a fetal spine posterior had the highest NICU admission rate at 26.5% (in 9 out of 34 patients), followed by those with a fetal spine anterior position at 16.0% (in 25 out of 156 patients) and fetal spine lateral position at 13.7% (in 19 out of 139 patients) (Table 9). Furthermore, significant associations were noted between patient parity, fetal birth weight, and use of Pitocin during labour with the mode of delivery (VagD/ Non-VagD) in patients post-induction of labour (Table 10).

Table 6. The relationship between fetal occiput position during the first stage of labour and the maternal outcomes

Maternal Outcomes	Occiput Anterior Position n (%)	Occiput Transverse Position n (%)	Occiput Posterior Position n (%)	Not Related n(%)	p-value
Mode of delivery					<0.001[b]
SVD	106(32.2)	132 (40.1)	41(12.5)		
Ventouse	5(1.5)	5 (1.5)	4(1.2)	21	
Forceps	1(0.3)	2(0.6)	0 (0.0)		
Emergency CS	3(0.9)	22(6.7)	8(2.4)		
Use of Pitocin					0.020[a]
Yes	16(4.9)	41(12.5)	14(4.3)	1	
No	99(30.1)	120(36.5)	39(11.8)	20	
Duration of first stage (mins) *	322.52 (162.13)	360.16 (147.82)	365.83 (157.39)		<0.001
Analgesic					0.414[a]
None	77(23.4)	96(29.2)	30(9.1)	16	
Pethidine	29(8.8)	49(14.9)	17(5.2)	2	
Epidural	9(2.7)	16(4.9)	6(1.8)	3	
Complications					
Retained placenta* **					
No	110(37.2)	136(45.9)	45(15.2)	-	1.000[b]
Yes	2(0.7)	3(1.0)	0		
Postpartum haemorrhage					
No	106(32.2)	142(43.2)	42(12.8)	-	
Yes	9(2.7)	19(5.8)	11(3.3)	-	0.001[a]
500 – 1000 mls	8(2.4)	12(3.6)	7(2.1)	-	
1000 – 1500 mls	1(0.3)	6(1.8)	4(1.3)	-	
1500 – 2000 mls	0	1(0.3)	0	-	
Perineum tear* **					0.323[b]
Intact perineum	20(6.8)	21(7.1)	5(1.7)	-	
First degree	47(15.9)	47(15.9)	14(4.7)	-	
Second degree	2(0.7)	1(0.3)	0	-	
Episiotomy	43(14.5)	69(23.3)	25(8.4)	-	
3rd/4th degree	0	1(0.3)	1(0.3)	-	

Note: * Mean with SD. ** Median with IQR. Otherwise, all values are in frequency with percentage. [a]Pearson Chi square test applied. [b]Fisher's exact test applied. Level of significance was set at 0.05. ***n=296

Table 7. The relationship between fetal spine position during first stage of labour and the Maternal outcomes

Maternal Outcomes	Spine Anterior Position n (%)	Spine Lateral Position n (%)	Spine Posterior Position n (%)	Not Related n(%)	p-value
Mode of delivery					<0.001[b]
SVD	140(42.6)	117(35.6)	22(6.7)		
Ventouse	6(1.8)	6(1.8)	2(0.6)	21	
Forceps	2(0.6)	1(0.3)	0		
Emergency CS	8(2.4)	15(4.6)	10(3.0)		
Use of Pitocin					0.018[a]
Yes	29(8.8)	29(8.8)	13(4.0)	1	
No	127(38.6)	110(33.4)	21(6.4)	20	
Duration of first stage (mins) *	350.62	338.19	375.29		<0.001
	(158.73)	(154.47)	(141.24)		
Analgesic					0.350[a]
None	101(30.7)	85(25.8)	17(5.2)	16	
Pethidine	42(12.8)	41(12.5)	12(3.6)	2	
Epidural	13(4.0)	13(4.0)	5(1.5)	3	
Complications					
Retained placenta* **					0.779[b]
No	146(49.3)	121(40.9)	24(8.1)	-	
Yes	2(0.7)	3(1.0)	0		
Postpartum haemorrhage					<0.001[b]
No	144(48.6)	125(42.2)	21(7.0)		
Yes	12(4.0)	14(4.7)	13(4.4)		
500 – 1000 mls	7(2.4)	9(2.7)	11(3.7)	-	
1000 – 1500 mls	4(1.3)	5(1.7)	2(0.7)	-	
1500 – 2000 mls	1(0.3)	0	0	-	
Perineum tear* **					0.841[b]
Intact perineum	21(7.1)	20(6.8)	5(1.7)	-	
First degree	58(19.6)	43()	7(2.1)	-	
Second degree	1(0.3)	2(0.7)	0	-	
Episiotomy	66(22.3)	59(20.0)	12(3.6)	-	
3rd/4th degree	2(0.7)	0	0	-	

Note: * Mean with SD. ** Median with IQR. Otherwise, all values are in frequency with percentage [a]Pearson Chi square test applied. [b]Fisher's exact test applied. Level of significance was set at 0.05. ***n=296

Table 8. The relationship between fetal occiput positions and neonatal outcomes

Neonatal Outcomes	OA position n(%)	OT position n (%)	OP position n (%)	Not Related n(%)	p-value
Prior IOL					
Apgar S at 1 min				-	0.139[b]
0-3	2(0.6)	0	0		
4-6	5(1.4)	4(1.1)	6(1.7)		
7-10	103(29.4)	151(43.1)	79(22.6)		
Apgar S at 5 mins				-	-
0-3	0	0	0		
4-6	0	0	0		
7-10	110(31.4)	155(44.3)	85(24.3)		
Birth weight (g)				-	0.523[b]
<2500g	8(2.3)	7(2.0)	5(1.4)		
2500 -2999g	25(7.1)	44(12.6)	24(6.9)		
3000 – 3499g	46(13.1)	71(20.3)	45(12.9)		
3500 – 3999g	26(7.4)	27(7.7)	10(2.9)		
4000 - 4499g	4(1.1)	5(1.4)	1(0.3)		
≥4500g	1(0.3)	1(0.3)	0		
Admission to NICU				-	0.341[a]
Yes	24(6.9)	24(6.9)	13(3.7)		
No	86(24.6)	131(37.4)	72(20.6)		
During First Stage of Labour					
Apgar S at 1 min					0.480[b]
0-3	1(0.3)	0	1(0.3)	0	
4-6	6(1.7)	5(1.4)	3(0.9)	1(0.3)	
7-10	108(30.9)	156(44.6)	49(14.0)	20(5.7)	
Apgar S at 5 mins					
0-3	0	0	0	0	-
4-6	0	0	0	0	
7-10	115(32.9)	161(46.0)	53(15.1)	21(6.0)	
Birth weight (g)					0.865[b]
<2500g	8(2.3)	10(2.9)	2(0.6)	0	
2500 -2999g	29(8.3)	41(11.7)	18(5.1)	5(1.4)	
3000 – 3499g	53(15.1)	79(22.8)	20(5.7)	10(2.9)	
3500 – 3999g	21(6.0)	27(7.7)	11(3.1)	4(1.1)	
4000 - 4499g	4(1.1)	3(0.9)	2(0.6)	1(0.3)	
≥4500g	0	1(0.3)	0	1(0.3)	
Admission to NICU					0.037[a]
Yes	17(4.9)	24(6.9)	12(3.4)	8(2.3)	
No	98(28.0)	137(39.1)	41(11.7)	13(3.7)	

[a]Pearson Chi square test applied. [b]Fisher's exact test applied. Level of significance was set at 0.05

Table 9. The relationship between the fetal spine positions and neonatal outcomes

Neonatal Outcomes	Anterior spine position n (%)	Lateral spine position n (%)	Posterior spine position n (%)	Not Related n(%)	p-value
Prior IOL					
Apgar S at 1 min				-	0.737[b]
0-3	1(0.3)	1(0.3)	0		
4-6	6(1.7)	5(1.4)	4(1.1)		
7-10	130(37.1)	150(42.9)	53(15.1)		
Apgar S at 5 mins				-	-
0-3	0	0	0		
4-6	0	0	0		
7-10	137(39.1)	156(44.6)	57(16.3)		
Birth weight (g)				-	0.073
<2500g	10(2.9)	7(2.0)	3(0.9)		
2500 -2999g	34(9.7)	42(12.0)	17(4.9)		
3000 – 3499g	62(17.7)	66(18.9)	34(9.7)		
3500 – 3999g	26(7.4)	34(9.7)	3(0.9)		
4000 - 4499g	5(1.4)	5(1.4)	0		
≥4500g	0	2(0.6)	0		
Admission to NICU				-	0.999[a]
Yes	24(6.9)	27(7.7)	10(2.9)		
No	113(32.3)	129(36.9)	47(13.4)		
During First Stage of Labour					
Apgar S at 1 min					0.867[b]
0-3	1(0.3)	1(0.3)	0	0	
4-6	8(2.3)	4(1.1)	2(0.6)	1(0.3)	
7-10	147(42.0)	134(38.3)	32(9.1)	20 (5.7)	
Apgar S at 5 mins					-
0-3	0	0	0	0	
4-6	0	0	0	0	
7-10	156(44.6)	139(39.7)	34(9.7)	21(6.0)	
Birth weight (grams)					0.991[b]
<2500g	11(3.1)	7(2.0)	2(0.6)	0	
2500 -2999g	43(12.3)	36(10.3)	9(2.6)	5(1.4)	
3000 – 3499g	68(19.4)	68(19.4)	16(4.6)	10(2.8)	
3500 – 3999g	29(8.3)	24(6.9)	6(1.7)	4(1.1)	
4000 - 4499g	5(1.4)	3(0.9)	1(0.3)	1(0.3)	
≥4500g	0	1(0.3)	0	1(0.3)	
Admission to NICU					0.021[a]
Yes	25(7.1)	19(5.4)	9(2.6)	8(2.3)	
No	131(37.4)	120(34.2)	25(7.1)	13(3.7)	

[a]Pearson Chi square test applied. [b]Fisher's exact test applied. Level of significance was set at 0.05

Table 10. Predictor factors of mode of delivery (VagD/Non VAg D) among pregnant women who had an induction of labour (n=350)

Birth Outcomes	Mode of Delivery		p-value
	$V_{ag}D$, n (%)	Non-$V_{ag}D$, n (%)	
Age (years)			0.217[a]
<20	5 (1.4)	0	
21-25	64 (18.3)	11 (3.1)	
26-30	129 (36.9)	32 (9.1)	
31-35	64 (18.3)	7(2.0)	
>36	34 (9.7)	4 (1.1)	
Parity			<0.001[a]
Primigravida	131 (37.4)	42 (12.0)	
G2P1	59 (16.9)	6 (1.7)	
Multiparous	106 (30.3)	6 (1.7)	
BMI			0.745[b]
<18.0	12 (3.4)	1 (0.3)	
18.0-24.9	121 (34.6)	18 (5.1)	
25.0-29.9	96 (27.4)	19 (5.4)	
30.0-34.9	49 (14.0)	12 (3.4)	
35.0-39.9	11 (3.1)	3 (0.9)	
>40.0	7 (2.0)	1 (0.3)	
Fetal weight (grams)			0.046[b]
<2500	19 (5.4)	1 (0.3)	
2500-2999	80 (22.9)	13 (3.7)	
3000-3499	138 (39.4)	24 (6.9)	
3500-3999	52 (14.9)	11 (3.1)	
4000-4499	7 (2.0)	3 (0.6)	
>4500	0	2 (0.3)	
Use of epidural			0.169[a]
No	270 (77.1)	46 (13.1)	
Yes	26 (7.4)	8 (2.3)	
Use of pitocin			0.031[a]
No	55 (15.7)	17 (4.9)	
Yes	241 (68.9)	37 (10.6)	

Note: * Mean with SD. ** Median with IQR. Otherwise, all values are in frequency with percentage [a]Pearson Chi square test applied, [b]Fisher's exact test applied. Level of significance was set at 0.05.

Discussion

In this study, primigravid mothers accounted for 49.4% of all labour inductions. This rate was found to be lower compared to other studies, which reported rates of 60.4% [4] and (71.4).[9] The analysis relied on parity to facilitate comparison with previous studies. Moreover, the exclusion criteria effectively identified and excluded potential factors associated with induction of labour that could impact birth and fetal outcomes, such as abnormal CTG readings and the presence of a nuchal cord.

We observed that the most common fetal occiput position before induction of labour and during the first stage of labour was in the OT position at 44.3% and 49.0%, respectively. The incidence of OP before IOL (24.3%) and during the first stage of labour (16.0%) was lower compared to previous studies.[4,10,15] However, the rate of OP position during the first stage of labour was similar to that reported by Gardberg.[11]

In our study, we observed that before IOL, the fetal spine positions were distributed as follows: 44.6% spine lateral, 39.1% spine anterior, and 16.3% spine posterior. During the first stage of labour, the distribution shifted, with the anterior spine position being the most prevalent at 47.4%, while the posterior spine position was the least common at 10.3%. Importantly, we did not analyse individual fetuses for changes in occiput and spine positions; instead, we assessed the rates of these positions independently before IOL and during the first stage of labour. Our findings revealed no concordant relationship between the fetal occiput and fetal spine positions, consistent with findings from other studies.[3,4,9,12]

We interpreted this lack of concordance as indicative of the fetal occiput's ability to rotate within a 90-degree arc to the right or left of the fetal spine axis. As a result, the occiput and spine positions may not align consistently throughout all stages of labour. This study has revealed no significant association between fetal occiput positions or fetal spine positions before IOL and the mode of delivery. These findings are consistent with previous studies by Kamel et al. and Perigrine et al..[3,4] Additionally, Verhoeven et al. asserted that OP position before IOL did not influence the mode of delivery. They concluded that sonographic assessment of fetal head position before IOL should not be implemented in clinical practice.[5] However, it's worth noting that concordant occipital lateral and spine lateral positions are considered ideal at the onset of labour, as they facilitate successful anterior rotation of the occiput and progression through the birth canal during the first and second stages of labour, potentially leading to a smoother labour and ultimately contributing to successful delivery.

While previous studies have acknowledged that most fetuses are in the OA or OT positions at the onset of labour [5,16], they have not provided a clear explanation of how the OP position ultimately engages in the pelvic brim. We hypothesis that fetal occiput with a posterior spine position may initially engage in OT position. Subsequently, once engaged, the fetal spine should rotate to facilitate occiput anterior rotation within the pelvic cavity. However, the occiput may remain posterior if the spine fails to rotate to a lateral or anterior position. The concern arises when the fetal head is engaged with the fetal spine still in the posterior position, increasing the likelihood of posterior rotation of the fetal occiput and resulting in persistent OP at delivery. Looking ahead, interventions or techniques to assist or influence the engagement of the fetal occiput, such as maternal positioning in labour, could be explored to potentially mitigate the risk of persistent occiput posterior position and improve labour outcomes.

In our study, we identified a significant association between fetal occiput positions during the first stage of labour and the mode of delivery. Notably, the incidence of delivery via SVD was highest in cases with OA positions during the first stage of labour, accounting for 92.2% (in 106 out of 115 patients) of deliveries. Conversely, 15.1% (in 8 out of 53 patients) of fetuses in OP positions during the first stage of labour were delivered via EMLSCS, which was lower than reported by other studies [6,15,16], however, it represented the highest percentage among specific positions. Additionally, 7.5% of fetuses in OP position during the first stage of labour were delivered via instrumental vaginal delivery.

While we did not have specific data on the persistence of OP position at delivery, previous ultrasound studies have reported a range of 5-22% for OP position at the start of labour.[4,5,10,11] These findings highlight the importance of assessing fetal occiput positions during the first stage of labour as they may influence the mode of delivery and subsequent maternal and neonatal outcomes.

Our study also identified a significant association between fetal spine position during the first stage of labour and the mode of delivery. Among the findings during the first stage of labour, 94.9% (in 148 out of 156) of fetuses in the spine anterior position were delivered vaginally, followed by those in the spine lateral position (89.2%) and spine posterior position (70.6%). Conversely, the incidence of caesarean delivery and instrumental vaginal delivery was highest among fetuses in the posterior spine position compared to the other spine positions, with EMLSCS rates at 29.4% and instrumental vaginal delivery rates at 5.9%. In contrast, only 5.1% of fetuses in spine anterior positions were delivered via EMLSCS. Notably, the rate of EMLSCS with the posterior spine position was lower than the reported study by Gizzo et al..[12] These findings indicate that the fetal spine posterior during the first stage of labour appears to be highly predictive of operative delivery or caesarean section, underscoring the importance of monitoring fetal spine position in clinical management.

There were significant associations between fetal occiput position and fetal spine position with the mode of delivery, the use of Pitocin during labour, the duration of the first stage of labour, and post-partum haemorrhage. Specifically, the fetal occiput position during the first stage of labour showed a statistical difference in the duration of the stage. The most prolonged duration in the first stage of labour was observed in the spine posterior position compared to the spine anterior position and spine lateral position (375.29 mins ±141.24, 350.62 mins ± 158.73, 338.19 mins ± 154.47, respectively). Consistent with the findings of Gizzo et al.[12], our study indicates that the OP position predicts a longer duration of labour.

In our study, 20.8% of the mothers with fetuses in OP position experienced estimated blood loss of more than 500 mL to 1500 mL, compared to 11.8% of mothers with fetuses in OT position and 7.8% of OA of the fetuses. Notably, the highest incidence of PPH was observed in mothers with fetuses in the spine posterior position at 38.2% compared to 10.1% in mothers with fetuses in the spine lateral position and 4.7% in the spine anterior position. The incidence of PPH was correlated with the longer duration of the first stage of labour and the higher incidence of CS delivery and operative vaginal delivery in the OP position fetuses. Our findings align with a study by Senecal et al.[17], which also reported a higher risk of PPH, partly attributed to a higher caesarean delivery rate. Notably, there was no significant difference in the perineal tear among all study groups, and no association was found between the type of anaesthesia and the patient.

Many overlook the relationship between the fetal occiput position and the fetal spine position during labour. Correcting the fetal spine position to align laterally with the maternal uterine axis in early labour may promote the OT position. The initial fetal spine position at the onset of labour may indicate the extent of rotation required for head descent. Currently, when women are informed of a fetus in an OP position, they often experience anxiety and attempt various methods to change the fetal position. However, the fetal spine position during engagement is frequently overlooked.

Encouraging appropriate maternal position based on the fetal back's orientation may help align the fetal spine laterally with the uterine axis. By promoting lateralisation based on maternal-fetal spine alignment, there may be increased OA rotation, potentially reducing the occurrence of fetal OP malrotation. This approach could aid in optimising fetal positioning and potentially improving labour outcomes.

The rate of fetal OP before induction of labour is not necessarily associated with unfavourable neonatal outcomes, as many fetuses can rotate to the OT position and engage, subsequently descending into the cavity. However, those with an OP position and posterior spine position during early intrapartum may experience unfavorable outcomes, including an increased risk of caesarean section and subsequent NICU admission. To mitigate these risks, repositioning the mother to encourage fetal spine position to the lateral or anterior position during early labour may be beneficial. This can assist the occiput in entering the pelvic inlet in a transverse position and becoming engaged in the pelvic cavity, facilitating subsequent rotation to the anterior position. Such interventions could potentially improve labour outcomes and reduce the need for interventions such as caesarean section.

No significant association was observed between fetal occiput positions and spine positions with Apgar score in 1 minute, neonatal birth weight, or admission to NICU before IOL. However, a notable finding emerged regarding occipital positions during the first stages of labour and subsequent admission to the NICU. Specifically, 22.6% of fetuses presented with an OP position, 14.9 % with an OT position, and 14.8% with an OA position. Interestingly, this study's findings contrast with other studies that found no disparity in neonatal morbidity (NICU admission) across various occipital positions during the first stage of labour.[17] This discrepancy underscores the importance of further research to elucidate the underlying factors contributing to these outcome differences.

Significant associations were identified between fetal spine positions and NICU admission. Notably, 26.5% of neonates with a fetal spine posterior position were admitted to the NICU, followed by 16.0% of neonates with a fetal spine anterior position and 13.7% of neonates with a fetal spine lateral position. However, no significant associations were found between fetal occiput position and fetal spine position with the Apgar score at 1 minute or 5 minutes of life and neonatal birth weight.

Significant associations were observed between the parity of patients, fetal birth weight, and the use of oxytocin during labour with the mode of delivery (VagD/ Non-VagD) in patients undergoing IOL. Specifically, 77.8% of nulliparous women underwent EMLSCS compared to only 11.1% of primiparous and multiparous women. This aligns with findings reported by Akmal et al. Who identified parity as a robust independent predictor of caesarean section, with a nearly seven-fold difference between women who have experienced vaginal birth and nulliparous women.[6] However, other studies have reported varying CS rates among nulliparous with OP deliveries. For instance, Fitzpatrick et al. found that 26.0% of nulliparous women with OP positions underwent caesarean delivery, compared to 17% in multiparous women with OP positions.[8] Similarly, Senecal et al. reported that 15.2% of nulliparous women with OP positions underwent caesarean delivery compared to 6.0% in OT positions and 3.4% in OA positions.[17]

Fetal occiput or spine positions were not significantly associated with the weight of the fetus at birth. However, Fetal birth weight may influence the indication for caesarean section and the incidence of OP position, particularly with increasing birth weight.[19] Research by Gardberg et al. Demonstrated that infants delivered in the OP position tended to have higher birth weights.[11] It is hypothesised that larger fetuses may encounter increased difficulty in rotating as labour progresses, potentially leading to the persistence of the OP position and necessitating higher levels of operative intervention.[11]

68.5% of patients who underwent pitocin augmentation delivered via EMLSCS compared to vaginal delivery (VagD). The duration of the first stage of labour was longest in cases where the fetal OP position was observed (365.83 ± 157.39 minutes), and this duration was correlated with the use of Pitocin during labour. Sizer et al. noted that the incidence of prolonged first-stage labour in the presence of the OP position remains unclear. However, it is suggested that inadequate uterine action may hinder the rotation of the fetal head.[19] In cases where the fetal head is moulded in the OP position, despite adequate contractions, rotation may be difficult, potentially leading to an increased risk of operative vaginal delivery and caesarean section rates. This highlights the importance of closely monitoring labour progression and considering alternative interventions in cases where the OP position persists.

We observed that maternal age over 36 years was not significantly associated with EMLSCS, with a rate of 7.4% compared to vaginal delivery at 11.5%. However, the incidence of EMLSCS in obese patients (BMI 9 30.0 kgm2) was notably higher at 29.7% compared to 22.7% for vaginal delivery. This finding aligns with previous research by Gardberg et al., which reported that BMI was associated with increased rates of operative vaginal delivery and caesarean section.[11] In our study, the mean BMI was 26.3 kg/m2 (±5.52), and only 23.7% of patients with a BMI > 30 kg/m2 underwent labour induction. Mocanu et al. similarly identified obesity, high newborn birth weight, nulliparity, and labour induction as factors increasing the risk of cesarean birth.[20] However, in our cohort, there was no significant association between BMI and the risk of caesarean section after IOL, with the majority of the mothers categorised as overweight or below. Furthermore, the use of epidural anaesthesia was not found to be significantly related to the mode of delivery in our study, possibly due to only 10% of participants receiving epidural anaesthesia.

The limitations of this study are related to the positioning of the mother both before IOL and during the first stage of labour, the timing of performing ultrasound examination, and inadequate data on fetal occiput at birth. Specifically:

1. Lack of standard Maternal Positioning: The study did not institute a standard maternal positioning protocol. Variations in maternal positioning could influence the spine to be in lateral or anterior positions, which in turn may facilitate the anterior rotation of the fetal head and lead to a successful vaginal delivery. The absence of a standardised approach to maternal positioning introduces a potential confounding factor that may affect the study outcomes.

2. The timing of ultrasound scan during the first stage of labour: While it is recognised that the fetal head may undergo some degrees of internal rotation by the time of ultrasound examination upon admission to the labour room, obtaining dynamic images of this rotation during labour remains challenging. This limitation underscores the need for further research to develop standardised protocols for timing ultrasound scans and to explore innovative techniques for capturing and analysing fetal head rotation dynamics in real-time.

3. Inadequate data on occiput position at birth: The study lacked sufficient data on the occiput position at birth. Without comprehensive information on the occiput position, it was impossible to interpret how the occiput position may be associated with events before induction of labour or during the first stage of labour. This limitation restricts the depth of analysis regarding the relationship between occiput position and labour outcomes.

Addressing these limitations in future research endeavours could significantly enhance our understanding of the role of maternal positioning and occiput position in labour progression and delivery outcomes. By implementing standardised protocols for maternal positioning both before induction of labour and during the first stage of labour, researchers can better control for potential confounding variables and accurately assess the impact of maternal positioning on fetal presentation and labour dynamics. Incorporating these improvements into future research studies would advance our knowledge of obstetric care and contribute to the development of evidence-based practices to improve labour progression and delivery experiences for both mothers and babies.

Conclusion

Fetal occipitoposterior position and fetal spine posterior during the first stage of labour following induction of labour are significantly associated with a higher rate of caesarean section. Moreover, a significant correlation was found between the fetal occiput and spine positions during the first stage of labour and the duration of labour, as well as the occurrence of postpartum haemorrhage and admission to the neonatal intensive care unit. Additionally, other predictive factors for the mode of delivery among pregnant women who underwent induction of labour include parity, fetal weight and use of Pitocin during labour.

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