Original Article

Transvaginal Ultrasound Versus Bishop Score in Predicting Labour Dystocia at Full-Term Nullipara Undergoing Labour Induction

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Abstract

Objective: Precise assessment of cervical conditions before labor induction is crucial for predicting the success of normal vaginal delivery. The cervix primary condition has a significant value in determining the succession of induction of labour. Traditionally, assessment of cervix before induction has been based on a cervix digital examination using Bishop's scoring method.This study compares transvaginal ultrasonographic (TVS) cervical assessment with the traditional Bishop score in nulliparous women undergoing labor induction, aiming to evaluate their predictive abilities for labor dystocia.

Materials and methods: In a prospective observational study of 200 pregnant women at Al Hussein University Hospital between October 2022 and July 2023, cervical length, funneling, and posterior cervical angle were measured using transvaginal ultrasound. The Bishop score was recorded before induction. Statistical analyses, including Student's "t"-test and ROC curve, were conducted using SPSS.

Results: 68% delivered via normal vaginal delivery (NVD) and 32% via cesarean section (CS). The NVD group exhibited significantly higher Bishop scores (6.82±1.36 vs 3.70±0.94), lower cervical length (25.46±3.99 vs 37.34±2.09),and higher cervical angle (121.39±5.70 vs 89.01±6.09), than the CS group. ROC curve analysis revealed that a Bishop score ≥4.5 had 89% sensitivity and 87.5% specificity, a cervical angle ≥ 92.5 had 98.5% sensitivity and 95.3% specificity, and a cervical length ≥31.5 had 96.9% sensitivity and 97.1% specificity for predicting NVD.

Conclusion: The posterior cervical angle, alongside cervical length, proves to be a more sensitive indicator for predicting labor dystocia during induction compared to the traditional Bishop score.

Keywords: Dystocia; Ultrasonography; Labor; Induced

Introduction

Precise assessment of cervical conditions before labor induction is crucial for predicting the success of normal vaginal delivery (1). The cervix primary condition has a significant value in determining the

succession of induction of labour, traditionally, assessment of cervix before induction has been based on a cervix digital examination using Bishop's scoring method (2).

Labor induction refers to the intentional commencement of labor in a pregnant woman who has reached the stage of fetal viability. This procedure is carried out while the fetal membranes are intact, and there is no objective evidence of active

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labor, accomplished through either pharmacological or mechanical means (3).

During pregnancy, the cervix, which is usually firm and closed, undergoes a process of transformation that results in softening and eventual ripening as delivery approaches, the initial stage of remodelling is called softening, and it may begin as early as the first trimester (fiest 3 months of pregnancy) when tissue tensile strength begins to decline. Usually, this initial phase is gradual yet progressive. The subsequent cervical ripening stage begins throughout the weeks before delivery and spontaneous labour (4, 5).

Extended labor without previous childbirth is responsible for 30% of cesarean deliveries, with factors such as labor induction and occiput posterior position increasing the likelihood of this outcome. Nevertheless, accurately predicting this result based simply on clinical evaluation remains difficult (6).

Typically, the initial evaluations of labor progression involve using digital vaginal examinations, which are visually depicted on a partogram (7).

Induction of labor is advised when the advantages to both the mother and fetus surpass the hazards linked to an extended pregnancy, as is the case in situations of intra uterine growth retardation, past date, or certain medical conditions of pregnancy (2).

The success of labor induction can be predicted by evaluating cervical measurements, and transvaginal sonography has been found to be diagnostically equivalent to the standard Bishop score (1).

Sonographic measuring, which provides enhanced objectivity and precision, enables the digital preservation of images, fulfilling multiple functions (8).

Cervical length measured by transvaginal ultrasound have been demonstrated to anticipate preterm birth in both women with alow risk and those with threatening preterm birth (9).

The sonographic measurement of cervical length is commonly used to predict the results of labor induction, especially in nullipara women, Compared to multiparous women, nulliparous women experience cervical dilatation at a faster rate. Near term cervical lenght exhibited a acceptable ability to expect successful delivery results after labour induction (10). The uterocervical angle (UCA), which is created by the front wall of the uterus and the canal of the cervix, is a dependable indication of the effectiveness of labor induction (11).

On the other hand, the often employed Bishop score exhibits inconsistent sensitivity and subjectivity, hence diminishing its reliability as a predictor of labor outcomes (12).

The sensitivity of the Bishop score, which is frequently used to predict successful deliveries, ranges from 23% to 64% (13).

The objective of this research is to evaluate the effectiveness of preinduction transvaginal ultrasonographic (TVS) cervical evaluation in pregnant women who are having induction of labor (IOL), by comparing it with the Bishop score. The aim is to ascertain the efficacy of TVS assessment in forecasting incidence rate of labour dystocia.

Materials and methods

This study was prospective observational research conducted at Al Hussein University Hospital between October 2022 and July 2023. It included a sample of 200 pregnant women who had labor induction.

This research has a research ethics certificate approved by the Research and Ethics Committee of quality education assurance unit, AL-AZHAR FACULTY OF MEDICINE with REGISTRATION NUMBER: 533. All subjects provided informed written consent, and ethical approval was obtained from the institutional review board.

The study only considered pregnancies that met the following criteria: the fetus was a single viable one, it was in the head-first position, and the mother was anullipara pregnant woman between the ages of 18 and 40. In addition, participants were mandated to have a longitudinal lie vertex presentation, a viable fetus with intact membranes, and no prior instances of vaginal bleeding. The criteria for inclusion in the study were limited to individuals with a gestational age falling within the range of 37 to 42 weeks.

The study's exclusion criteria included instances with non-vertex presentation, a history of previous uterine surgery, pregnancies with multiple gestations, placenta previa, known fetal malformations, cephalopelvic disproportion, and abnormal umbilical artery Doppler indices. Participants who met any of these criteria were eliminated from the study in order to ensure a homogeneous and specific group for the examination.

Labor induction is recommended for pregnancies that have gone beyond the expected due date, as well as for pregnancies with certain regulated medical disorders such as diabetes, pregnancy-induced hypertension (PIH), and preeclampsia (PET). It is also considered for pregnancies with low levels of amniotic fluid (oligohydramnios), fetal development

limitation, and a history of medical conditions and surgeries, such as hypertension, diabetes, or previous cervix operations.

Every participant went through a meticulous procedure that began with gaining verbal permission and doing a detailed assessment, which included gathering information on their personal, current, and obstetric histories. Following that, the medical team assessed the patient's vital signs and abdominal examination (level of fundus, fetal heartbeats, and any scar from prevoius abdominal or pelvic operation) performed.

Standard laboratory tests, such as a full blood count, coagulation profile, renal function tests, and liver function tests, were conducted. In addition, a comprehensive transabdominal ultrasound was performed to evaluate the location of the placenta, the viability of the fetus, the presentation of the fetus, the estimated weight of the fetus, and the gestational age. The implementation of this comprehensive strategy facilitated a full comprehension of the health state of each participant and enhanced the strength and reliability of the study data.Top of Form

Utilizing a Voluson P8 Ultrasound equipment with abdominal probe 3.5 MHz and Vaginal probe 7.5 MHz frequency, transvaginal ultrasonography evaluated cervical length, posterior cervical angle, and the occurrence of funneling. The method entailed positioning the woman in the lithotomy posture, followed by the insertion of a lubricated transvaginal probe to obtain measurements in the sagittal plane.

The evaluation of cervical parameters involved measuring the length of the cervix, with three measurements done and the shortest possible length recorded. The external os, internal os, and endocervical canal were observed in the sagittal view (Figure 1).

Funneling, which is defined as the protrusion of the amniotic membrane into the internal os measuring three millimeters or more, was also observed and documented. In addition, the posterior cervical angle

was assessed, which is defined as the angle formed by an imaginary line crossing the cervical canal and another line that is perpendicular to the posterior wall of the uterus at the internal os. The precise measurements yielded a thorough comprehension of the cervical status throughout the investigation.
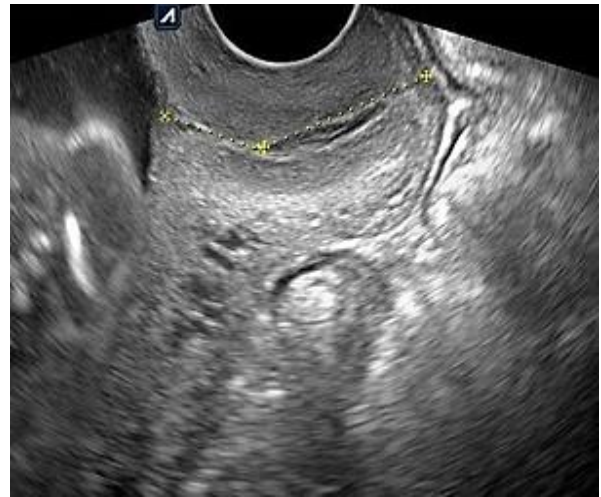

Figure 1: The cervical length was measured from internal to external os

The Bishop's score (14) was used to evaluate cervical dilatation, station, effacement, consistency, and position after the ultrasound was performed. The scores for dilation, station, and effacement varied from 0 to 3, whereas the scores for consistency and position were from 0 to 2 (Table 1).

In accordance with the hospital's established procedure, labor induction was carried out using Prostaglandin E2 (Prostin E2, Dinoprostone 3mg), with a maximum of 3 doses administered at intervals of at least 6 hours. The objective was to attain 4-5 contractions within a span of 10 minutes. Subsequent evaluations were conducted after a duration of 6 hours, and vaginal inspections were carried out at intervals of 4 hours once labor had commenced.

Table 1: Bishop Scoring system used for assessment of inducibility (Cunningham et al, 2005)

Parameter	Score				Description
	0	1	2	3	
Position	Posterior	Intermediate	Anterior	–	The position of the cervix varies between individual women: facing, anterior, intermediate and posterior locations.
Consistency	Firm	Intermediate	Soft	–	
Effacement	0–30%	31–50%	51–80%	>80%	
Dilatation	0 cm	1–2 cm	3–4 cm	> 5 cm	The length of the stretched cervix.
Fetal station	−3	−2	−1, 0	+1, +2	Fetal station describes the position of the foetus' head in relation to the distance from the ischial spine. Negative numbers indicate that the head is inside above the ischial spine.

Statistical Analysis: The data analysis was performed with the SPSS version 25. Numerical data can be represented using mean ± standard deviation and median with interquartile values. The categorical data were expressed as proportions and counts. Diagnostic testing accuracy was evaluated using sensitivity and specificity.

Results

The research, carried out at Al Hussein hospital between October 2022 and July 2023, included two hundred mothers who had never given birth to more than one child at a time. The prevalence of normal vaginal delivery (NVD) was 68%, whereas cesarean section (CS) was performed in 32% of the individuals (Figure 2). The statistical analysis showed a notable disparity in age between the NVD and CS groups, with the NVD group exhibiting a lower average age (23.82±3.58 vs. 25.95 ± 4.73). Nevertheless, there were no significant disparities in BMI and hemoglobin (HB) concentrations between the two cohorts (Table 2).
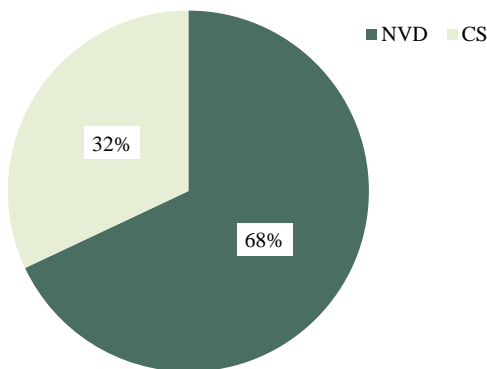
significant relationship between gestational age and the success of labor induction (P value 0.001), highlighting the considerable

NVD: normal vaginal delivery, C.S: ceserian section, value is significant at p< 0.05.

Influence of gestational age on the outcomes of induced labor. Subsequent research revealed significant disparities between the NVD and CS groups in various crucial metrics. The NVD group demonstrated a significantly higher Bishop score (6.82 ± 1.36 vs. 3.70 ± 0.94), indicating a more advanced level of cervical preparation. In addition, the NVD group had a significantly shorter cervical length (25.46 ± 3.99 vs. 37.34 ± 2.09), a greater cervical angle (121.39 ± 5.70 vs. 89.01±6.09), and a smaller distance of the presenting part (34.96 ± 3.24 vs. 58.31±5.31) in comparison to the CS group (Table 3).

These findings indicate that age, gestational age, Bishop score, cervical length, cervical angle, and the distance of the presenting component are significant determinants of the effectiveness of labor induction and the method of delivery (Figures 3, 4) (Tables 2-4).
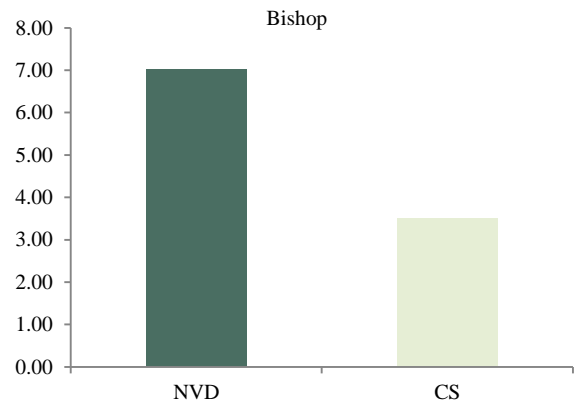

Figure 2: Mode of delivery of the studied groups

The study found a strong and statistically

Figure 3: Bishop score of the studied groups

Table 2: A comparative analysis of demographic data concerning the mode of delivery within the studied groups

	NVD (n=136)	CS (n=64)	Independent student t test	
			t	p-value
Age (year)	18-35	18-39	-3.196	0.002
	23.82 ± 3.58	25.95 ± 4.73		
BMI	23-30	23-30	-0.418	0.677
	26.79 ± 2.05	26.91 ± 1.91		
HB level gm/dl	10-12	10-12	-0.314	0.754
	11.10 ± 0.52	11.13 ± 0.58		
GA	38-41	37-39	2.34	0.001
	39.2 ± 1.5	37.81 ± 1.75		

Table 3: Correlation between ultrasonographic criteria, Bishop score, and the mode of delivery

Parameter	MODE OF DELIVERY										P value
	NVD					C.S					
	Mean	SD	Median	Mini	Max	Mean	SD	Median	Min	Max	
C.A (CERVICAL ANGLE)	122.74	15.75	125.00	75.00	150.00	90.43	11.86	89.80	70.00	130.00	< 0.001
C.L (CERVICAL LENGTH)	27.94	5.04	29.00	15.00	40.00	36.71	5.63	38.00	22.00	48.00	< 0.001
BISHOP Score	6.86	2.21	6.00	.00	10.00	4.57	1.63	5.00	2	8.00	< 0.001

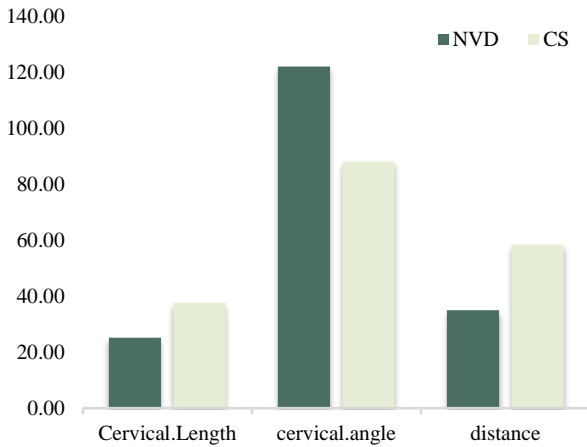NVD: Normal vaginal delivery, C.S: Ceserian section, value is significant at p< 0.05.

Figure 4: US parameters of the studied groups

The observed statistically significant differences highlight the potential usefulness of these factors in predicting and improving the outcomes of induced labor in women who have not given birth before.

Derived from the preceding data, a statistically significant inverse association was observed between the posterior cervical angle determined through TVS, funneling, and Bishop Score with labor dystocia. Furthermore, a statistically significant positive correlation was identified between labor dystocia and cervical length.

Key Predictive Cut-off Points: We identified precise thresholds for the Bishop score, cervical angle, and cervical length in our research, which offer crucial information on their ability to predict normal vaginal delivery (NVD).

- **Bishop Score ≥4.5**
- Sensitivity: 89%
- Specificity: 87.5%

- A Bishop Score of 4.5 or higher exhibited notable sensitivity and specificity, signifying its efficacy in predicting NVD.
- **Cervical Angle ≥92.5**
- Sensitivity: 98.5%
- Specificity: 95.3%
- A cervical angle of 92.5 or higher demonstrated exceptional sensitivity and specificity, establishing it as a robust predictor for NVD.
- **Cervical Length ≥31.5:**
- Sensitivity: 96.9%
- Specificity: 97.1%

Cervical length surpassing 31.5 showcased remarkable sensitivity and specificity, underlining its robust predictive value for NVD.

The specified cut-off points offer clinicians precise criteria for the Bishop score, cervical angle, and cervical length (Figure 5). This enables accurate evaluations and well-informed decision-making when inducing labor. Integrating these particular thresholds into clinical practice can improve the accuracy of predicting successful vaginal birth outcomes in pregnant women.Top of Form the posterior cervical angle is considered superior to cervical length as a sensitive indicator of labour dystocia and bishop score.

Discussion

The main aim of this study was to assess and evaluate the accuracy of ultrasonographic measures and the Bishop Score in predicting labor dystocia in women underwent labour induction. The results, derived from a sample of 200 participants, indicated that 68% of women were delivered vaginally, while 32% underwent a cesarean section.

Table 4: A comparative analysis of funneling in relation to the mode of delivery within the studied groups

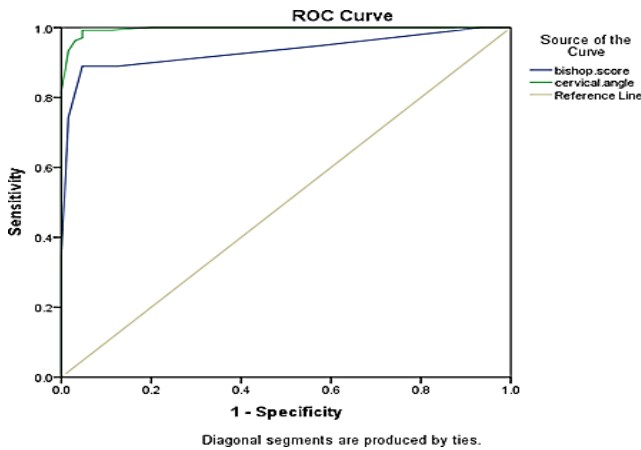|		NVD (n=136)	CS (n=64)	Chi-square test	
				X²	p-value
Funneling	Yes	112 (82.4%)	0 (0%)	119.786	≤ 0.001
	No	24 (17.6%)	64 (100%)		

Figure 5: ROC curve for cervical angle and Bishop score as an indicator of NVD

Transvaginal ultrasound exhibited higher sensitivity and specificity in predicting labor dystocia when compared to the Bishop Score, with 98.5 % sensitivity and 95.3 % specificity for cervical angle, and 96.9% sensitivity, 97.1% for cervical lenghth, versus 89% sensitivity and 87.5 specificity for bishop Score.

The findings of our study are consistent with prior studies, providing evidence that ultrasonographic measurements, particularly cervical angle and length, are superior to the conventional Bishop Score. Yang et al. (2004) (15) and Pandis et al. (2001) (16) both found similar patterns in their research, emphasizing the importance of cervical length as a critical component that affects the chances of effective labor induction within a 24-hour period.

Tan et al. (2007) (8) provided more evidence to corroborate these findings, highlighting the ability of both the Bishop Score and cervical length to predict outcomes. The study found that cervical length was a less invasive and more patient-friendly method compared to the Bishop Score. This supports the practical implications of our study, which recommends using transvaginal sonography instead of digital tests to improve patient comfort. Strobel et al. (2006) (17) investigated the estimation of the initiation of spontaneous labor and the duration of delivery in pregnancies that last longer than usual. Their findings demonstrated that the combination of Bishop Score and sonographic cervical length provided more precise estimations than bishop score alone, especially for nulliparous women.

However, In contrast to our study, Chandra et al. (2001) (18) found that no ultrasound distinctive predicted successful vaginal delivery however,

Bishop score, mother age and cervical position independently anticipate vaginal delivery, which contradicts our own findings. In their study, Groenevelda et al. (2010) (19) assessed the features of the cervix before to induction and discovered that only the Bishop Score exhibited a significant correlation with the success of induction in nulliparous women. The disparity in finding underscores the intricacy of distinguishing labor failure and the differences in induction techniques and criteria.

Ultimately, our research emphasizes the dominance of sonographic data, specifically cervical angle and length, in accurately predicting labor dystocia during induced labor. The non-invasive and patient-friendly characteristics of transvaginal sonography enhance its potential as a more dependable and easily accessible technique for doctors. Additional investigation should persist in examining different approaches to inducing labor and enhancing the definitions of labor failure in order to enhance the uniformity and practicality of predictive models in various clinical environments.

Conclusion

The results of our study emphasize that the posterior cervical angle is a more accurate predictor of labor dystocia and the probability of a normal vaginal delivery compared to cervical length and Bishop score. The established thresholds offer clinicians valuable cut-off points for these measures, facilitating more precise assessments and informed decision-making during labor induction. Integrating these precise thresholds into medical practice can enhance the quality of care and lead to more favorable results for nulliparous women who are undergoing induced childbirth.

Conflict of Interests

Authors declare no conflict of interests.

Acknowledgments

References

1. Abdullah ZH, Chew KT, Velayudham VR, Yahaya Z,

Jamil AA, Abu MA, et al. Pre-induction cervical assessment using transvaginal ultrasound versus Bishops cervical scoring as predictors of successful induction of labour in term pregnancies: A hospital-based comparative clinical trial. PLoS ONE 2022;17(1):e0262387.

2. Keepanasseril A, Suri V, Bagga R, Aggarwal N. Pre-induction sonographic assessment of the cervix in the prediction of successful induction of labour in nulliparous women. Aust N Z J Obstet Gynaecol 2007;47(5):389-393.

3. Ezebialu IU, Eke AC, Eleje GU, Nwachukwu CE. Methods for assessing pre-induction cervical ripening. Cochrane Database Syst Rev 2015;(6):CD010762.

4. Timmons B, Akins M, Mahendroo M. Cervical remodeling during pregnancy and parturition. Trends Endocrinol Metab 2010;21(6):353-361.

5. Read CP, Word RA, Ruscheinsky MA, Timmons BC, Mahendroo MS. Cervical remodeling during pregnancy and parturition: molecular characterization of the softening phase in mice. Reproduction 2007;134(2):327-340.

6. Verhoeven CJ, Opmeer BC, Oei SG, Latour V, van der Post JA, Mol BW. Transvaginal sonographic assessment of cervical length and wedging for predicting outcome of labor induction at term: a systematic review and meta-analysis. Ultrasound Obstet Gynecol 2013;42(5):500-508.

7. Caughey AB, Cahill AG, Guise JM, Rouse DJ, American College of Obstetricians and Gynecologists. Safe prevention of the primary cesarean delivery. American journal of obstetrics and gynecology 2014;210(3):179-93.

8. Tan PC, Vallikkannu N, Suguna S, Quek KF, Hassan J. Transvaginal sonographic measurement of cervical length vs. Bishop score in labor induction at term: tolerability and prediction of Cesarean delivery. Ultrasound Obstet Gynecol 2007;29(5):568-573.

9. Kwasan S, Paisarntuntiwong R, Charoenchainont P. Cervical length measurement by transvaginal sonography in preterm pregnant women for prediction of preterm birth. J Med Assoc Thai 2005;88(Suppl 2):S48-S55.

10. Kwon JY, Wie JH, Choi SK, Park S, Kim SM, Park IY. The degree of cervical length shortening as a predictor of successful or failed labor induction. Taiwan J Obstet Gynecol 2021;60(3):503-508.

11. Eser A, Ozkaya E. Uterocervical angle: an ultrasound screening tool to predict satisfactory response to labor induction. J Matern Fetal Neonatal Med 2020;33(8):1295-1301.

12. Rayburn WF, Zhang J. Rising rates of labor induction: present concerns and future strategies. Obstet Gynecol 2002;100(1):164-167.

13. Bueno B, San-Frutos L, Pérez-Medina T, Barbancho C, Troyano J, Bajo J. The labor induction: integrated clinical and sonographic variables that predict the outcome. J Perinatol 2007;27(1):4-8.

14. Cunningham FG, Gant NF, Leveno KJ, Gilstrap LC III, Hauth JC, Wenstrom KD. Williams Obstetrics: 22nd ed. New York: McGraw Hill Professional, 2005.

15. Yang SH, Roh CR, Kim JH. Transvaginal ultrasonography for cervical assessment before induction of labor. J Ultrasound Med 2004;23(3):375-385.

16. Pandis GK, Papageorghiou AT, Ramanathan VG, Thompson MO, Nicolaides KH. Preinduction sonographic measurement of cervical length in the prediction of successful induction of labor. Ultrasound Obstet Gynecol 2001;18(6):623-628.

17. Strobel E, Sladkevicius P, Rovas L, De Smet F, Karlsson ED, Valentin L. Bishop score and ultrasound assessment of the cervix for prediction of time to onset of labor and time to delivery in prolonged pregnancy. Ultrasound Obstet Gynecol 2006;28(3):298-305.

18. Chandra S, Crane JM, Hutchens D, Young DC. Transvaginal ultrasound and digital examination in predicting successful labor induction. Obstet Gynecol 2001;98(1):2-6.

19. Groeneveld YJ, Bohnen AM, Van Heusden AM. Cervical length measured by transvaginal ultrasonography versus Bishop score to predict successful labour induction in term pregnancies. Facts Views Vis Obgyn 2010;2(3):187-193.