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COMPARISON OF ULTRASONOGRAPHIC CERVICAL LENGTH AND THE BISHOP'S SCORE IN PREDICTING SUCCESSFUL LABOUR INDUCTION

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Abstract

Background: The Bishop's score is widely used to assess cervical readiness and predict the success of labour induction, drawing on factors such as foetal position, effacement, dilation, and cervical consistency. Higher scores, particularly above 7, are strongly associated with successful vaginal delivery. However, cervical assessment via digital examination can be challenging, especially with a closed cervix, and subjective evaluations are less reliable at lower scores. Transvaginal ultrasound offers a more objective and reproducible method for measuring cervical length, allowing for improved assessment of cervical status, including regions that are difficult to evaluate clinically.

Aim: To investigate the relationship between transvaginal ultrasonographic cervical length measurements and the Bishop's score in predicting successful labour induction.

Methods: Study group consists of 136 pregnant women attending a tertiary care centre of south India. Transvaginal ultrasound was performed to measure cervical length one day prior to labour induction, using a 6.5 MHz probe with participants in the lithotomy position and an empty bladder. The measurement, performed by a single radiologist, spanned from the internal to the external OS. The Bishop's score was determined through digital examination, and induction methods were selected based on the score: Foley catheter for scores <3, PGE1 for scores 4–5, and ARM or oxytocin for scores >6. Labour progress and outcomes were systematically recorded.

Results: The study found that a cervical length of 27 mm demonstrated a sensitivity of 84.5% and a specificity of 80.1%, indicating a reasonable balance between these two metrics (AUC = 0.91). Furthermore, participants with a Bishop's score of 4 exhibited the highest sensitivity at 89% and a specificity of 91%, indicating that this cutoff is both highly sensitive and specific (AUC = 0.95).

Conclusion: The study demonstrates the significant predictive value of both cervical length and Bishop's scores in assessing the likelihood of successful labour induction, with the Bishop's score showing greater predictive capability than cervical length. These findings support the integration of these assessments into clinical practice to enhance induction outcomes, optimize resource utilization, and improve maternal and foetal health.

Key words: Induction, Cervical length, Labour, Bishop's score

Introduction

Foetal organ system development is typically completed prior to the natural and well-coordinated onset of spontaneous labour, which—when feasible—should be allowed to progress without intervention. Labour induction, defined as the artificial initiation of uterine contractions after foetal viability, is warranted only when the anticipated benefits for the mother or foetus clearly outweigh the risks associated with continued pregnancy. Currently, induction of labour is performed in approximately 40% of pregnancies and has been associated with a significant reduction in perinatal mortality compared to expectant management. However, an estimated 20% of induced labours culminate in Caesarean delivery, underscoring the importance of careful selection and individualized decision-making.

Indications for labour induction may be maternal, foetal, or both, and must be clearly established, as unnecessary induction may introduce iatrogenic risks. Successful induction is more likely among multiparous women, those of taller stature, with lower body mass index (BMI), and those approaching full term. Common induction modalities include mechanical approaches such as transcervical balloon catheters and hygroscopic dilators, as well as pharmacologic agents like prostaglandin E1 (PGE1) and E2 (PGE2). The choice of method is often guided by the modified Bishop's score, which evaluates cervical length, dilation, consistency, position, and foetal station.

The Bishop's score remains a widely accepted clinical tool for predicting the likelihood of successful vaginal delivery. Scores exceeding 7 are strongly correlated with favourable outcomes, with over 90% resulting in vaginal births. However, in patients with an unfavourable cervix—particularly with a closed external OS—the digital assessment of cervical effacement, length, or funnelling becomes unreliable and subjective. Moreover, the Bishop's score is limited by considerable inter- and intra-observer variability, diminishing its predictive consistency, especially at lower scores.

Given these limitations, alternative and more objective approaches to cervical assessment have gained attention. Transvaginal ultrasound (TVS), in particular, offers a reproducible and non-invasive method for measuring cervical length, which has shown promising utility in predicting the outcome of labour induction. For instance, Anikwe et al. (2020) reported that pre-induction cervical length, as measured by ultrasound, significantly correlates with labour outcomes, supporting the notion that TVS may enhance clinical decision-making in this context [1]. Similarly, Deif et al. (2024) demonstrated that ultrasonographic parameters—especially cervical length and angle—outperformed the Bishop's score in predicting labour dystocia among nulliparous women undergoing induction [2]. Further reinforcing these findings, Agrawal et al. (2022) highlighted the effectiveness of a composite "TVS cervical score," which integrates several ultrasonographic markers, in predicting successful labour induction more accurately than the classical Bishop's score [3]. In a systematic review, Verhoeven et al. concluded that sonographic cervical length measurements provided more reliable predictive value for induction outcomes than traditional clinical assessments, contributing to a growing body of literature that challenges the longstanding reliance on the Bishop's score [4].

In light of these developments, transvaginal ultrasound is increasingly recognized as a superior, objective modality for cervical evaluation. It enables a more comprehensive assessment, including visualization of the supravaginal portion of the cervix—an area inaccessible to digital examination—and proves particularly advantageous when the cervix is closed or effacement is minimal. The method is safe for both mother and foetus and is becoming an integral part of modern obstetric practice. This study aims to explore the comparative predictive value of transvaginal ultrasonographic cervical length and the Bishop's score in determining the success of labour induction.

Methods

A descriptive study was conducted in the Department of Obstetrics and Gynaecology, of a tertiary care centre from 2023 to 2024, following approval by the Institutional Ethics Committee. The study included 136 pregnant women, both primigravida and multigravida, with singleton cephalic pregnancies between 37 and 42 weeks who were scheduled for elective induction of labour. Women with multiple gestations, acute genital herpes, a scarred uterus, intrauterine foetal demise, premature rupture of membranes, cephalopelvic disproportion, malpresentation, or placenta previa were

excluded. Participants were selected through consecutive sampling, and informed written consent was obtained from all eligible patients.

Preinduction cervical length was measured one day before scheduled induction using a transvaginal ultrasound probe (6.5 MHz, GE Voluson), performed by a single consultant radiologist. Participants were placed in the lithotomy position with an empty bladder to minimize cervical elongation; the probe, covered with a condom and gel, was gently inserted, and cervical length was determined by measuring the distance between the internal and external OS according to standard technique. The Bishop's score was assessed digitally, and induction methods were chosen based on the modified Bishop's score: Foley catheter for scores less than 3, PGE1 for scores of 4–5, and artificial rupture of membranes or oxytocin for scores greater than 6. Labour progress was tracked with a partogram, and outcomes, including mode of delivery, were documented to explore the relationship between ultrasound cervical length and labour outcome (normal delivery or Caesarean section).

Statistical analysis was performed using SPSS Version 27. Continuous variables, such as cervical length and birth weight, were summarized as mean ± standard deviation or median with interquartile range, while categorical variables were described by frequencies and percentages. Receiver operating characteristic (ROC) curves were generated to determine the optimal cutoff for sonographic cervical length in predicting successful induction, and area under the curve (AUC), sensitivity, specificity, and predictive values were calculated. Results were considered statistically significant at a p-value less than 0.05.

Results

The study group consists of 136 primi gravida and multi gravida mothers. The mean age of the study group was 27.1±3.3 years. Gestational age of the study group ranges from 37 weeks to 42 weeks. The results were analysed using SPSS and the findings are given below.

Table 1 Socio demographic and clinical characteristics

Variable	Category	No	%
Age (years)	<25	36	26.5
	26-30	76	55.8
	>30	24	17.6
Parity	Nulliparous	58	42.6
	Multiparous	78	57.4
Gestational age (weeks)	37-38	29	21.4
	38-39	33	24.2
	39-40	58	42.6
	>40	16	11.7
Comorbidities	GDM	43	31.6
	Hypertension	54	39.7
	Anaemia	14	10.3
	Hypothyroid	17	12.5
Indication of induction	GDM	43	31.6
	FGR	27	19.8
	Small for gestation	19	13.9
	Oligohydramnios	16	11.7
	Hypertension	25	18.4
	Others	6	4.4
Bishop's score (mean± SD)	5.1±1.4		
Cervical length (mean± SD)	25.6 ±6.7 mm		
Mode of induction	Foleys	27	19.8
	PGE2	99	72.8
	Oxytocin	49	36.1
Method of induction	Single method	85	62.5

	Combination	51	37.5
Birth weight (Kg)	≤2.5	47	34.5
	>2.5	89	65.5
	Male	65	47.8
Gender	Female	71	52.2

A total of 136 pregnant women were enrolled in the study, comprising both nulliparous and multiparous individuals with singleton cephalic presentations at term (37–42 weeks). The distribution of background characteristics is presented in **Table 1**.

The majority of participants were aged between 26 and 30 years (55.8%), followed by those under 25 years (26.5%), and above 30 years (17.6%). Multiparous women constituted 57.4% of the study population, while nulliparous women comprised 42.6%. Regarding gestational age at induction, 42.6% were between 39 and 40 weeks, 24.2% between 38 and 39 weeks, 21.4% between 37 and 38 weeks, and 11.7% beyond 40 weeks.

The most prevalent comorbidity was hypertension (39.7%), followed by gestational diabetes mellitus (GDM, 31.6%), hypothyroidism (12.5%), and anaemia (10.3%). Indications for induction included GDM (31.6%), foetal growth restriction (FGR, 19.8%), small for gestational age (13.9%), oligohydramnios (11.7%), hypertension (18.4%), and other causes (4.4%).

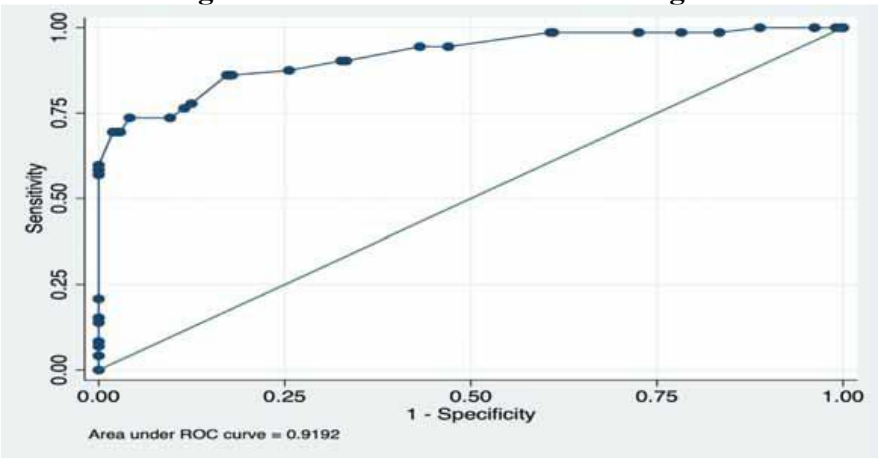
The mean (±SD) Bishop's score at induction was 5.1 ± 1.4, and the mean preinduction cervical length measured by transvaginal ultrasound was 25.6 ± 6.7 mm.

With respect to induction methods, prostaglandin E2 (PGE2) was the most frequently used (72.8%), followed by Foley catheter (19.8%) and oxytocin (36.1%). A single induction method was used in 62.5% of cases, while a combination was required in 37.5%. Regarding neonatal characteristics, 65.5% of newborns weighed >2.5 kg and 34.5% weighed ≤2.5 kg. The sex distribution was nearly equal, with 52.2% females and 47.8% males.

Table 2 Diagnostic Accuracy of Cervical Length for Predicting Successful Labour Induction

Cervical length	Sensitivity (%)	Specificity (%)	AUC
≤ 25	49.10	86.90	
≤ 26	62.10	82.60	
≤ 27	84.50	80.10	0.919
≤ 28	88.70	67.50	
≤ 29	90.50	57.40	

Figure 1: ROC curve for cervical length



The diagnostic performance of preinduction transvaginal ultrasonographic cervical length in predicting successful labour induction was evaluated using receiver operating characteristic (ROC)

curve analysis. Various cervical length thresholds were assessed for their sensitivity and specificity in predicting successful induction (Table 2).

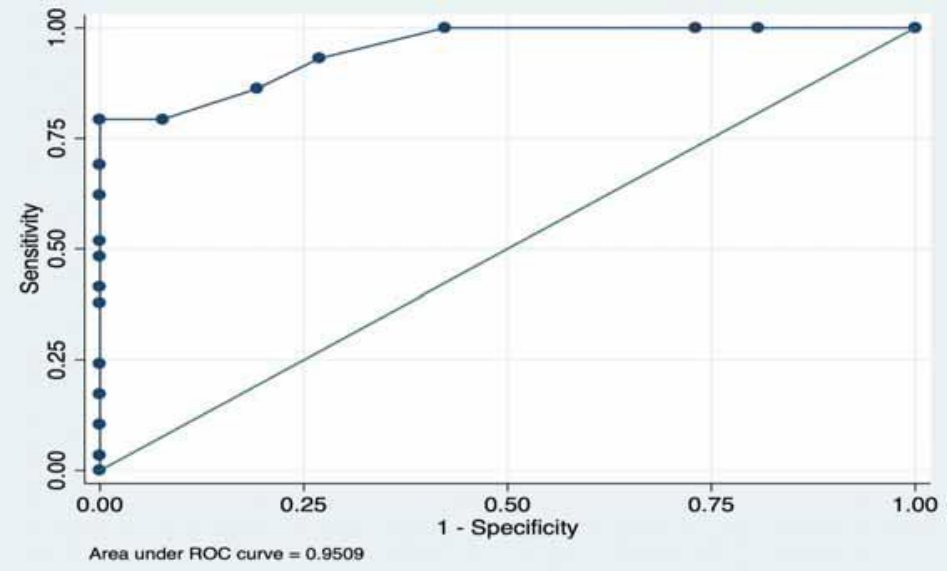
A cervical length cut-off of **≤27 mm** demonstrated optimal diagnostic performance, with a sensitivity of **84.5%** and a specificity of **80.1%**. The corresponding area under the ROC curve (AUC) was **0.919**, indicating excellent discriminatory ability. Lower cut-off values, such as ≤25 mm and ≤26 mm, had higher specificity (86.9% and 82.6%, respectively) but substantially lower sensitivity (49.1% and 62.1%, respectively). Conversely, higher cut-off values (≤28 mm and ≤29 mm) increased sensitivity (88.7% and 90.5%, respectively) but at the expense of specificity (67.5% and 57.4%, respectively).

These findings suggest that a cervical length threshold of **≤27 mm** provides the best balance between sensitivity and specificity for predicting successful labour induction in this population.

Table 3 Diagnostic Accuracy of Bishop's Score in Predicting Successful Labour Induction

Bishop's score	Sensitivity (%)	Specificity (%)	AUC
≤ 2	40.50	96.40	
≤ 3	60.40	93.20	0.951
≤ 4	89.20	91.50	
≤ 5	91.90	80.50	

Fig 2: ROC curve for Bishop's score



The diagnostic value of the Bishop's score in predicting successful labour induction was also evaluated using ROC analysis. Several Bishop's score thresholds were assessed for sensitivity and specificity (Table 3).

A Bishop's score cut-off of **≤3** achieved a sensitivity of **60.4%** and a specificity of **93.2%**, with an area under the ROC curve (AUC) of **0.951**, indicating outstanding discriminatory ability. Lower thresholds, such as ≤2, provided higher specificity (96.4%) but lower sensitivity (40.5%). At higher cut-offs (≤4 and ≤5), sensitivity increased to 89.2% and 91.9%, respectively, with corresponding decreases in specificity (91.5% and 80.5%).

These results indicate that a Bishop's score threshold of **≤3** offers an excellent balance between sensitivity and specificity for predicting successful induction of labour in this cohort. The Bishop's score demonstrated a marginally higher overall predictive accuracy, with an area under the ROC curve (AUC) of **0.951** at a threshold of ≤3, compared to an AUC of **0.919** for a cervical length cut-off of ≤27 mm. This indicates that the Bishop's score offers slightly superior discrimination between women who will and will not experience successful induction.

In terms of sensitivity and specificity, both methods achieved high values at their optimal thresholds. For cervical length ≤27 mm, sensitivity was **84.5%** and specificity was **80.1%**. For Bishop's score

≤3, sensitivity was **60.4%** but specificity was notably higher at **93.2%**. At higher Bishop's score thresholds (≤4 and ≤5), sensitivity increased (up to 91.9%), though with a corresponding decrease in specificity.

Discussion

The study cohort comprised 136 pregnant women scheduled for elective induction of labour at term, including both nulliparous (42.6%) and multiparous (57.4%) participants. Most women were between 26 and 30 years of age (55.8%), with the remaining distributed below 25 years (26.5%) and above 30 years (17.6%). The gestational age at induction was predominantly between 39 and 40 weeks (42.6%), followed by 38–39 weeks (24.2%), 37–38 weeks (21.4%), and over 40 weeks (11.7%). Common comorbidities included hypertension (39.7%) and gestational diabetes mellitus (31.6%), with smaller proportions affected by hypothyroidism (12.5%) and anaemia (10.3%). Indications for induction were most frequently gestational diabetes mellitus (31.6%) and foetal growth restriction (19.8%), with other causes such as small for gestational age, oligohydramnios, and hypertension also represented. The mean Bishop's score at induction was 5.1 ± 1.4, and the mean preinduction cervical length was 25.6 ± 6.7 mm. Prostaglandin E2 was the predominant method of induction (72.8%), and the majority of neonates weighed more than 2.5 kg (65.5%), with a near-equal distribution of male and female infants.

Induction of labour (IOL) remains one of the most frequently performed obstetric interventions, occurring in up to 40% of pregnancies globally [4]. IOL employs pharmacological or mechanical methods to initiate labour when the risks of continuing pregnancy outweigh the benefits, such as in cases of post-term pregnancy, pre-eclampsia, or intrauterine growth restriction [5]. Traditionally, the effectiveness of IOL has been assessed by achieving delivery within 24 hours; however, guidelines now emphasize the onset of labour as the indicator of success, with failed induction defined as the absence of established labour after one treatment cycle according to NICE recommendations [6]. While the modified Bishop's score is conventionally used to predict IOL success, its subjectivity and high interobserver variability limit its reliability [7,8]. Numerous studies suggest that TVS cervical length measurement may offer superior predictive value compared to the traditional Bishop's score. One recent study demonstrated that cervical length measured via TVS had a sensitivity of 66% and specificity of 76% for predicting successful induction, compared to the Bishop's score, which exhibited a sensitivity of 77% but a notably lower specificity of 56% [9]. Similarly, another study found that TVS measurements could potentially replace the Bishop's score as an effective metric, suggesting a trend towards favouring ultrasonographic evaluations in clinical settings [10]. Furthermore, a significant correlation between Bishop's scores and cervical length identified, emphasizing that TVS might provide more reliable measurements, particularly in distinguishing between different states of cervical readiness [11]

In terms of practical application, studies indicate a potential for TVS to reduce the likelihood of caesarean sections following labour induction. Incorporation of TVS and Bishop's score could yield more clinical information and can optimize predictive capabilities, with established cut-off points (20 mm for cervical length) proving effective [12]. This was underscored by a recent study which concluded that by including cervical length among other parameters, can led to more objective measures [13]. The transition to utilizing more objective metrics like TVS is critical as the obstetrics field seeks to improve clinical outcomes. TVS can be less painful than digital examinations, contributing to heightened patient comfort during assessments [14]. The accuracy of TVS in measuring cervical conditions could also alleviate subjective discrepancies often associated with the Bishop's score, a point echoed across various studies [2,15]

Physiologically, the predictive value of both Bishop's score and cervical length is rooted in the cervical remodelling process during pregnancy, governed by biochemical changes such as collagen breakdown and increased water content, which are mediated by prostaglandins and other factors. These changes promote cervical softening and dilation, facilitating successful labour induction. Our

ROC curve analysis revealed high predictive accuracy for both cervical length (AUC = 0.919) and Bishop's score (AUC = 0.950), with an optimal cervical length cutoff of 27 mm providing balanced sensitivity (84.5%) and specificity (80.1%). This cutoff indicates sufficient cervical remodelling for vaginal delivery, while scores above 4 on the Bishop's scale are highly sensitive and specific predictors of induction success. These findings reinforce the clinical utility of both assessments in anticipating induction outcomes and support their integration into routine obstetric practice.

Conclusion

In summary, both the Bishop's score and ultrasonographic cervical length demonstrated high diagnostic accuracy in predicting successful labour induction, with the Bishop's score showing a marginally higher area under the ROC curve (AUC 0.951) compared to cervical length (AUC 0.919). At their optimal thresholds, the Bishop's score (≤3) offered greater specificity (93.2%) while the cervical length (≤27 mm) provided higher sensitivity (84.5%). These findings underscore the clinical utility of both methods, with the Bishop's score maintaining a slight advantage in overall predictive performance. However, ultrasonographic measurement of cervical length remains a robust and objective alternative, particularly valuable in scenarios where digital assessment may be limited. Integrating both assessments may further optimize individualized induction strategies and improve maternal and neonatal outcomes.

From a clinical perspective, these findings suggest that while both assessments are highly informative, the **Bishop's score is marginally superior in overall predictive accuracy** for successful induction. However, **ultrasonographic cervical length provides comparable performance**, particularly in settings where a standardized, objective assessment is preferred or where digital examination may be limited by provider experience or patient comfort.

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