ORIGINAL ARTICLE

# Study of Transvaginal Sonographic Assessment of Cervix in Predicting the Success of Labour Induction in Nulliparous Women

**Rizwana Habib Kant, Aquisa Bashir, Shruti Gupta**

**Abstract**

The current study prospective observational was undertaken for one year to determine the accuracy of ultrasonographic assessment of cervix in predicting the successful induction of labour in about 200 nulliparous women undergoing induction of labour. The cervical length of 3.0 cm had a sensitivity of 84% and specificity of 70.7% in predicting a successful labour induction while posterior cervical angle of 100 degree had sensitivity of 85.6% and specificity of 66.7% in predicting successful induction. Both were found to be statistically significant in predicting the mode of delivery. But percentage of funnelling was found to be statistically insignificant in predicting successful induction. Transvaginal sonographic assessment of cervix has significant association with outcome of induction of labour.

**Key Words**

Bishop Score, Transvaginal Ultrasound, Cervical Length, Posterior Cervical Angle, Induction of Labour

## Introduction

Induction of labour is the most common intervention in modern obstetrics (1). Induction of labour is defined as iatrogenic stimulation of uterine contraction to accomplish delivery prior to the onset of spontaneous labour (2). Induced labour can also be defined as one in which pregnancy is terminated artificially any time after fetal viability is attained by a method that aims to secure vaginal delivery (3). Induction of labour is indicated when benefits to mother or the fetus outweigh those of continuing the pregnancy such as postdated pregnancy, pre-eclampsia or foetal growth retardation and foetal demise etc (4).Cervical status is one of the most important factors of predicting likelihood of successful induction of labour (5). During pregnancy cervical ripening initiate long before term. Traditionally, pre-induction cervical assessment is based on the digital examination of cervix using pelvic scoring system proposed by Bishop (6) which is simple and easy to perform. A score of 5 or less suggests that labour is unlikely to start without induction. A score of 9 or more indicates that labour will most likely commence spontaneously (7). The five components of Bishops score depends solely on the digital assessment of cervix and the level of presenting part. One of the most common labour ward problem is the different results of digital assessment of the cervix by different medical examiners. The main reason behind this conflict is the subjective nature of the digital examination of cervix, especially the assessment of cervical length (8). The supravaginal portion of the cervix makes up about 50% of the cervical length and varies from women to women. This portion of cervix is difficult to estimate digitially and it makes assessment highly subjective (9). Therefore, more recently several authors have tried to find a more objective and uniform method of assessment of cervix using transvaginal sonography for the prediction of outcome of labour induction (10,6,11-14). The measurement of cervical length and the presence of funnelling by transvaginal ultrasonography has been widely used before for prediction of preterm delivery in patients at risk of or with pre-term labour. Nowadays, transvaginal ultrasonography is also used as pre-induction predictor of successful induction in term pregnancy. Nulliparity is associated with a longer duration of induced labour (13) and this is probably due to later occurrence of acceleration- phase than in parous women (15) So in nullipara to assess preinduction cervical status, transvaginal sonography appears to be feasible alternative to the traditional Bishop's score, since it is considered to be reproducible (16), easy to learn (17,18) and with images that can be documented for intra and interobserver comparsion. Initial changes at the internal os of the cervix can be observed by transvaginal sonography even in the absence of cervical dilatation. The main objective of this study is to determine the usefulness of transvaginal ultrasonographic parameters in predicting successful induction of labour in nulliparous women.

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## Material and Methods

This prospective observational study was conducted over a period of 1 year. A total of 200 nulliparous women undergoing induction of labour for pregnancy induced hypertension, postdatism and Intrauterine growth retardation were taken for the study. Nulliparous women with singleton, live pregnancy with gestational age greater than thirty seven weeks as determined by menstrual period or by first or second trimester ultrasound scan were included in the study. Women with previously attempted induction of labour and who underwent caesarean section within one hour of induction of labour were excluded from the study. Written informed consent was taken from all patients included in this study. Data was obtained from the maternal notes on maternal age, obstetric history, gestational age and indication for induction. Ultrasound was performed using ultrasound machine (5-7 MHz transducer). Ultrasound examination was done prior to digital examination. Cervical length was measured with callipers in ultrasound machine. The posterior cervical angle was measured with the software for measuring angle in the ultrasound image taken in a saggital plane at the level of internal os approximated to the nearest 10°. In case of a funnelled or an excessively curved cervix, the angle was assessed at the junction of the line measuring the cervical length and the posterior uterine wall. As funnelling is a subjective finding, the percentage of funnelling was used in the study. It is calculated as follow. Percentage of funnelling = A/A+B

A= Funnel length (Length of imaginary line that connects the apex of the funnel to the cranial most edge of the base of funnel)

B= Residual or functional cervical length (cervical length distal to the funnel).

Digital examination was done by two specialist examiners (same examiners in all cases) blinded to each other using Bishop's scoring system and results noted. In women with Bishop score <5 (unfavourable cervix) induction of labour was done with intravenous oxytocin after cervical ripening with intra-cervical dinoprostone gel while as women with Bishop score >5 only intravenous oxytocin was used. The successful prediction of labour induction, resulting in vaginal delivery, by both Bishop score and the ultrasound parameters were analysed statistically.Data was described as mean ± standard deviation and percentage . The metric data was compared by student's t-test and Non metric data by × 2 and Mann Whitney 'U' test. Binary logistic regression analysis was used to predict best estimates. The intergroup variants was checked with 95% confidence interval.

## Results

The mean maternal age , gestational age & BMI depicted in *Table-1*. Among 200 patients 127 patients (63.5%) had transvaginal sonographically measured cervical length less than 3 cm while 73 patients (36.5%) had cervical length more than 3 cm so cervical length of 3 cm was used as a cut off value. And among 200 women, 132 women (66%) had posterior cervical angle measuring more than 100 degree on transvaginaal ultrasonography while only 68 women had angle than 100 degree.The cervical length of 3.0 cm had a sensitivity of 84% and specificity of 70.7% in predicting a successful labour induction while posterior cervical angle of 100 degree had sensitivity of 85.6% and specificity of 66.7% in predicting successful induction. Both were found to be statistically significant in predicting the mode of delivery. But percentage of funnelling was found to be statistically insignificant in predicting successful induction.The area under receiver operating curve for posterior cervical angle is more in predicting mode of delivery.The area under receiver operating curve for cervical length is more in predicting mode of delivery. The total Bishop score and its individual parameters assessed by first and second examiner were not statistically significant in predicting mode of delivery. The total Bishop's score and its individual parameters assessed by both examiners were found to be statistically insignificant as compared to transvaginal sonographic cervical length regarding predicting mode of delivery.The total Bishop's score and its individual parameters assessed by both examiners were found to be statistically insignificant as compared to transvaginal sonographic posterior cervical angle in predicting mode of delivery.

## Discussion

Success of induction of labour is determined in large part by the initial state of the cervix. Cervical assessment is being done by traditional Bishop scoring which has been shown to be subjective with high inter and intra-observer variation. This variation sometimes results in poor prediction of the mode of delivery , so there was a need for objective method of assessment of cervix. Recently a more objective assessment of the cervix using transvaginal sonography for the prediction of outcome of labour induction has been developed.

This study was conducted in nulliparous women with singleton pregnancy. We included only nullipara in the study to exclude the effect of parity on prediction of mode of delivery. In this study, women who had vaginal or caesarean delivery had no statistical difference in birthweight, gestational age, and the body mass index(BMI). Another important aspect of this study was that only two methods were used as induction agents (Prostaglandin E1 and intravenous Oxytocin). It is possible that different induction agents have an effect on the duration as well as mode of delivery. The mean age of women in this study was 24.8+3.2 years, minimum of 20 years and maximum age of 30 years. There was no statistically significant difference between the women who delivered vaginally or those by caesarean section regarding the mean maternal age. Our observation was similar to that made by Keepanasseril *et al* (4), Linas R *et al* (19), Pandis GK *et al* (6) , Hoogeveeen MM, *et al*

***Table 1 Clinical Characteristics***

| Parameters | mean ± SD |
|---|---|
| 1 Maternal Age | 24.8 years |
| 2. Gestational Age(weeks) | 39.0 ± 1.4 (37,42) |
| 3. Body Mass Index (kg/m$^2$) | 26.3 ± 3.1 (20.2,32.9) |

***Fig 1.TVS Characteristics of the Studied Subjects***

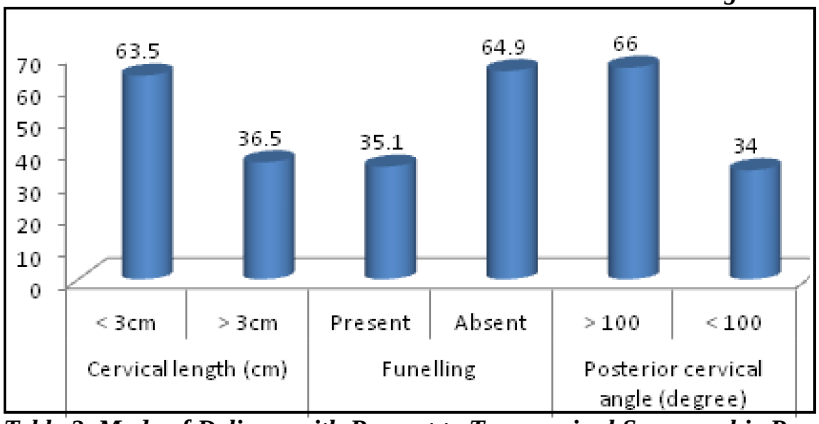



***Fig 2. Receiver Operating Characteristic Curve***

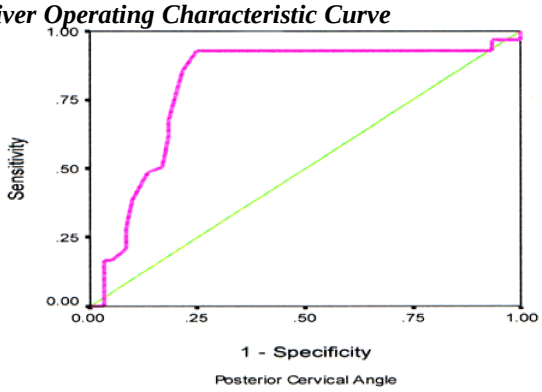



***Table 2. Mode of Delivery with Respect to Transvaginal Sonographic Parameters***

| | | Normal Vaginal | | LSCS | | |
|---|---|---|---|---|---|---|
| | | N | % | N | % | P value |
| Cervical Length | =3 cm | 105 | 84.0 | 22 | 29.3 | 0.000 (Sig) |
| | >3 cm | 20 | 16.0 | 53 | 70.7 | |
| Cervical Length (cm) | | 2..3± 0.9 (1,4) | | 3.5± 0.6 (1.5,4) | | |
| Posterior Cervical Angle (degree) | >100 | 107 | 85.6 | 25 | 33.3 | 0.000 (Sig) |
| | =100 | 18 | 14.4 | 950 | 66.7 | |
| Posterior Cervical Angle (degree) | | 107.0 ± 10.4 (78,128) | | 94.3 ± 11.1(80,131) | | |
| Percentage of Funnelling | | 44.4 ± 7.9 (31.4,60.0) | | 42.1 ± 4.4 (37.1,51.9) | | 0.222 (NS) |

***Fig 3. Receiver Operating Characteristic Curve***

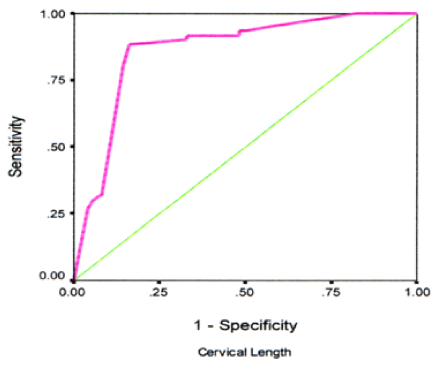
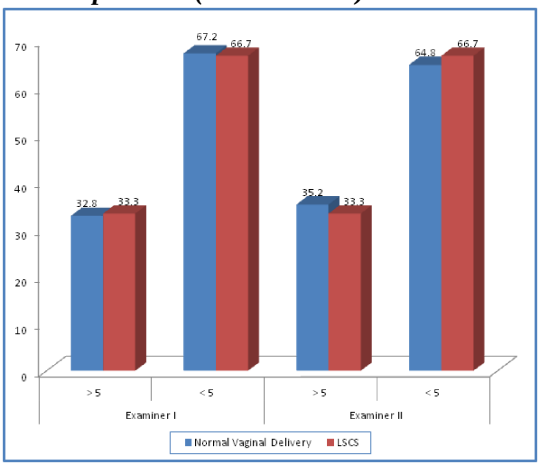



***Fig 4. Bishop's score (Pre-induction)***




be statistically insignificant with respect to mode of delivery which was consistent with the study conducted by Keepanasseril A , *et al* (4) and Kang WS *et al* (21). The mean body mass index of women in our study was 26.3 kg/m$^2$ and its p value was 0.965 which was insignificant regarding prediction of mode of delivery and was similar to results obtained by other studies (6,19,21). The ultarasonographic parameters studied were cervical (20) and Kang WS *et al* (21). The mean gestational age at induction was more than 37 weeks and was found to

***Table 3. Comparison of Ultrasonographic Cervical Length with Bishop Score in Predicting Mode of Delivery***

| Cervical Length | | | = 3 cm | | >3 cm | | P value | |
|---|---|---|---|---|---|---|---|---|
| | | | N | % | N | % | | |
| Position of cervix | Posterior | E1 | 59 | 46.5 | 37 | 50.7 | | |
| | | E2 | 45 | 35.4 | 36 | 49.3 | E1 | 0.921 |
| | Mid | E1 | 45 | 35.4 | 17 | 23.3 | | |
| | | E2 | 61 | 48.0 | 22 | 30.1 | | |
| | Anterior | E1 | 23 | 18.1 | 19 | 26.0 | E2 | 0.253 |
| | | E2 | 21 | 16.5 | 15 | 20.5 | | |
| Consistency of cervix | Firm | E1 | 16 | 12.6 | 2 | 2.7 | | |
| | | E2 | 7 | 5.5 | 5 | 6.8 | E1 | 0.649 |
| | Medium | E1 | 16 | 12.6 | 21 | 28.8 | | |
| | | E2 | 30 | 23.6 | 11 | 15.1 | | |
| | Soft | E1 | 95 | 74.8 | 50 | 68.5 | E2 | 0.327 |
| | | E2 | 90 | 70.9 | 57 | 78.1 | | |
| Cervical Effacement | 0 to 30 | E1 | 81 | 63.8 | 54 | 74.0 | | |
| | | E2 | 82 | 64.6 | 54 | 74.0 | E1 | 0.066 |
| | 40 to 50 | E1 | 33 | 26.0 | 19 | 26.0 | | |
| | | E2 | 37 | 29.1 | 19 | 26.0 | | |
| | 60 to 70 | E1 | 13 | 10.2 | 0 | 0.0 | E2 | 0.111 |
| | | E2 | 8 | 6.3 | 0 | 0.0 | | |
| Dilatation of cervix | Closed | E1 | 52 | 40.9 | 29 | 39.7 | | |
| | | E2 | 60 | 47.2 | 29 | 39.7 | | |
| | 1 to 2 | E1 | 52 | 40.9 | 24 | 32.9 | E1 | 0.445 |
| | | E2 | 46 | 36.2 | 26 | 35.6 | | |
| | 3 to 4 | E1 | 21 | 16.5 | 20 | 27.4 | | |
| | | E2 | 17 | 13.4 | 18 | 24.7 | E2 | 0.215 |
| | >5 | E1 | 2 | 1.6 | 0 | 0.0 | | |
| | | E2 | 4 | 3.1 | 0 | 0.0 | | |
| Station of head | -3 | E1 | 45 | 35.4 | 31 | 42.5 | | |
| | | E2 | 45 | 35.4 | 32 | 43.8 | E1 | 0.806 |
| | -2 | E1 | 64 | 50.4 | 27 | 37.0 | | |
| | | E2 | 62 | 48.8 | 26 | 35.6 | | |
| | -1 | E1 | 18 | 14.2 | 15 | 20.5 | E2 | 0.612 |
| | | E2 | 20 | 15.7 | 15 | 20.5 | | |
| Bishop's score (Pre-induction) | >5 | E1 | 40 | 31.5 | 26 | 35.6 | | |
| | | E2 | 42 | 33.1 | 27 | 37.0 | E1 | 0.552 |
| | =5 | E1 | 87 | 68.5 | 47 | 64.4 | | |
| | | E2 | 85 | 66.9 | 46 | 63.0 | E2 | 0.576 |

length, posterior cervical angle and funnelling. Cut-off of 3.0 cm for the cervical length had a sensitivity of 84% and specificity of 70.7% and posterior cervical angle of 100° had 85.6% sensitivity and 66.7% specificity in predicting a successful labour induction. Cervical length of 3 cm (p value =0.000) was found to be statistically significant as an independent predictor of the mode of delivery in nulliparous women. Posterior cervical angle of 100° (p value=0.000) was also found to be significant in predicting the mode of delivery. But the percentage of funnelling was statistically insignificant (p value=0.222) in predicting successful induction. As funnelling was present in only 35.1% women so it could not be used as an independent predictor of mode of delivery. The absence of funnelling can be explained by the phenomenon that towards the end of pregnancy head descends so funnelling disappears. Neither total Bishop score and nor its individual parameters were found to be statistically significant compared to cervical length and posterior cervical angle in predicting the mode of delivery. Our results are consistent with the study conducted by Keepanasseril *et al* (4), Paterson-Brown *et al* (22), Cromi A *et al* (23). In our study mean cervical length of 2.6 cm and posterior cervical angle of 100 degree were independent predictors of normal delivery. T.M. Eggebo *et al* (24), also found that cervical length less than 26 mm and cervical angle greater than 90° were the best cut-off levels for predicting vaginal delivery. Studies by Marija *et al* (25) and Alabi-isama *et al* (26) also were consistent with our study. In our study we compared

***Table 4. Comparison of Ultrasonographic Posterior Cervical Angle with Bishop Score in Predicting Mode of Delivery***

| Posterior cervical angle (degree) | | | >100 | | =100 | | P value | |
|---|---|---|---|---|---|---|---|---|
| | | | N | % | N | % | | |
| Position of cervix | Posterior | E1 | 64 | 48.5 | 32 | 47.1 | E1 | 0.330 |
| | | E2 | 44 | 33.3 | 37 | 54.4 | | |
| | Mid | E1 | 46 | 34.8 | 16 | 23.5 | E2 | 0.124 |
| | | E2 | 68 | 51.5 | 15 | 22.1 | | |
| | Anterior | E1 | 22 | 16.7 | 20 | 29.4 | | |
| | | E2 | 20 | 15.2 | 16 | 23.5 | | |
| Consistency of cervix | Firm | E1 | 12 | 9.1 | 6 | 8.8 | E1 | 0.114 |
| | | E2 | 3 | 2.3 | 9 | 13.2 | | |
| | Medium | E1 | 19 | 14.4 | 18 | 26.5 | E2 | 0.457 |
| | | E2 | 31 | 23.5 | 10 | 14.7 | | |
| | Soft | E1 | 101 | 76.5 | 44 | 64.7 | | |
| | | E2 | 98 | 74.2 | 49 | 72.1 | | |
| Cervical Effacement | 0 to 30 | E1 | 88 | 66.7 | 47 | 69.1 | E1 | 0.792 |
| | | E2 | 89 | 67.4 | 47 | 69.1 | | |
| | 40 to 50 | E1 | 36 | 27.3 | 16 | 23.5 | E2 | 1.000 |
| | | E2 | 40 | 30.3 | 16 | 23.5 | | |
| | 60 to 70 | E1 | 8 | 6.1 | 5 | 7.4 | | |
| | | E2 | 3 | 2.3 | 5 | 7.4 | | |
| Dilatation of cervix | Closed | E1 | 53 | 40.2 | 28 | 41.2 | E1 | 0.124 |
| | | E2 | 61 | 46.2 | 28 | 41.2 | | |
| | 1 to 2 | E1 | 61 | 46.2 | 15 | 22.1 | E2 | 0.323 |
| | | E2 | 49 | 37.1 | 23 | 33.8 | | |
| | 3 to 4 | E1 | 16 | 12.1 | 25 | 36.8 | | |
| | | E2 | 18 | 13.6 | 17 | 25.0 | | |
| | >5 | E1 | 2 | 1.5 | 0 | 0.0 | | |
| | | E2 | 4 | 3.0 | 0 | 0.0 | | |
| Station of head | -3 | E1 | 52 | 39.4 | 24 | 35.3 | E1 | 0.361 |
| | | E2 | 52 | 39.4 | 25 | 36.8 | | |
| | -2 | E1 | 61 | 46.2 | 30 | 44.1 | E2 | 0.527 |
| | | E2 | 59 | 44.7 | 29 | 42.6 | | |
| | -1 | E1 | 19 | 14.4 | 14 | 20.6 | | |
| | | E2 | 21 | 15.9 | 14 | 20.6 | | |
| Bishop's score (Pre-induction) | >5 | E1 | 38 | 28.8 | 28 | 41.2 | E1 | 0.078 |
| | | E2 | 42 | 31.8 | 27 | 39.7 | | |
| | <5 | E1 | 94 | 71.2 | 40 | 58.8 | E2 | 0.268 |
| | | E2 | 90 | 68.2 | 41 | 60.3 | | |

transvaginal sonographically measured cervical length with Bishop score in predicting mode of delivery and we analysed that cervical length was better predictor than Bishop score. Our results were consistent with Yildiz Udyar *et al* (27) and Rane SM *et al* (11). We also analysed that cervical length of 3.0 cm was an independent predictor of mode of delivery. Maitra N *et al* (28) also assessed that at less than 3cm cervical length, the probability of caesarean was less than 30% while with 4 cm cervical length the probability became greater than 75%. One unit increase in cervical length increased the probability of caesarean section by 46%. In our study we found transvaginal sonographically measured cervical length and posterior cervical angle to be better predictors than Bishops score in predicting labour outcome which was further supported by studies done by Tan PC *et al* (29). Briegeret *et al* (30) did observational study and found no consistent relationship between funnel length and width in prediction of mode of delivery. But there was an inverse relation between cervical length and duration of labour. The results were in accordance with our study.

## Conclusion

Transvaginal sonography is more objective and uniform method of assessment of the cervix than conventional Bishop scoring which is subjective, with high inter and intra observer variation. It was also concluded that preinduction transvaginal sonography is of greater

importance in predicting mode of delivery as it is reproducible and comparatively accurate. Transvaginal assessment of the cervix in predicting likelihood of spontaneous onset of labour and risk of caserean section is valuable for decision making in patients needing induction.

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