

# Does Cervical Length Measurement Help to Predict the Success Rate of Labor Induction Using Misoprostol at Term in Women With Strictly Unfavorable Cervix?

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## Abstract

**Objectives:** To evaluate the clinical use of transvaginal ultrasonographic cervical length measurement for predicting successful labor induction at term in women with strictly unfavorable cervixes.

**Materials and Methods:** Seventy four women at term with maternal and fetal indications for labor induction were included in the study. All women had singleton pregnancies in vertex presentation and a Bishop score of  $\leq 4$  in the presence of closed cervixes without evidence of uterine contractions. Fifty  $\mu\text{g}$  sublingual misoprostol every four hours up to a maximum six doses was commenced. Cervical length was measured by transvaginal ultrasound, and receiver operator curve characteristics were analyzed for predictability of cesarean delivery and induction failure as judged on the basis of no delivery or no uterine contractions within 24 hours.

**Results:** Fourteen cesarean deliveries (18.9%) and seven induction failures (9.4%) were diagnosed. Using the optimum cut-off value of 30 mm as a threshold of cervical length for the prediction of induction failure, a sensitivity of 85.7%, a specificity of 44.3%, a positive predictive value of 15% and a negative predictive value of 96.4% were obtained. Using the optimum cut-off value of 30 mm as a threshold of cervical length for the prediction of cesarean delivery, a sensitivity of 85.7%, a specificity of 43.3%, a positive predictive value of 26% and a negative predictive value of 92.9% were obtained. The cesarean section rate was 26.1% for the women who had a cervical length  $\geq 30$  mm, while it was 7.1% for the women with a cervical length  $\leq 30$  mm ( $p=0.04$ ). Fetal birth weight was a better predictor of failed induction (Area Under the Curve [AUC]: 0.65) followed by cervical length (AUC: 0.63).

**Discussion:** Although cervical length measurement has some predictive value, AUC analysis revealed that it is far from being an ideal test for detecting induction failures. 30 mm can be a good clinical cut-off value to predict cesarean deliveries in women with misoprostol induced labor.

**Keywords:** induced labor, ultrasonography, cervix uteri, treatment failure, cesarean sections

## Özet

### Termde Uygunuz Serviks Sahip Kadınlarda Mizoprostol ile Doğum İndüksiyonunun Başarısını Öngörmeye Servikal Uzunluk Ölçümü Yardımcı Olabilir mi?

**Amaç:** Uygunuz serviks sahip kadınlarda termde doğum indüksiyonunun başarısını öngörmeye transvajinal ultrasonografik olarak servikal uzunluk ölçümünün klinik öneminin değerlendirilmesi.

**Materyal ve Metot:** Çalışmaya maternal ve fetal endikasyonlar nedeniyle doğum indüksiyonu uygulanan yetmiş dört ardeşik term kadın dahil edildi. Tüm kadınlar verteks prezentasyonunda tekil gebeliğe sahipti ve uterin kontraksiyonlar olmaksızın, kapalı serviks varlığında, Bishop skoru  $\leq 4$  idi. Dört saatte bir 50  $\mu\text{g}$  olmak üzere maksimum altı doz sublingual mizoprostol uygulandı. Transvajinal ultrasonografi ile servikal uzunluk ölçümü gerçekleştirildi. Sezaryen doğum oranları ve 24 saat içerisinde doğumun gerçekleşmemesi ya da uterin kontraksiyonların indüklenememesi şeklinde tanımlanan başarısız indüksiyon oranlarının öngörülmesini belirlemek üzere ROC analizi yapıldı.

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**Sonuç:** On dört sezaryen doğum (%18.9) ve yedi başarısız indüksiyon (%9.4) tanısı konuldu. Başarısız indüksiyonun öngörülmesinde optimum servikal uzunluk eşik değeri olarak 30 mm kullanıldığında %85.7 duyarlılık, %44.3 özgüllük, %15 pozitif prediktif değer ve %96.4 negatif prediktif değer elde edildi. Sezaryen doğumun öngörülmesinde optimum servikal uzunluk eşik değeri olarak 30 mm kullanıldığında %85.7 duyarlılık, %43.3 özgüllük, %26 pozitif prediktif değer ve %92.9 negatif prediktif değer elde edildi. Servikal uzunluğu  $\geq 30$  mm olan kadınlarda sezaryen oranı %26.1 iken  $< 30$  mm olanlarda %7.1 olarak saptandı ( $p=0.04$ ). Başarısız indüksiyonun öngörülmesinde daha iyi bir prediktör olan fetal doğum ağırlığını (AUC: 0.65) servikal uzunluk takip etti (AUC: 0.63).

**Tartışma:** Servikal uzunluk ölçümünün bir miktar prediktif değeri olmasına karşılık AUC (eğri altında kalan alan) analizleri göstermiştir ki mizoprostolle indüklenen doğumlarda başarısız indüksiyonun tahmininde ideal bir test olmaktan halen uzaktır. 30 mm eşik değeri, sezaryen doğumların tahmininde iyi bir klinik bulgu olabilir.

**Anahtar sözcükler:** doğum indüksiyonu, transvajinal sonografi, servikal uzunluk, başarısız indüksiyon, sezaryen doğum

## Introduction

Labor induction at term with medical indications has been performed in 20% of all deliveries but labor has not been achieved in approximately 5-10% of these inductions (1,2). Deliveries complicated by prolonged labor place both the fetus and the mother at increased risk of multiple medical interventions, maternal fatigue, increased morbidity, prolonged hospitalization as well as increased incidence of operative intervention and cesarean section (3). Considering that 18% of the patients having induction of labor need a cesarean section for delivery, the need for more specific criteria for the prediction of successful induction of labor is understandable (4).

Even though preinduction cervical assessment has traditionally been accomplished on the Bishop score for decades, assessments of the cervix digitally vary considerably even among experienced obstetricians and effacement is difficult to determine in the presence of closed cervix (5). Also, Bishop score has a poor predictive value for the outcome of induction of labor (6). Transvaginal ultrasound has been a relatively new technique in the assessment of the cervix for the prediction of successful labor induction and transvaginal ultrasound scanning of the cervix during the third trimester of pregnancy gives much less inter-observer variation. It may accurately reflect the cervical anatomy and has been better-tolerated than the often painful digital examination of the pelvis (7,8).

The aim of this study was to evaluate the use of pre-induction transvaginal sonographic assessment of cervical length in the prediction of failed induction of labor and cesarean delivery in women with closed cervices.

## Material and Methods

This was a prospective follow-up study conducted on 74 singleton pregnancies at term that attended for induction of labor with misoprostol for maternal and fetal indications at Department of Obstetrics and Gynecology of Kocaeli University Faculty of Medicine between February 2004 and February 2005.

Criteria for enrolment included: 1) singleton cephalic presentation of the fetus, 2) gestational age  $\geq 37$  weeks of gestation as determined from the date of the last menses and confirmed by

first trimester ultrasound measurements, 3) less than four uterine contractions per hour, 4) no previous cesarean section or any uterine surgery, 5) a Bishop score  $\leq 4$  in the presence of a closed cervix, and 6) no contraindication to vaginal birth.

The indications for induction were prolonged pregnancy beyond 41 weeks of gestation in 28 cases (37.8%), oligohydramnios in 8 cases (10.8%), premature rupture of the membranes in 6 cases (8.1%), preeclampsia in 6 cases (8.1%), intrauterine growth restriction in 5 cases (6.7%), maternal diabetes mellitus in 5 cases (6.7%). In the remaining 16 (21.6%) patients, the indications for induction of labor were maternal medical problems, poor obstetrical history, maternal cholestasis, hypothyroidism, large for gestational age infant, previous pregnancy complicated by shoulder dystocia, reduced fetal movements and a biophysical score of 6 or less. Approval from the Research and Ethics Committee of the hospital was obtained for the study and those giving written informed consent were enrolled in the study.

Transvaginal ultrasonographic measurement of the cervical length from the internal os to the external os, with an empty bladder was performed before induction by a consultant obstetrician. The probe was placed in the vagina approximately 3 cm proximal to the cervix to avoid any cervical distortion of its position or shape and a sagittal view of the cervix, with the echogenic endocervical mucosa along the length of the canal, was obtained. Three measurements were obtained using a Siemens (Siemens Inc, Germany) ultrasound machine equipped with a 5-7-MHz probe, and the shortest measurement was recorded.

**Table 1.** Demographic characteristics of the study population (n=74)

Variables	Values
Age (years)*	27.5 $\pm$ 5.7 (18-44)
Gestational age (weeks)*	39.2 $\pm$ 1.2 (37-41.4)
Body mass index (kg/m <sup>2</sup> )*	28 $\pm$ 3.5 (22.5-37.3)
Tobacco use†	6 (8.1%)
Education >8 years†	40 (54%)
Anemia†	6 (8.1%)
Hospital stay (hours)*	35 $\pm$ 25 (10-120)

\*Values are expressed as mean  $\pm$ SD (minimum-maximum ranges)

†Values are expressed as number (%)

Patients were given 50 µg (one-quarter tablet) misoprostol (Cytotec® 200 µg; Ali Raif İlac Sanayi, Turkey) sublingually every 4 hours for a maximum of 6 doses by an obstetrics consultant or resident, who were uninformed on the ultrasonographic measurements. Digital vaginal examination was performed every two hours.

After the cervix became favorable for an induction (Bishop score  $\geq 6$ ), oxytocin was begun if indicated at a starting dose of 1 mU/min at least 4 hours after the last misoprostol dose as recommended by the American College of Obstetricians and Gynecologists (ACOG) guidelines and increased by of 1mU/min at every 15 minute intervals until a minimum of four uterine contractions/10 min were achieved (9). Amniotomy was performed in women with a Bishop score  $\geq 8$ , except for the women who were induced for the indication of premature rupture of the membranes.

The induction to delivery interval and route of delivery were recorded. If undelivered, the Bishop score of all women were recorded at 24<sup>th</sup> hour of induction. A Foley catheter inflated with 50 ml saline solution was applied to the internal cervical ostium in all cases with Bishop score  $< 6$  at 24<sup>th</sup> hour and 250 ml of extraamniotic saline solution was infused together with concomitant intravenous oxytocin infusion. Dystocia was diagnosed if the cervical score did not change for four hours in the presence of effective uterine contractions or if no uterine contractions were achieved.

Results were analysed primarily to determine the criteria for the predictive use of cervical length in the prediction of induction failure. Induction was considered a failure when delivery was not achieved within the first 24 hours after induction if the cervical Bishop score was  $< 6$  or no uterine contractions induced until 24<sup>th</sup> hour of induction. Secondary to these were the criteria for cesarean delivery for any reason.

The statistical analysis of the data was performed using statistical software (Statistical Package for the Social Sciences, SPSS Inc, IL, USA). Receiver-operating curve characteristics (ROC) were constructed and coordinate points were evaluated to determine a cut-off value and the possible predictors of cesarean deliveries and failed inductions. Area under the curve (AUC) was calculated for each variable. The time interval from induction to delivery was analyzed using Kaplan-Meier analyses. Categorical variables were compared via Fisher's exact test. Probability value  $p < 0.05$  was considered to be statistically significant.

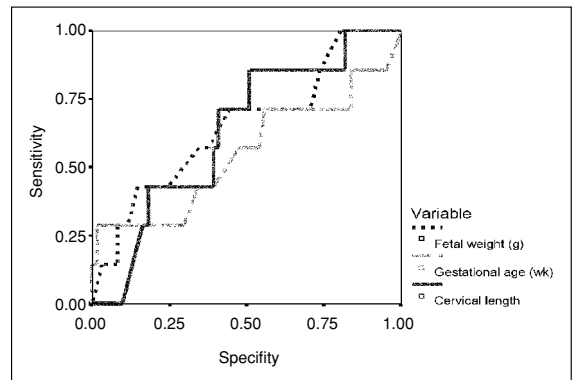
## Results

Among the 74 women enrolled into the study 38 (51.4%) were nulliparas and 36 (48.6%) were multiparas. The mean gravidity of the study population was  $2 \pm 1.3$  (R=1-7) and the mean parity was  $0.7 \pm 1$  (R=0-6).

Selected maternal characteristics such as age, body mass index, tobacco use, education, anemia and length of hospital

stay are presented in Table 1. The mean gestation at induction was  $39.2 \pm 1.2$  weeks (Table 1). The mean birth weight was  $3311 \pm 515$  g (range 1650-4400). The mean induction to delivery time was  $608 \pm 351$  minutes. Sixty seven (90.6%) women delivered within 24 hours of induction. Seven (9.4%) of the cases were considered as failed inductions. Fourteen (18.9%) women had a cesarean section, indications were emergent cesarean delivery for fetal heart rate abnormalities in nine (12.2%) of the cases and dystocia in five (6.8%) of the cases. Tachysystole occurred in twelve (16.2%) of the cases.

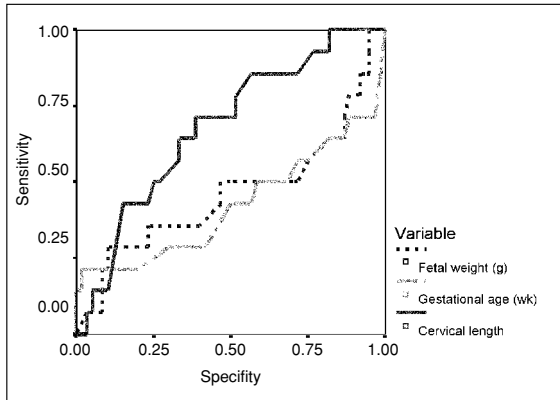
Parity was not a good predictor of induction failure (Area under the Curve (AUC): 0.54). Fetal birth weight was a better predictor of induction failure than cervical length measurements (AUC: 0.65 and 0.63 respectively). Area under the curve (AUC) for gestational week was 0.55. Using the optimum cut-off value of 30 mm as a threshold of cervical length for the prediction of induction failure, a sensitivity of 85.7%, a specificity of 44.3%, a positive predictive value of 15% and a negative predictive value of 96.4% were obtained (Figure 1).



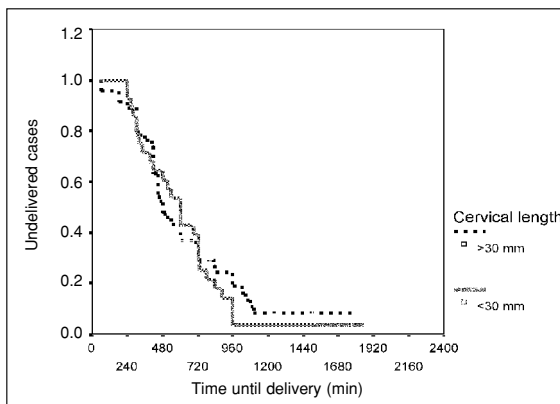
**Figure 1.** Diagnostic values of different variables in the prediction of failed induction of labor

Cervical length measurement for the prediction of cesarean delivery had the highest area under the ROC curve (AUC: 0.68). Using the optimum cut-off value of 30 mm as a threshold for the prediction of cesarean delivery, a sensitivity of 85.7%, a specificity of 43.3%, a positive predictive value of 26% and a negative predictive value of 92.9% were obtained (Figure 2). The cesarean section rate was 26.1% for the women who had a cervical length  $\geq 30$  mm, it was 7.1% for the women with a cervical length  $\leq 30$  mm ( $p=0.04$ ).

Kaplan-Meier analysis revealed that delivery characteristics in time was not different in women with a cervical length  $\geq 30$  mm or  $< 30$  mm (Figure 3) (Log rank 0.26,  $p=0.61$ ). A total of 96.4% (27/28) of the cases with a cervical length  $< 30$  mm delivered within 24 hours while 87% (40/46) of the cases with a cervical length  $\geq 30$  mm delivered within 24 hours ( $p=0.2$ ).



**Figure 2.** Diagnostic values of different variables in the prediction of cesarean delivery



**Figure 3.** Kaplan-Meier survival curve estimates of proportions of undelivered cases, by 30 mm cut-off value as a threshold cervical length. Log rank 0.26,  $p=0.61$

## Discussion

There have been different articles reporting conflicting results about the mode of delivery of the induced deliveries in the literature. Ware and Raynor found in their study that when a cervical length of 30 mm was used as a cut-off point for the prediction of vaginal delivery, a sensitivity of 91% and a specificity of 92% were obtained, respectively (10).

Rane et al. studied 604 singleton pregnancies undergoing induction of labor at 35–42 weeks of gestation by dinoprostone gel or pessier and reported that sonographic cervical length and parity provided significant independent contribution in the prediction of cesarean section (11). Researchers, assuming the sonographic cervical length and parity as significant predictive factors, argue that, successful delivery within 24 hours of induction occurs in approximately in 80% of nulliparous and in 90% of multiparous women with a cervical length <20 mm; while the chance of remaining undelivered with a cervix measuring  $\geq 30$  mm is 90% for the nulliparas and 60% for the multiparas (12).

Pandis et al. performed preinduction cervical assessment in 240 women with singleton pregnancies at 37–42 weeks of gestation and suggested an optimized cut-off value of 28 mm for the prediction of successful induction with a sensitivity of 0.87 and a specificity of 0.71 which appears to be a better predictor than the Bishop score (sensitivity 0.58 and specificity 0.77) (3). Baytur et al. reported that transvaginal ultrasound assessment of the cervix provided significant independent prediction of the likelihood of induction to delivery interval and mode of delivery whereas parity was not an independent factor as seen in our study (13). Roman et al. alleged that the length of the latent phase and that of the whole labor were significantly longer when cervical length was  $\geq 27$  mm, and they reported that ultrasound measurement of cervical length was not more accurate at predicting the duration of labor than the Bishop score (14,15).

Paterson-Brown et al. enrolled 50 pregnant women in their study and found no relation in between clinical cervical effacement and cervical length and reported that there was not any significant correlation between sonographic measurement of cervical length, Bishop score and induction-to-delivery interval, and that cervical length could not predict the mode of delivery successfully (16). Rozenberg et al. compared two hundred and sixty six women with singleton pregnancies in between 34<sup>+0</sup> and 41<sup>+3</sup> weeks of gestation requiring induction of labor with two different prostaglandins (misoprostol vs dinoprostone) for the standardization of the method of induction in two different studies. They reported that the Bishop score was a better predictor of the time interval from induction to delivery, to vaginal delivery and the risk of cesarean delivery than monographic cervical length measurement. They reported that neither the Bishop score nor monographic cervical length measurement could predict induction failure or the risk of cesarean for failure to progress (17,18).

Our study is different than the other studies in the literature in two points. Firstly, we studied only term pregnancies and secondly, we studied cases with strictly unfavorable Bishop scores and closed cervixes in whom cervical effacement can not be assessed accurately. The 30 mm cut-off value is longer than the 27 and 28 mm found in different studies (3,15) and this probably results from including only women with strictly unfavorable cervixes in our study. Our cut-off value of 30 mm cervical length was not a very useful predictor of failed inductions although significantly more women had cesarean sections if the cervical length was  $\geq 30$  mm. This may be due to more cases of soft tissue dystocia with longer cervixes and more cases of non-reassuring fetal heart rate tracings when the cervix remains firmly closed in the presence of uterine contractions. We have previously shown that induction failures can be successfully managed using cervical Foley catheter application (2). As a result, Foley catheter application prior to misoprostol induction of labor may help decrease cesarean delivery rate in women with a cervical length  $\geq 30$  mm.

In conclusion, even though transvaginal cervical length measurement is an objective method to assess the cervix where Bishop score is inconclusive, it may not provide adequate information for the prediction of failed induction but can identify women at risk for cesarean delivery. Possible molecular factors complicating cervical ripening limit the value of cervical length measurement.

## References

1. Royal College of Obstetricians and Gynaecologists (RCOG). Induction of labor. In Evidence Based Clinical Guideline Number 9. London: RCOG Clinical Support Unit, 2001.
2. Çalışkan E, Dilbaz S, Gelisen O, Dilbaz B, Ozturk N, Haberal A. Unsuccessful labor induction in women with unfavorable cervical scores: Predictors and management. *Aust N Z J Obstet Gynaecol* 2004;44:562-7.
3. Pandis GK, Papageorgiou 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;18:623-8.
4. Çalışkan E, Bodur H, Ozeren S, Corakçı A, Ozkan S, Yucesoy I. Misoprostol 50 µg sublingually versus vaginally for labor induction at term: A randomized study. *Gynecol Obstet Invest* 2005;59:155-61.
5. Jackson GM, Ludmir J, Bader TJ. The accuracy of digital examination and ultrasound in the evaluation of cervical length. *Obstet Gynecol* 1992;79:214-8.
6. Dhall K, Mittal SC, Kumar A. Evaluation of pre-induction scoring systems. *Aust N Z J Obstet Gynaecol* 1987;27:309-11.
7. Lazanakis M, Marsh MS, Brockbank E, Economides DL. Assessment of the cervix in the third trimester of pregnancy using transvaginal ultrasound scanning. *Eur J Obstet Gynecol Reprod Biol* 2002;105:31-5.
8. Braithwaite JM, Economides DL. Acceptability by patients of transvaginal sonography in the elective assessment of the first-trimester fetus. *Ultrasound Obstet Gynecol* 1997;9:91-3.
9. American College of Obstetricians and Gynecologists: Induction of Labor with Misoprostol. ACOG Committee on Obstetrics Practice. Washington: ACOG, 1999.
10. Ware V, Raynor BD. Transvaginal ultrasonographic cervical measurement as a predictor of successful labor induction. *Am J Obstet Gynecol* 2000;182:1030-2.
11. Rane SM, Guirgis RR, Higgins B, Nicolaides KH. The value of ultrasound in the prediction of successful induction of labor. *Ultrasound Obstet Gynecol* 2004;24:538-49.
12. Rane SM, Guirgis RR, Higgins B, Nicolaides KH. Pre-induction sonographic measurement of cervical length in prolonged pregnancy: The effect of parity in prediction of induction-to-delivery interval. *Ultrasound Obstet Gynecol* 2003;22:40-4.
13. Baytur Y, Uyar Y, Özçakır HT, İnceboz Ü, Laçın S, Erbay G, Çağlar H. Doğum indüksiyonu öncesinde transvaginal serviks ölçümü: Bishop skoru ve paritenin değerlendirilmesi. *Perinatoloji Dergisi* 2004;12:33-7.
14. Roman H, Verspyck E, Vercoustre L, Degre S, Col JY, Firmin JM, Caron P, Marpeau L. The role of ultrasound and fetal fibronectin in predicting the length of induced labor when cervix is unfavorable. *Ultrasound Obstet Gynecol* 2004;23:567-73.
15. Roman H, Verspyck E, Vercoustre L, Degre S, Col JY, Firmin JM, Caron P, Marpeau L. Does ultrasound examination when the cervix is unfavorable improve the prediction of failed labor induction? *Ultrasound Obstet Gynecol* 2004;23:357-62.
16. Paterson-Brown S, Fisk NM, Edmonds DK, Rodeck CH. Preinduction cervical assessment by Bishop's score and transvaginal ultrasound. *Eur J Obstet Gynecol Reprod Biol* 1991;40:17-23.
17. Rozenberg P, Chevret S, Ville Y. Comparison of pre-induction ultrasonographic cervical length and Bishop score in predicting risk of cesarean section after labor induction with prostaglandins. *Gynecol Obstet Fertil* 2005;33:17-22.
18. Rozenberg P, Chevret S, Chastang C, Ville Y. Comparison of digital and ultrasonographic examination of the cervix in predicting time interval from induction to delivery in women with a low Bishop score. *BJOG* 2005;112:192-6.