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## Research Article

### Influence of Utero-cervical Angle and Cervical Length on Labor Induction

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#### Abstract

**Background:** Successful labor induction is clearly related to the state of the cervix. The utero-cervical angle and cervical length represent novel ultrasonographic markers. **Aim:** To assess the relationship between utero-cervical angle and cervical length and satisfactory response to labor induction. **Methods:** Prospective cohort study was conducted in Al-Elwyia Maternity Teaching Hospital for a period of six months; 100 cases were enrolled in the study, a pre labor induction measurement of utero-cervical angle and cervical length using transvaginal ultrasound scanning were followed up till the end of labor to estimate the rate of success of induction of labor. **Results:** 65 patients had successful induction of labor and 35 failed to do so. No differences were found in demographic data and previous obstetric history. Short cervical length and wide utero-cervical angle were found in successful induction of labor. Significant negative correlation found between utero-cervical angle and labor duration. At cutoff point of 97.5 degree of utero-cervical angle, the sensitivity was 83.12%, specificity was 71.4%, positive predictive value was 84.38%, negative predictive value was 69.45% and the accuracy was 88%. At a cutoff point of less than 29.5 mm of cervical length, the sensitivity was 92.3%, specificity was 80%, positive predictive value was 89.55%, negative predictive value was 84.84% and the accuracy was 88%. **Conclusion:** Utero-cervical angle and cervical length may be independent predictors of a successful induction of labor.

**Keywords:** Cervical length, Induction of labor, utero-cervical angle.

#### تأثير زاوية الرحم وعنق الرحم وطول عنق الرحم على تحريض المخاض

#### الخلاصة

**الخلفية:** يرتبط تحريض المخاض الناجح بوضوح بحالة عنق الرحم. تمثل زاوية الرحم وعنق الرحم وطول عنق الرحم علامات جديدة بالموجات فوق الصوتية. **الهدف:** تقييم العلاقة بين زاوية الرحم وعنق الرحم وطول عنق الرحم والاستجابة المرضية لتحريض المخاض. **الأساليب:** أجريت دراسة أترابية مستقبلية في مستشفى العلوية التعليمي للولادة لمدة ستة أشهر. تم تسجيل 100 حالة في الدراسة. تم متابعة قياس تحريض ما قبل المخاض لزاوية الرحم وعنق الرحم وطول عنق الرحم باستخدام المسح بالموجات فوق الصوتية عبر المهبل حتى نهاية المخاض لتقدير معدل نجاح تحريض المخاض. **النتائج:** نجح تحريض المخاض في 65 مريضا وفشل في 35. لم يتم العثور على اختلافات في البيانات الديموغرافية وتاريخ التوليد السابق. تم العثور على علاقة سلبية معنوية بين زاوية الرحم وعنق الرحم ومدة المخاض. تم العثور على علاقة سلبية معنوية بين زاوية الرحم وعنق الرحم وطول عنق الرحم، وكانت الحساسية 83.12%، وكانت الخصوصية 71.4%، والقيمة التنبؤية الإيجابية 84.38%، والقيمة التنبؤية السلبية 69.45%، وكانت الدقة 88%. عند نقطة انقطاع أقل من 29.5 ملم من طول عنق الرحم، كانت الحساسية 92.3%، وكانت الخصوصية 80%، والقيمة التنبؤية الإيجابية 89.55%، والقيمة التنبؤية السلبية 84.84%، والدقة كانت 88%. **الاستنتاج:** قد تكون زاوية الرحم وعنق الرحم وطول عنق الرحم تنبؤات مستقلة لتحريض ناجح للمخاض.

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## INTRODUCTION

Labor induction is the mechanical or pharmacologic stimulation of uterine contractions before spontaneous labor to induce cervical dilatation and delivery. It differs from augmentation, which stimulates uterine contractions when spontaneous contractions are insufficient [1]. In USA, the rate of labor induction is rising for all gestational ages, which may be due to more labor inductions for postdate pregnancies and elective inductions for various reasons (including maternal desire) [1]. Some institutions have labor induction rates as high as 40%, whereas Latin America has 11.4% and Africa has 4.4% [2]. Induction is indicated when the risk of continuing the pregnancy, for either the mother or the fetus, is greater than the risk of inducing labor and delivery. It should be prioritized by the health care team based on the clinical situation's urgency and available resources [3]. The condition of the cervix is directly related to the success of labor induction. Women with an unfavorable cervix who have not experienced a cervical ripening period before to labor pose the most difficulty in terms of inducing labor. In addition, parity and, to a lesser extent, baseline uterine activity and sensitivity to oxytocic medications increase the duration of labor induction [4,5]. Cervical ripening is the process that culminates in the cervix becoming soft and disposable, hence aiding labor and delivery [6]. There is an inverse association between the Bishop score and the rate of induction failure [7], with low scores associated with a high likelihood of induction failure. Moreover, stimulating uterine contractions in the presence of an immature cervix is more likely to result in a cesarean delivery, and even if vaginal delivery is eventually achieved, the labor is frequently protracted [1]. A substantial amount of study has been conducted on techniques to prepare or ripen the cervix prior to labor induction. Although several of these treatments can also induce uterine activity, it is important to note that their primary function is to soften the immature cervix regardless of uterine activity [8-11]. It has been proposed that the Bishop score is an unreliable predictor of the outcome of term labor induction and should not be utilized [12]. Two other transvaginal ultrasound indicators, cervical length (CL) and utero-cervical angle (UCA), have been proposed. Bishop Score is less desirable than cervical length for predicting the success of induction of labor. Various cervical lengths, ranging from 16 to 32 mm, have been utilized to denote maturity. When these different cervical lengths are evaluated together, a "short" cervical length predicts success and a "long" cervical length predicts failure of labor induction [5]. The aim of the current study was to evaluate the association between utero-cervical angle and cervical length and a favorable response to labor induction.

## METHODS

### *Study design*

A prospective cohort study was undertaken at AL-Elwiyia Maternity Teaching Hospital, Department of Obstetrics and Gynecology from April 2021 to November 2021, spanning an eight-month period. It was assumed that 100 patients who met the inclusion and exclusion criteria and granted informed consent to participate in the study would be enrolled in the study. Inclusion criteria included term (> 37 weeks) pregnant women with a vertex presentation, an unfavorable cervix (defined as a Bishop Score of fewer than 6) and non-laboring patients. Exclusion criteria included previous cesarean delivery, prior uterine or cervical surgery, predicted macrosomia (ultrasound estimated body weight > 4,500 g), fetal congenital abnormalities or fetal death, and contraindications to vaginal delivery.

### *Data collection*

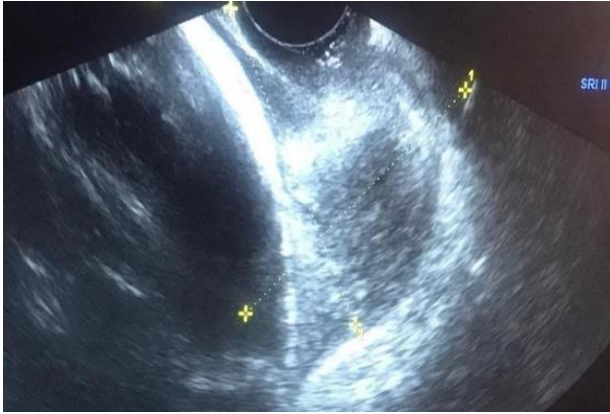
A signed consent was obtained from each participant after a thorough explanation of the goal of the study. This consent ensures that the acquired data will be used solely for research purposes and will be kept anonymous. All patients were evaluated using a preform that included demographic information, a history of hypertension, diabetes, preeclampsia, and oligohydramnios, as well as a bishop score and transvaginal ultrasound examination, and were followed until delivery, with the duration of labor, mode of delivery, and induction of labor being recorded.

### *Measurement of CL and UCA*

Philips HD11 XE (Germany) ultrasound machine was utilized for trans-vaginal ultrasonography. The ultrasonographic measurements were taken using a trans-vaginal transducer of 8.5 MHz with recoding of the cervical length (CL), which was accomplished by drawing a straight line from the internal cervical os to the exterior cervical os. The anterior Utero-Cervical Angle (UCA) was measured by passing the first ray from the internal os to the external os through the endocervical canal and the second ray through the anterior portion of the lower uterine segment (Figure 1).

### *Induction of labor*

A misoprostol vaginal tablet (25 µg) was delivered to the posterior vaginal fornix when the Bishop score was less than 5. If enough cervical softening was not attained after 6 to 8 hr, more doses were administered.



**Figure 1:** UCA measurement by trans-vaginal ultrasound.

This method is repeated until the necessary cervical ripening is attained (defined as Bishop Score  $> 7$ ), four pills have been administered, or 24 hr have passed. Monitoring of the fetal heart was performed one hour after PGE2 administration and every three hours thereafter. The decision to remove the misoprostol tablet is based on uterine tachysystole, a non-reassuring fetal heart rate, effective cervical ripening, and/or 24 hr after insertion. Participants who responded positively to labor induction were transported to the delivery room, and if necessary, oxytocin was administered to increase labor. The decision to insert oxytocin was based on the patterns of uterine contractions. If necessary, augmentation of labor with oxytocin was performed by intravenous administration of a diluted oxytocin infusion. Failure of induction of labor was defined as failure to produce cervical dilation  $> 4$  cm after  $12 \pm 3$  hr of oxytocin administration (with a goal of 3 contractions/10 min) or caesarean section. As previously indicated, the enrolled females were divided into two groups: group A (patients who had successful induction of labor) and group B (patients who had unsuccessful induction of labor).

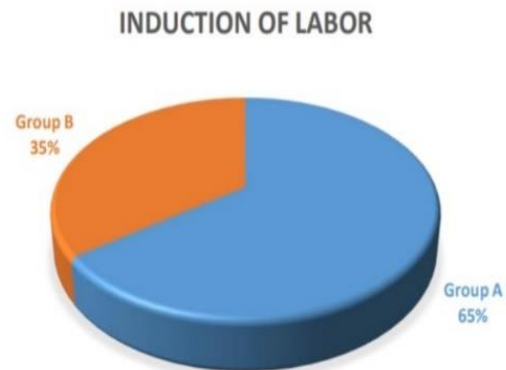
### Statistical analysis

The acquired data were entered into worksheet 16 of Microsoft Excel and then loaded into IBM SPSS V26 for statistical analysis. There were tables used to display descriptive statistics (number and frequency, means and standard deviations). The Chi-square test was used to quantify the level of significance for categorical data, but the Mann Whitney U test was used to determine the significance of differences between continuous variables due to the abnormal distribution of gathered data, which is

a prerequisite for the t test. A correlation test was performed to determine the relationship between CL, UCA, and work duration. Then, the linear regression between UCA, CL, and labor duration is estimated. A *P*-value of less than 0.05 was deemed the threshold for distinguishing significance. Using receiver operator curve (ROC) to determine the area under the curve and Youden's J index test to determine the best cutoff point above which the sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy of the tests were maximized, the predictive ability of each of CL and UCA in predicting the success of the IOL was then estimated.

### RESULTS

Figure 2 demonstrates that 65 women in this study had successful induction of labor (group A), while 35 women had unsuccessful induction of labor (group B).

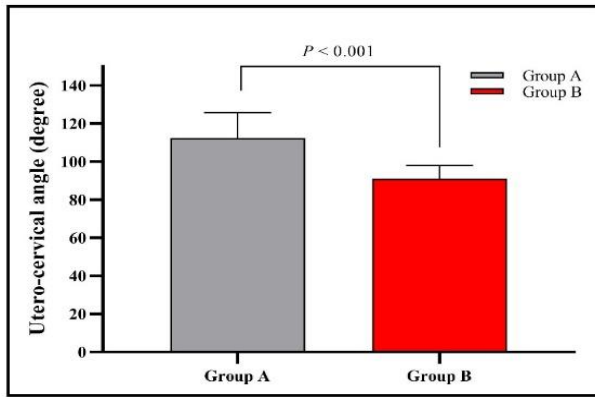


**Figure 2:** Allocation to groups according to the rate of successful induction.

According to Table 1, the mean age of women in group A was  $29.55 \pm 7.8$  years, while the mean age of women in group B was  $28.08 \pm 7.5$  years. In group A, the average gestational age was  $39.85 \pm 1.5$  weeks, while in group B it was  $39.59 \pm 1.05$  weeks. In group A, the mean BMI was  $27.44 \pm 3.63$  kg/m<sup>2</sup>, while in group B, it was  $27.61 \pm 3.71$  kg/m<sup>2</sup>. There were no statistically significant differences between the two groups for these three metrics ( $P > 0.05$ ). In Figure 3, the mean utero-cervical angle was  $112.48 \pm 13.3$  degrees in group A and  $91.06 \pm 6.97$  degrees in group B, which was statistically significant ( $P < 0.001$ ).

**Table 1:** Demographical characters of the studied subjects.

Parameters	Group	Range	Mean±SD	P-value
Age (year)	A	16.0-42.0	29.6±7.9	0.345
	B	17.0-39.0	28.1±7.5	
Gestational age (weeks)	A	37.1-42.9	39.9±1.5	0.184
	B	38.0-41.4	39.6±1.1	
BMI (kg/m <sup>2</sup> )	A	21.7-34.4	27.4±3.6	0.786
	B	21.9-33.5	27.6±3.7	



**Figure 3:** Utero-cervical angle in the two groups.

In addition, Table 2 demonstrates that group A had a shorter mean cervical length (25.09±3.2 mm) than group B (30.85±1.47 mm), a statistically significant difference. In groups A and B, the average duration of labor was 891.62±56.26 minutes and 1381.61±51.41 minutes, respectively, which is statistically significant ( $P < 0.001$ ) (Table 2).

**Correlation analysis of the variables**

**Table 2:** Duration of labor and cervical length in the two groups.

Parameters	Group	Range	Mean±SD	P-value
Labor duration (min)	A	480-1390	891.6±226.3	< 0.001
	B	1099-1616	1381.6±151.4	
Cervical length (mm)	A	20-33	25.1±3.2	< 0.001
	B	28-33	30.9±1.5	

**Estimation of predictive ability**

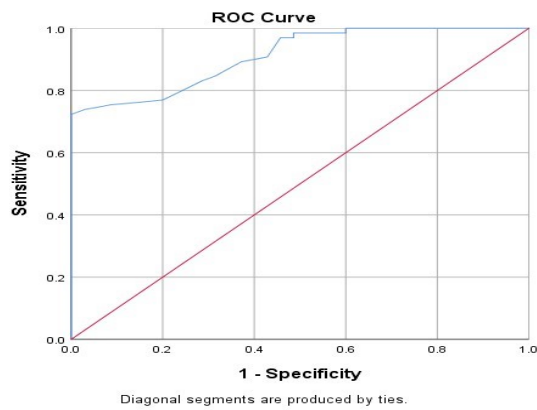
After running a receiver operation curve (ROC) analysis for UCA, an area under the curve (AUC) of 0.911 was obtained at a cutoff point of more than 97.5 degrees. The sensitivity was 83.12%, specificity was 71.4%, PPV was 84.38%, NPV was 69.45%, and the accuracy was 88% (Figure 4). While ROC analysis for CL shows an AUC value of 0.940 at a cutoff point of less than 29.5 mm, the

The association between UCA and labor duration was considerably negative, with a correlation coefficient of -0.544 and a significance level of  $P < 0.001$ . In addition, there was a negative correlation between UCA and CL with a correlation value of -0.754 and a significance level of  $P < 0.001$ . In other words, an increase in the UCA correlates with a decrease in both CL and labor length. On the other hand, there was a positive association between CL and duration of labor with a correlation value of 0.548 and a significance level of  $P < 0.001$ .

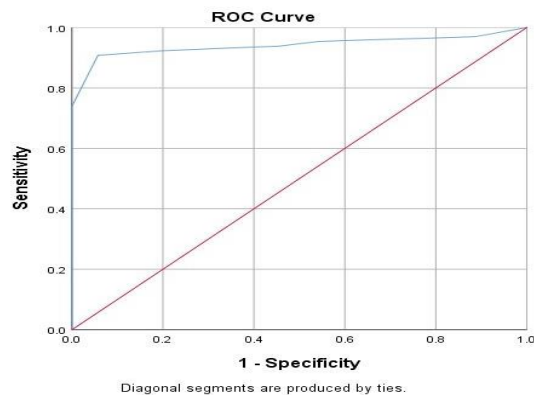
**Regression analysis of the variables**

The linear regression analysis revealed significant associations between UCA (beta coefficient: -0.482,  $P < 0.001$ ), cervical length (beta coefficient: 0.527,  $P < 0.001$ ), and the duration of labor. The UCA equation for estimating labor duration in minutes is (duration of labor = -9.17 x UCA + 1987.808172.09) and the CL equation is (duration of labor = 44.19 x CL-135.009196.9). On multiple regression analysis, we found that both UCA and CL were independent factors in the prediction of successful induction of labor.

sensitivity was 92.3%, specificity was 80%, PPV was 89.55%, NPV was 84.84%, and the accuracy was 88% (Figure 5). The sensitivity was 76.92%, the specificity was 97.14%, the PPV was 98.04%, the NPV was 69.39%, and the accuracy was 84% when both UCA and CL length were combined.



**Figure 4:** ROC curve analysis of utero-cervical angle (UCA).



**Figure 5:** ROC curve analysis of cervical length (CL).

## DISCUSSION

Previous research [13] has demonstrated a tight association between uterine cervix features and the spontaneous commencement of labor. On the assumption that the same power is exerted over a shorter distance, a shorter CL may indicate a more successful induction of labor. Despite the fact that CL is brief, the efficiency of force may vary based on the vector's transmission to the labor force. This force vector's predictable component is the UCA; if this angle is acute, the vector may distribute the force, resulting in a force that is less than the original labor force. In contrast, if the angle is obtuse, the vector may not distribute the force, resulting in a force distribution comparable to the initial labor force [14]. This hypothesis requires additional examination. In accordance with the findings of Eser and Ozkaya [15], Sochacki *et al.* [16], and Kanza Gül [17], no statistical significance was observed between the demographical data and the prediction of successful labor induction in our investigation. In cases of successful induction of labor, the mean CL was lower, with a cutoff value of 29.5 mm below which the prediction of success was 92.3% sensitive and 80% specific. Kanza Gül [17]

found comparable outcomes using a cutoff point of 29.5 mm with sensitivity and specificity values of 91.7% and 57.3%, respectively. In contrast, Eser and Ozkaya [15] observed that a cutoff value of 27 mm was related with decreased sensitivity and a specificity value of 64 percent for each of them. These disparities can be linked to the fact that their study only included first-time mothers. Based on multiple regression analysis, we discovered that CL is an independent predictor of successful induction of labor, whereas Dagdeviren *et al.* [14] concluded in their study of primigravida patients that CL was not an independent predictor of successful induction of labor. Tanvir *et al.* [18] address the effect of multigravida on cervical characteristics, stating that multigravida patients had a lower CL and 82.6% of multigravida patients delivered after 37 weeks had a CL < 25 mm, but just 1.7% of primigravida patients had a CL < 25 mm. Recent systematic reviews and meta-analyses reveal both the benefits and drawbacks of using CL to predict IOL, despite the fact that CL is the most extensively utilized sonographic sign for evaluating the cervix. In a meta-analysis conducted by Hatfield *et al.*, CL was not a reliable indicator of IOL success. Despite the varying definitions of IOL in the literature, CL has been shown to accurately predict IOL in terms of ripening [5]. Papillon-Smith and Abenhaim [19] conducted a similar meta-analysis and discovered that near-term CL was only moderately helpful at predicting IOL. In both reports, CL's score was inferior than that of Bishop. Therefore, approaches that incorporate both sonography and digital inspection may be more appropriate. The cervix is susceptible to change due to pressure from pelvic organs or a growing uterus or fetus. Cervical effacement, a crucial aspect of the laboring process, theoretically shortens the cervix and expands the lower uterine segment. On ultrasound, women with a healthy cervix should exhibit a short cervical length and a wide utero-cervical angle [20]. The force the uterus exerts on the cervix varies with the utero-cervical angle; uterine contraction at an acute utero-cervical angle strengthens the closure of the endo-cervical canal, whereas the same force applied at an obtuse angle can hasten the opening of the cervix, resulting in rapid emptying of the uterine contents into the vagina [14]. The anterior utero-cervical angle was larger in cases that resulted in a successful induction of labor, with a corresponding reduction in labor duration. Above a threshold temperature of 97.5 degrees, we observed a sensitivity of 83.12% and a specificity of 71.4% in predicting the success of induction of labor. Eser and Ozkaya [15] determined that the ideal cutoff value is 97 degrees (64% sensitivity, 91% specificity), but Kanza Gül [17] determined that the optimal cutoff point is 98.5 degrees. Rane *et al.* [21], who examined the difference between ultrasonic characteristics and the Bishop score, discovered a specificity of 75%. The sensitivity and specificity rates were 75% and 73.5 %, respectively. The

ultrasound findings were 89% sensitive, while the Bishop score was 65% sensitive [17]. UCA is an independent predictor of effective induction of labor, as determined by Dagdeviren *et al.* [14] with a cutoff temperature of 96 degrees. We discovered that when combining CL and UCA data, the positive predictive value reached 98.04%, making them a good predictor of successful induction of labor. To our knowledge, this result has not been thoroughly studied in the literature.

## Conclusion

The trans-vaginal ultrasound indicators (UCA and CL) may represent independent and highly predictive factors of a successful induction of labor.

## Acknowledgement

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## Conflict of interest

Nothing declared

## Data sharing statement

Supplementary data can be provided based on a reasonable request.

## REFERENCES

- James DK, Steer PJ, Weiner CP, Gonik B. High risk pregnancy e-book: management options-expert consult, Elsevier Health Sciences; 2010.
- Lueth GD, Kebede A, Medhanyie AA. Prevalence, outcomes and associated factors of labor induction among women delivered at public hospitals of MEKELLE town-(a hospital based cross sectional study). *BMC Pregnancy Childbirth*. 2020;20(1):203. doi: 10.1186/s12884-020-02862-7.
- Leduc D, Biringer A, Lee L, Dy J. Induction of labor. *J Obstet Gynaecol Can*. 2013;35(9):840-857. doi: 10.1016/S1701-2163(15)30842-2.
- Zhang L, Troendle J, Branch DW, Hoffman M, Yu J, Zhou L, Duan T, *et al.* The expected labor progression after labor augmentation with oxytocin: A retrospective cohort study. *PLoS One*. 2018;13(10):e0205735. doi: 10.1371/journal.pone.0205735.
- Hatfield AS, Sanchez-Ramos L, Kaunitz AM. Sonographic cervical assessment to predict the success of labor induction: a systematic review with metaanalysis. *Am J Obstet Gynecol*. 2007;197(2):186-192. doi: 10.1016/j.ajog.2007.04.050.
- Mukhtar A. Comparison of vaginal isosorbide mononitrate with prostaglandin E2 for pre-induction cervical ripening at term. *J Rawalpindi Med Coll*. 2013;17(1):110-112.
- Baños N, Migliorelli F, Posadas E, Ferreri J, Palacio M. Definition of failed induction of labor and its predictive factors: Two unsolved issues of an everyday clinical situation. *Fetal Diagn Ther*. 2015;38(3):161-169. doi: 10.1159/000433429.
- Gelber S, Sciscione A. Mechanical methods of cervical ripening and labor induction. *Clin Obstet Gynecol*. 2006;49(3):642-657. doi: 10.1097/00003081-200609000-00022.
- Alabi-isama L, Sykes L, Rai R, Khullar V, Bennett P, Teoh T. Cervix length vs. cervical volume in predicting preterm birth. *Ultrasound Obstetr Gynecol*. 2011;38:168-281. doi: 10.1002/uog.9845.
- Jurek B, Neumann ID. The oxytocin receptor: From intracellular signaling to behavior. *Physiol Rev*. 2018;98(3):1805-1908. doi: 10.1152/physrev.00031.2017.
- Howarth GR, Botha DJ. Amniotomy plus intravenous oxytocin for induction of labor. *Cochrane Database Syst Rev*. 2001;2001(3):CD003250. doi: 10.1002/14651858.CD003250.
- Kolkman DG, Verhoeven CJ, Brinkhorst SJ, Van Der Post JA, Pajkrt E, Opmeer BC, *et al.* The Bishop score as a predictor of labor induction success: a systematic review. *Am J Perinatol*. 2013;30(08):625-630. doi: 10.1055/s-0032-1331024.
- Hassan SS, Romero R, Haddad R, Hendler I, Khalek N, Tromp G, *et al.* The transcriptome of the uterine cervix before and after spontaneous term parturition. *Am J Obstet Gynecol*. 2006;195(3):778-786. doi: 10.1016/j.ajog.2006.06.021.
- Dagdeviren E, Çetin BA, Mathyk BA, Koroglu N, Topcu EG, Yuksel MA. Can uterocervical angles successfully predict induction of labor in nulliparous women? *Eur J Obstet Gynecol Reprod Biol*. 2018;228:87-91. doi: 10.1016/j.ejogrb.2018.06.014.
- 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. doi: 10.1080/14767058.2018.1517324.
- Sochacki-Wójcicka N, Wojcicka J, Bomba-Opon D, Wielgos M. Anterior cervical angle as a new biophysical ultrasound marker for prediction of spontaneous preterm birth. *Ultrasound Obstet Gynecol*. 2015;46(3):377-8. doi: 10.1002/uog.14801.
- Kanza Gül, D. Can uterocervical angle and cervical length determine the success of induction of labor in late-term and post-term nulliparous pregnant women? *Cukurova Med J*. 2020;45(4):1634-1643. doi: 10.17826/cumj.779429.
- Tanvir, Ghose S, Samal S, Armugam S, Parida P. Measurement of cervical biometry using transvaginal ultrasonography in predicting preterm labor. *J Nat Sci Biol Med*. 2014;5(2):369-372. doi: 10.4103/0976-9668.136189.
- Papillon-Smith J, Abenhaim HA. The role of sonographic cervical length in labor induction at term. *J Clin Ultrasound*. 2015;43(1):7-16. doi: 10.1002/jcu.22229.
- Daskalakis G, Theodora M, Antsaklis P, Sindos M, Grigoriadis T, Antsaklis A, *et al.* Assessment of uterocervical angle width as a predictive factor of preterm birth: A systematic review of the literature. *Biomed Res Int*. 2018;2018:1837478. doi: 10.1155/2018/1837478.
- 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(5):538-549. doi: 10.1002/uog.