

# Diagnostic Accuracy of Transperineal Sonography in Determining Accurate Cervical Length At 24-32 Weeks of Gestation

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## ABSTRACT

**Background:** Nowadays, cervical sonography is a standard procedure in maternal healthcare. According to a study, a small cervical length found early on by sonography is a reliable indicator of premature birth. Regardless of any risk factors, there is a roughly 50% chance of premature delivery before 32 weeks if the cervical length is less than 15 mm. There are several ways for cervical imaging, such as transvaginal, translabial, and transabdominal techniques.

**Methods:** The Department of Obstetrics & Gynecology at PIMS Hospital in Islamabad carried out this descriptive, cross-sectional validation study from February 28, 2021, to August 20, 2021. 186 women in all, aged 20–40 years, with singleton pregnancies between 24 and 32 weeks of gestation, were included. Individuals with a history of cervical surgery, cervical incompetence, or premature rupture of the membranes were not included. A 4–9 MHz ultrasound probe was used to assess the transvaginal cervical length after informed consent was obtained. In the operating room, the cervical length of each patient was measured three times, and the smallest measurement was noted. After that, participants were monitored till birth in order to evaluate results.

**Results:** Thirteen were false positives and 110 were real positives among TVS positive patients. 49 of the TVS negative instances were true negatives, whereas 14 were fake negatives. Overall diagnostic accuracy, sensitivity, specificity, positive predictive value, negative predictive value, and sensitivity were 88.71%, 79.03%, 89.43%, 77.78%, and 85.48%, in that order.

**Conclusion:** The study concludes that transvaginal cervical length measurement after cerclage is a highly accurate method for predicting preterm delivery.

**Keywords:** Cervical Length Measurement, Cervix Uteri, Ultrasonography, Prenatal, Pregnancy, Gestational Age.

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## INTRODUCTION

When labor begins between weeks 20 and 37 of pregnancy, it is appropriately referred to as preterm. Among the things that could lead to preterm labor are changes in cervical status, such as dilatation and effacement<sup>1</sup>. Connective tissue, which comprises 10–15% smooth muscle, collagen, and elastin, makes up the majority of the cervix. During pregnancy, the hard, cartilage-like rigidity of the cervix transforms into soft tissue. When the ratio of elastin to collagen rises and the concentration of collagen falls, the cervix's rigid structure becomes softer. This shift may begin far sooner than anticipated. This alteration, referred to as "cervical ripening," facilitates parturition by allowing the cervix to grow<sup>2,3</sup>.

Preterm delivery is defined as giving birth before 37 complete weeks or 259 days of gestation<sup>4</sup>. In almost every high- and middle-income country in the world, preterm birth is the leading cause of infant mortality. Additionally, preterm birth increases the newborn's risk of dying from other causes, such as infections<sup>5</sup>. Preterm delivery is thought to be the cause of at least 50% of all baby deaths<sup>6</sup>. Premature birth increases the risk of respiratory conditions, intellectual disabilities, sensory deficits, and cerebral palsy compared to full-term birth<sup>7</sup>.

Cervical cerclage is often done to prevent or delay PTB8 in women who have a previous diagnosis of cervical inadequacy or who have a short cervix on ultrasound scans (USS)<sup>8</sup>. Genital shortening (usually defined as  $\leq 25$  mm) in women who have previously undergone cervical surgery or PTB (USS indicated cerclage), when the cervix is dilating without contractions (rescue cerclage), or following multiple mid-trimester losses (MTL) or preterm delivery (history indicated cerclage)<sup>9</sup> are the three different clinical circumstances that can result in the placement of cerclage<sup>9</sup>.

The best method for predicting preterm delivery in women with a history of preterm birth is to measure cervical length<sup>10</sup>. Post-elective cerclage studies have shown a correlation between cervical length and the ultimate outcome of pregnancy<sup>11,12</sup>. Whether this relative recovery of cervical architecture following urgent or preventative cerclage predicts the outcome of pregnancy is unknown<sup>13</sup>. Finding the diagnostic accuracy of measuring the transvaginal cervical length after cerclage in order to predict preterm delivery in the local population is the aim of this study. The results will provide practical guidance on how to decrease cervical length and reduce fetal morbidity and death, as well as scientific support for high-risk women. The purpose of this study was to assess the diagnostic precision of transperineal sonography in determining the cervical length of expectant mothers who were between 24 and 32 weeks along in their pregnancy.

## METHODS

The PIMS Hospital in Islamabad's Department of Obstetrics & Gynecology was the site of this descriptive, cross-sectional validation investigation. The research period was from February 28, 2021, until August 20, 2021. The ethical approval was obtained from the Ethical Review Board Committee of the Shaheed Zulfiqar Ali Bhutto University, PIMS, Islamabad (Approval No: 1-1/2025/ERB/SZABMU/425 dated: 25-06-2022).

With a 95% confidence level, 10% desired precision, a 17.24% preterm birth prevalence, and a transvaginal cervical length measurement after cerclage with a sensitivity of 91.0% and specificity of 30.0% for preterm delivery prediction, 186 cases were selected as the sample size<sup>14</sup>. The approach of non-probability sequential sampling was utilized.

There were explicit inclusion and exclusion criteria used in the sample selection process. According to the last menstrual period (LMP), women who had a singleton pregnancy verified by trans-abdominal ultrasonography and a gestational age between 24 and 32 weeks met the inclusion criteria. The study comprised only primigravida and multigravida women who were receiving cerclage and were between the ages of 20 and 40. Individuals with multiple pregnancies (as determined by ultrasonography), cervical incompetence, women who had previously undergone cervical surgery, and patients with preterm premature rupture of membranes (as determined by clinical examination) were excluded.

To collect data, 186 individuals who satisfied the inclusion criteria were chosen. The institutional review committee granted ethical approval, and each subject gave their informed consent. A 4–9 MHz transvaginal ultrasonography probe was used in the operating room to measure transvaginal cervical length (TVS)<sup>15</sup>. Each patient had their cervical length measured at least three times, with the minimum measurement being noted. According to the investigator's operational definition, results from the TVS cervical length measurement for preterm birth prediction were recorded. Every patient was monitored until delivery, and the results of actual deliveries were compared with the TVS cervical length measurements.

SPSS version 20.0 was used to process the gathered data for data analysis. While variables including parity, previous history of preterm delivery, and preterm birth outcomes based on TVS cervical length measurements were given as frequencies and percentages, age and gestational age were displayed as mean and standard deviation. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and the diagnostic

accuracy of measuring transvaginal cervical length following cerclage in predicting premature delivery were all calculated using a 2x2 contingency table. Additionally, stratification was carried out according to age, parity, gestational age, and previous history of preterm birth. The chi-square test was used after stratification, and a p-value of less than 0.05 was deemed as statistically significant. The following formulas were used to determine the diagnostic accuracy:

- 'Sensitivity =  $a / (a + c) \times 100$ '
- 'Specificity =  $d / (b + d) \times 100$ '
- 'Positive Predictive Value (PPV) =  $a / (a + b) \times 100$ '
- 'Negative Predictive Value (NPV) =  $d / (c + d) \times 100$ '
- 'Diagnostic Accuracy =  $(a + d) / (a + b + c + d) \times 100$ '

The letters 'a', 'b', 'c', and 'd' in these formulas stand for true positives, false positives, and true negatives, respectively.

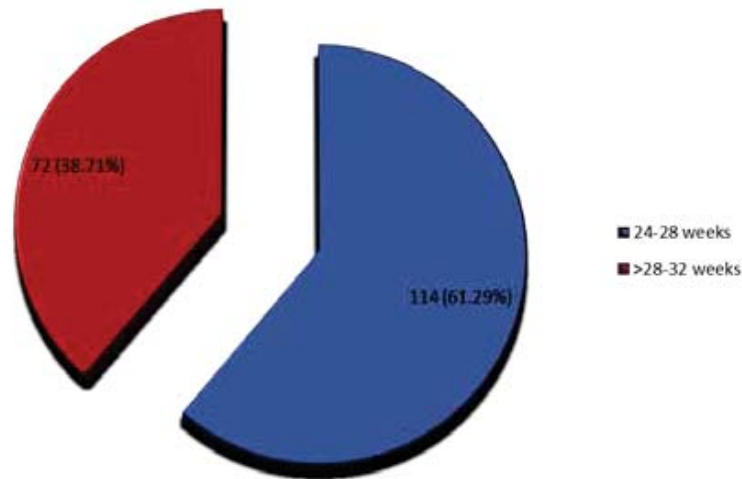
**RESULTS**

**Table 1: Distribution of patients' Age (n=186)**

Age (in years)	Frequency	%Age
20-30 years	100	53.76
31-40 years	86	46.24
Mean ± SD	29.30 ± 3.88 years	

The study's participants ranged in age from 20 to 40, with a mean age of 29.30 ± 3.88 years. According to **Table 1**, the majority of the 100 patients (53.76%) were in the 20–30 age range.

The mean gestational age was 28.10 ± 2.16 weeks, as shown in **Figure 1**.



**Figure 1: Distribution of patients according to Gestational age (n=186).**

**Table 2: Distribution of Patients According to Parity and History of Preterm Birth (n=186).**

Variable	Category	Frequency	Percentage (%)
Parity	Primiparous	76	40.86
	Multiparous	110	59.14
History of Preterm Birth	Yes	42	22.58
	No	144	77.42

Distribution of patients according to parity and h/o preterm birth is shown in Table 2.

**Table 3: Diagnostic Accuracy of Transvaginal Cervical Length Measurement After Cerclage for The Prediction of Preterm Delivery, Taking Actual Preterm Birth as The Gold Standard**

Delivery Results	Positive	Negative	P-Value
Positive result on TVS	110 (TP)*	13 (FP)**	0.0001
Negative result on TVS	14 (FN)**	49 (TN)****	

\*-TP=True positive \*\*-FP=False positive \*\*\*-FN=False negative \*\*\*\*-TN=True negative Sensitivity: 88.71%, Specificity: 79.03%, PPV: 89.43%, NPV: 77.78%, Accuracy: 85.48%

In individuals with TVS, 13 (False Positive) did not have a preterm birth at delivery, while 110 (True Positive) did. Of the 63 patients who tested negative for TVS, 14 (False Negative) had preterm births on TVS, but 49 (True Negative) did not have preterm births at delivery, as seen in Table IV. Transvaginal cervical length measurement after cerclage has the following sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic accuracy for predicting preterm delivery, using actual preterm birth as the gold standard: 88.71%, 79.03%, 89.43%, 77.78%, and 85.48%.

**Table 4: Stratification of Diagnostic Accuracy of Transvaginal Cervical Length Measurement After Cerclage by Age Group**

Age Group	TVS Result	Positive Delivery (Preterm)	Negative Delivery (Term)	P-value
20-30 years (n=100)	Positive Result on TVS	61 (TP)	7 (FP)	0.001
	Negative Result on TVS	6 (FN)	26 (TN)	
31-40 years (n=86)	Positive Result on TVS	49 (TP)	6 (FP)	0.001
	Negative Result on TVS	8 (FN)	23 (TN)	

20-30 years: Sensitivity 91.04%, Specificity 78.79%, PPV 89.71%, NPV 81.25%, Accuracy 87.0%. 31-40 years: Sensitivity 85.96%, Specificity 79.31%, PPV 89.09%, NPV 74.19%, Accuracy 83.72%. Stratification of diagnostic accuracy concerning age of patients is shown in Table 4.

**Table 5: Stratification of Diagnostic Accuracy of Transvaginal Cervical Length Measurement After Cerclage by Gestational Age**

Age Group	TVS Result	Positive Delivery (Preterm)	Negative Delivery (Term)	P-value
20-30 years (n=100)	Positive Result on TVS	61 (True Positive, TP)	7 (False Positive, FP)	0.001
	Negative Result on TVS	6 (False Negative, FN)	26 (True Negative, TN)	
31-40 years (n=86)	Positive Result on TVS	49 (True Positive, TP)	6 (False Positive, FP)	0.001
	Negative Result on TVS	8 (False Negative, FN)	23 (True Negative, TN)	

24-28 weeks: Sensitivity 88.31%, Specificity 75.68%, PPV 88.31%, NPV 75.68%, Accuracy 84.21%. 29-32 weeks: Sensitivity 89.36%, Specificity 84.00%, PPV 91.30%, NPV 80.77%, Accuracy 87.50%. While gestational stratification is shown in **Table 5**.

**Table 6: Stratification of Diagnostic Accuracy of Transvaginal Cervical Length Measurement After Cerclage by Parity**

Parity	TVS Result	Positive Delivery (Preterm)	Negative Delivery (Term)	P-value
Primiparous (n=76)	Positive Result on TVS	46 (True Positive, TP)	3 (False Positive, FP)	0.001
	Negative Result on TVS	6 (False Negative, FN)	21 (True Negative, TN)	
Multiparous (n=110)	Positive Result on TVS	64 (True Positive, TP)	10 (False Positive, FP)	0.001
	Negative Result on TVS	8 (False Negative, FN)	28 (True Negative, TN)	

Primiparous: Sensitivity 88.46%, Specificity 87.50%, PPV 93.88%, NPV 77.78%, Accuracy 88.16%. Multiparous: Sensitivity 88.89%, Specificity 73.68%, PPV 86.49%, NPV 77.78%, Accuracy 83.64%. Stratification of diagnostic accuracy with respect to parity is shown in **Table 6**.

**Table 7: Stratification of Diagnostic Accuracy of Transvaginal Cervical Length Measurement After Cerclage by History of Preterm Birth**

History of Preterm Birth	TVS Result	Positive Delivery (Preterm)	Negative Delivery (Term)	P-value
Positive H/o Preterm Birth (n=42)	Positive Result on TVS	26 (True Positive, TP)	6 (False Positive, FP)	0.001
	Negative Result on TVS	1 (False Negative, FN)	9 (True Negative, TN)	
No H/o Preterm Birth (n=144)	Positive Result on TVS	84 (True Positive, TP)	7 (False Positive, FP)	0.001
	Negative Result on TVS	13 (False Negative, FN)	40 (True Negative, TN)	

Positive H/o Preterm Birth: Sensitivity 96.30%, Specificity 60.00%, PPV 81.25%, NPV 90.00%, Accuracy 83.33%. No H/o Preterm Birth: Sensitivity 86.60%, Specificity 85.11%, PPV 92.31%, NPV 75.47%, Accuracy 86.11%. The relationship of diagnostic accuracy concerning h/o preterm birth is shown in **Table 7**.

## DISCUSSION

There is now substantial proof from multiple meta-analyses that a transvaginal sonographic CL measurement at 18–24 weeks of gestation is one of the most reliable and strong indicators of preterm birth in asymptomatic women with twin gestations<sup>16,17,18</sup>. and singleton gestations, irrespective of how well they have had prior experiences of preterm birth<sup>19,20</sup>.

More recent examination of repeated measurements of transvaginal sonographic CL. Transvaginal sonographic CL shortening over time has been linked in several studies to an increased risk of preterm birth<sup>21,22</sup>. Using actual preterm deliveries as the gold standard, this research was carried out in order to ascertain the diagnostic accuracy of transvaginal cervical length measurement following cerclage for predicting premature delivery. In the present research, using actual preterm birth as the gold standard, the transvaginal cervical length measurement after cerclage's sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic preciseness for predicting premature deliveries are '88.71%, 79.03%, 89.43%, 77.78%, and 85.48%', respectively. According to an investigation, the sensitivity and specificity of measuring the transvaginal cervical length following cerclage for predicting preterm delivery were '91.0% and 30.0%', respectively, while the prevalence of preterm birth was 17.24%<sup>23</sup>.

Women who presented with regular uterine contractions with dilatation or cervical change between 23 and 33 weeks of gestation were enrolled in the study for both singleton and twin pregnancies<sup>24</sup>. Excluded were women who had a stillbirth, ruptured membranes, placenta previa, vaginal hemorrhage, cervical dilatation greater than 3 cm, advanced labor, or cervical cerclage. Another study looked at twin and singleton pregnancies that had regular uterine contractions or cervical changes before 34 weeks of pregnancy. If a woman had a cervical cerclage, ruptured membranes, maternal pathology, or fetal limitations, she was not permitted to carry on with her pregnancy<sup>25</sup>.

Another research investigation examined twin pregnant women who had regular uterine contractions or cervical ripening. Participants in the study were excluded if they had a previous diagnosis of twin-to-twin syndrome, vaginal bleeding, uterine abnormalities, miscarriage or PTB between 16 and 32 weeks, or a cone biopsy<sup>14</sup>.

This study provides a clinical benefit by reporting transvaginal cervical length measurement following cerclage as a reproducible and non-invasive measure to accurately assess prematurity risk in women between 24-32 weeks gestation, supporting this as

protocol in routine care during heavy risk pregnancies. This study does have some limitations, being single-centered, not having a control group and the sample size was relatively small, which may further limit generalizability. Further, the study did not conduct transvaginal compared to transperineal sonography or evaluate longer-term neonatal outcomes. Future studies should include larger and multi-centered studies, compare different sonography techniques, consider incorporating biochemical markers for improved prediction of outcomes and evaluate longer-term maternal and neonatal outcomes to improve prevention strategies for preterm birth.

## CONCLUSION

Transvaginal cervical length measurement after cerclage provides a rather high diagnostic accuracy for anticipating preterm birth, the study's findings indicate. Therefore, we recommend transvaginal cervical length measurement after cerclage as the main technique for individuals at high risk for preterm labor. This way, appropriate measures may be taken to lower the perinatal mortality and morbidity of both the mother and the infant.

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## CONFLICT OF INTEREST

The authors declare no conflict of interest related to this study.

## ETHICAL APPROVAL

The ethical approval was obtained from the Ethical Review Board Committee of the Shaheed Zulfiqar Ali Bhutto University, PIMS, Islamabad (Approval No: 1-1/2025/ERB/SZABMU/425 dated: 25-06-2022).

## FUNDING

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## PATIENT CONSENT

Written informed consent was obtained from all participants before inclusion in the study.

## AUTHORS' CONTRIBUTION

All authors contributed equally to the ICMJE.

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