Section: Radiodiagnosis

Original Research Article

DEMOGRAPHIC & CERVICAL LENGTH CHARACTERISTICS IN SECOND-TRIMESTER CERVICAL ULTRASOUND ELASTOGRAPHY

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ABSTRACT

Background: Preterm delivery is a major cause of neonatal morbidity and mortality. Cervical remodeling and softening may precede cervical shortening, making assessment of cervical tissue stiffness by ultrasound elastography a potential method for early prediction of preterm delivery.

Materials and Methods: This prospective observational study included **43 pregnant women** with singleton pregnancies between **19 and 24 weeks of gestation** who underwent transvaginal cervical ultrasonography. Maternal age, BMI, gestational age and cervical length were analyzed and compared between the groups. Continuous variables were expressed using descriptive statistics, while categorical variables were analyzed using appropriate comparative tests. A p-value <0.05 was considered statistically significant.

Results: Of the 43 participants, **39 had term delivery and 4 had preterm delivery**. The mean maternal age was 26.99 ± 3.19 years in the term group and 30.00 ± 3.37 years in the preterm group (**p=0.081**). Mean BMI was 22.57 ± 3.17 and 22.35 ± 3.95 kg/m², respectively (**p=0.895**). Mean gestational age at examination was 21.07 ± 1.18 weeks in the term group and 21.32 ± 0.83 weeks in the preterm group (**p=0.682**). The mean cervical length was 3.73 ± 0.52 cm in the term group and 3.98 ± 0.21 cm in the preterm group, with an overall mean of 3.76 ± 0.50 cm.

Conclusion: Maternal age, BMI, and gestational age at examination were also comparable between term and preterm groups. Although cervical ultrasound elastography has the potential to detect cervical tissue remodeling and softening before conventional cervical shortening, its predictive value could not be established from the present data. Larger prospective studies incorporating standardized elastography measurements and validated stiffness thresholds are required to determine its role in early prediction of preterm delivery.

Keywords: Cervical elastography; Preterm delivery; Cervical length; Cervical stiffness; Transvaginal ultrasonography; Pregnancy; Second trimester; Preterm birth; Obstetric ultrasonography; Cervical remodeling.

INTRODUCTION

Preterm delivery, defined as birth before 37 completed weeks of gestation, remains a major cause of neonatal morbidity and mortality worldwide. Approximately 15 million babies are born preterm each year, and prematurity contributes substantially to neonatal mortality as well as long-term neurological and developmental morbidity. Early identification of women at risk of preterm delivery is therefore essential to facilitate appropriate surveillance and timely preventive interventions.[1,2] Preterm birth is a multifactorial syndrome involving inflammatory, infectious, biochemical and mechanical mechanisms. These processes ultimately result in premature cervical remodeling and initiation of labour.[3,4] During normal pregnancy, progressive cervical remodeling involves changes in collagen organization, increased tissue hydration and softening of the cervical stroma. These biomechanical changes may occur before clinically

detectable cervical shortening, making assessment of cervical tissue properties potentially useful for early identification of women at risk of preterm delivery.[5,6]

Transvaginal ultrasound measurement of cervical length is an established method for assessing the risk of spontaneous preterm birth. A shorter cervical length is associated with an increased probability of spontaneous preterm delivery and has consequently become an important component of obstetric assessment, particularly among women at increased risk.[7,8] Cervical sonography has therefore been incorporated into strategies for prediction and prevention of preterm birth.[9]

However, cervical shortening represents a relatively late anatomical manifestation of the cervical remodeling process. A proportion of women who subsequently deliver preterm may have a cervical length within the normal range during mid-gestation, limiting the predictive ability of cervical length measurement alone.[10]

Recent advances in ultrasound technology have introduced cervical ultrasound elastography as a technique for evaluating the biomechanical properties of the cervix. Elastography provides qualitative and quantitative information regarding tissue elasticity by assessing tissue displacement in response to mechanical stress. Since cervical softening precedes anatomical shortening, elastography may detect early changes in cervical stiffness that are not evident on conventional ultrasonography.

Therefore, the present study was undertaken to evaluate the role of cervical ultrasound elastography in predicting preterm delivery among pregnant women during the second trimester of pregnancy, with assessment of cervical characteristics between 19 and 24 weeks of gestation and subsequent correlation with pregnancy outcome.

MATERIALS AND METHODS

Study Design

This prospective observational study was conducted in the Department of Radiology and Imaging Sciences at Dr. Kamakshi Institute of Medical Sciences and Research, Chennai.

Study Population

Pregnant women presenting for routine antenatal ultrasonography between 19 and 24 weeks of gestation were recruited after obtaining informed consent.

Sample Size

A total of 43 pregnant women satisfying the eligibility criteria were included in the study.

Inclusion Criteria

- Singleton pregnancy.
- Gestational age between 19 and 24 weeks.
- Willingness to participate in the study.

Exclusion Criteria

- Multiple pregnancies.
- Major fetal congenital anomalies.
- Cervical cerclage.
- Previous cervical surgeries.
- Inability to undergo transvaginal ultrasonography.
- Patients unwilling to participate.

Ethical Approval

The study protocol was approved by the Institutional Ethics Committee of Dr. Kamakshi Institute of Medical Sciences and Research, Chennai. Written informed consent was obtained from all study participants before enrollment.

Based on the uploaded study, the **Study Procedure** section is currently only headed but not described in the manuscript (page 5). The study is a prospective observational study of **43 singleton pregnancies at 19–24 weeks**, with subsequent classification into term (n=39) and preterm (n=4) groups.

Study Procedure

Pregnant women presenting for routine antenatal ultrasonography between 19 and 24 weeks of gestation were assessed for eligibility. Women fulfilling the inclusion criteria and willing to participate were enrolled after obtaining written informed consent. A detailed obstetric history and relevant clinical information were recorded, including maternal age, body mass index, gestational age and other relevant pregnancy-related parameters. The gestational age was determined based on the available obstetric dating information.

Transvaginal ultrasonography was performed for assessment of the cervix. The cervical length was measured by identifying the internal and external cervical os and measuring the linear distance between them. Cervical ultrasound elastography was subsequently performed to assess the biomechanical properties of the cervical tissue. The elastographic examination was obtained under standardized conditions, with the cervix adequately visualized and the region of interest positioned over the cervical tissue. Elastographic findings were recorded for subsequent comparison between women who delivered at term and those who subsequently experienced preterm delivery.

All enrolled women were followed until delivery. Based on the gestational age at delivery, participants were categorized into **term and preterm delivery groups**. The elastographic findings and cervical length obtained during the second-trimester examination were then compared between the two groups to evaluate their potential role in predicting preterm delivery. The study included 43 participants, of whom 39 subsequently had term delivery and 4 had preterm delivery.

Statistical Analysis

Data collected during the study were entered into a statistical database and analyzed using appropriate statistical methods. Continuous variables such as maternal age, BMI, gestational age and cervical length were summarized using **mean, standard deviation, median, minimum, maximum and**

quartiles. The results were presented separately for the term and preterm delivery groups and for the overall study population. The descriptive analysis in the study reports mean age, BMI, gestational age and cervical length in this manner.

The continuous variables between the term and preterm groups were compared using an appropriate test based on the distribution of the data. Categorical variables, wherever applicable, were expressed as **frequency and percentage** and compared using the **Chi-square test or Fisher's exact test**, as appropriate. A **p-value <0.05 was considered statistically significant**.

RESULTS

Descriptive Statistics of Age

Among the 43 women included in the study, 39 belonged to the term group and 4 to the preterm group. The mean age was 26.99 ± 3.19 years in the term group and 30.00 ± 3.37 years in the preterm group, with an overall mean age of 27.27 ± 3.29 years. The median age was 27 years in the term group and 30 years in the preterm group. The overall age ranged from 19.50 to 35.00 years. Thus, women who subsequently had preterm delivery were relatively older than those with term delivery; however, the difference in age between the two groups was not statistically significant (p=0.081).

Table 1: Descriptive Statistics of Age

Age (years)	Term (n=39)	Preterm (n=4)	Total (n=43)
Mean	26.99	30.00	27.27
SD	3.19	3.37	3.29
Minimum	19.50	26.00	19.50
1st Quartile	25.00	27.50	25.00
Median	27.00	30.00	27.00
3rd Quartile	29.00	32.50	29.00
Maximum	35.00	34.00	35.00



Figure 1: Descriptive Statistics of Age

Descriptive Statistics of BMI

The mean BMI was 22.57 ± 3.17 kg/m² in the term group and 22.35 ± 3.95 kg/m² in the preterm group, with an overall mean BMI of 22.55 ± 3.19 kg/m². The median BMI was 22.56 kg/m² in the term group and 21.85 kg/m² in the preterm group. The BMI ranged from 15.22 to 31.62 kg/m² in the total study population. The mean BMI was therefore comparable between the two groups, and statistical analysis showed no significant association between BMI and preterm delivery (p=0.895).

Table 2: Descriptive Statistics of BMI

BMI (kg/m²)	Term (n=39)	Preterm (n=4)	Total (n=43)
Mean	22.57	22.35	22.55
SD	3.17	3.95	3.19
Minimum	15.22	18.67	15.22
1st Quartile	19.96	19.09	19.86
Median	22.56	21.85	22.56
3rd Quartile	24.78	25.61	24.78
Maximum	31.62	27.02	31.62

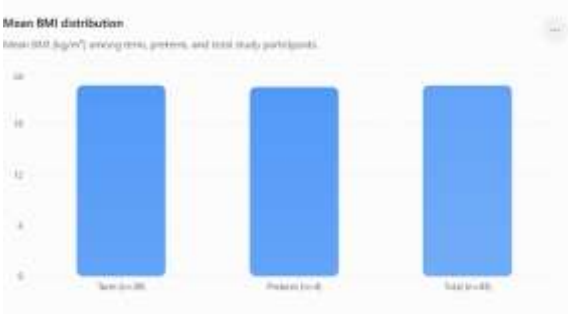


Figure 2: Descriptive Statistics of BMI

Descriptive Statistics of Gestational Age

The mean gestational age was 21.07 ± 1.18 weeks in the term group and 21.32 ± 0.83 weeks in the preterm group, with an overall mean of 21.10 ± 1.14 weeks. The median gestational age was 21.22 weeks in both the term and preterm groups. The overall gestational age ranged from 19.57 to 24.57 weeks. There was no statistically significant difference in gestational age between the term and preterm groups, with a p-value of 0.682.

Table 3: Descriptive Statistics of Gestational Age

Gestational Age (weeks)	Term (n=39)	Preterm (n=4)	Total (n=43)
Mean	21.07	21.32	21.10
SD	1.18	0.83	1.14

Minimum	19.57	20.43	19.57
1st Quartile	20.29	20.79	20.29
Median	21.22	21.22	20.71
3rd Quartile	21.88	21.86	21.85
Maximum	24.57	22.43	24.57

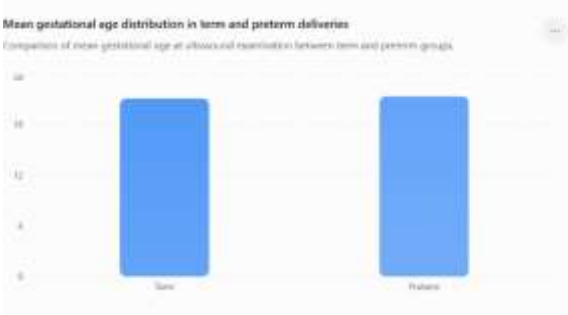


Figure 3: Descriptive Statistics of Gestational Age

Table 4. Cervix Length

The mean cervical length was 3.76 ± 0.50 cm in the overall study population. The mean cervical length was 3.73 ± 0.52 cm among women with term delivery and 3.98 ± 0.21 cm among women with preterm delivery. The cervical length ranged from 2.80–4.90 cm overall, while the preterm group had a range of 3.70–4.20 cm.

Table 4: Cervix Length

Cervix Length (cm)	Term (n=39)	Preterm (n=4)	Total (n=43)
Mean	3.73	3.98	3.76
Standard deviation	0.52	0.21	0.50
Minimum	2.80	3.70	2.80
1st Quartile	3.40	3.85	3.50
Median	3.80	4.00	3.80
3rd Quartile	4.10	4.10	4.10
Maximum	4.90	4.20	4.90

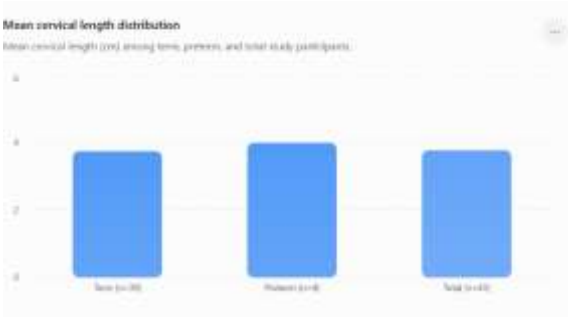


Figure 4: Cervix Length

DISCUSSION

The present prospective observational study evaluated the role of cervical ultrasound elastography in predicting preterm delivery among 43 pregnant women assessed at 19–24 weeks of gestation. Of these, 39 women had term delivery and 4 had preterm delivery.

The mean maternal age was higher in the preterm group than in the term group (30.00 ± 3.37 vs. 26.99 ± 3.19 years), although the difference was not statistically significant (p=0.081). Similarly, BMI was comparable between the term and preterm groups (22.57 ± 3.17 vs. 22.35 ± 3.95 kg/m²; p=0.895). Gestational age at ultrasound examination was also comparable (21.07 ± 1.18 vs. 21.32 ± 0.83 weeks; p=0.682).

The overall mean cervical length was 3.76 ± 0.50 cm, with mean values of 3.73 ± 0.52 cm in the term group and 3.98 ± 0.21 cm in the preterm group. Thus, women who subsequently delivered preterm did not demonstrate a shorter cervical length in this cohort. This finding highlights the potential limitation of cervical length alone in identifying all women at risk of preterm delivery and provides a rationale for evaluating cervical tissue characteristics using elastography.

Previous studies have demonstrated that cervical elastography can detect changes in cervical stiffness during pregnancy and may provide biomechanical information complementary to cervical length.[11,12] A soft cervix identified by shear-wave elastography during the second trimester has been associated with an increased risk of spontaneous preterm delivery, including in women with normal cervical length.[13] Other studies have reported that cervical elastography at 18–22 weeks may have predictive value for spontaneous preterm birth,[14] while combining elastographic parameters with cervical length may improve prediction compared with cervical length alone.[15]

Despite these promising findings, the predictive performance of cervical elastography remains dependent on the elastographic technique, measurement parameters and threshold values used.[16] In the present study, numerical elastography parameters, cut-off values, sensitivity, specificity and ROC analysis were not available; therefore, definitive conclusions regarding the diagnostic accuracy of elastography cannot be drawn.

The small sample size and particularly the limited number of preterm deliveries (n=4) are important limitations. Larger prospective studies with standardized elastography protocols and adequate preterm events are required to establish the clinical utility of cervical elastography for prediction of preterm delivery. Overall, the present findings

support further evaluation of cervical elastography as a potential adjunct to conventional cervical length assessment.

CONCLUSION

Conflict of Interest: Authos declare that this paper has not been previously published and is not currently under consideration by another journal and all authors have approved of and have agreed to submit the manuscript to this journal

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Ethical Committee Approval Statement

The **Ethical Committee of Dr. Kamakshi Institute of Medical Sciences & Research, Chennai**, unanimously approved the dissertation work entitled **"Role of Cervical Ultrasound Elastography in Predicting Preterm Delivery"** undertaken by **Dr. Priya Narayanasamy, DNB Student, Department of Radiodiagnosis**, for submission to the **National Board of Examinations, New Delhi**, in partial fulfilment of the requirements for the **Diplomate of National Board (DNB) in Radiodiagnosis**.

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