

# Uterocervical angle: a novel ultrasound screening tool to predict spontaneous preterm birth



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**BACKGROUND:** Mechanical alteration of the cervical angle has been proposed to reduce spontaneous preterm birth. Performance of the uterocervical angle as measured by ultrasound for predicting spontaneous preterm birth is poorly understood.

**OBJECTIVE:** We sought to determine whether a novel ultrasonographic marker, uterocervical angle, correlates with risk of spontaneous preterm birth in a general population.

**STUDY DESIGN:** We conducted a retrospective cohort study from May 2014 through May 2015 of singleton gestations between 16 0/7–23 6/7 weeks undergoing transvaginal ultrasound for cervical length screening. Images were remeasured for uterocervical angle between the lower uterine segment and the cervical canal. Primary outcome was prediction of spontaneous preterm birth <34 weeks and <37 weeks by uterocervical angle and secondary outcome evaluated cervical length and spontaneous preterm birth.

**RESULTS:** A total of 972 women were studied. The rate of spontaneous preterm birth in this cohort was 9.6% for delivery <37 weeks and 4.5% for <34 weeks. Uterocervical angle of  $\geq 95$  degrees was significantly associated with spontaneous preterm birth <37 weeks with sensitivity of 80% ( $P < .001$ ; confidence interval, 0.70–0.81; negative predictive value, 95%). Uterocervical angle of  $\geq 105$  degrees predicted spontaneous

preterm birth <34 weeks with sensitivity of 81% ( $P < .001$ ; confidence interval, 0.72–0.86; negative predictive value, 99%). Cervical length  $\leq 25$  mm significantly predicted spontaneous preterm birth <37 weeks ( $P < .001$ ; sensitivity, 62%; negative predictive value, 95%) and <34 weeks ( $P < .001$ ; sensitivity, 63%; negative predictive value, 97%). Regression analysis revealed a significant association of maternal age, nulliparity, race, and obesity at conception with spontaneous preterm birth and uterocervical angle. There was no correlation identified between history of dilation and curettage, abnormal Pap smear results, excisional cervical procedures, smoking, or obesity at delivery on spontaneous preterm birth and uterocervical angle.

**CONCLUSION:** A wide uterocervical angle  $\geq 95$  and  $\geq 105$  degrees detected during the second trimester was associated with an increased risk for spontaneous preterm birth <37 and <34 weeks, respectively. Uterocervical angle performed better than cervical length in this cohort. Our data indicate that uterocervical angle is a useful, novel transvaginal ultrasonographic marker that may be used as a screening tool for spontaneous preterm birth.

**Key words:** cervical length, preterm birth, transvaginal ultrasound, uterocervical angle

## Introduction

Preterm birth remains the leading cause of neonatal morbidity and mortality worldwide.<sup>1</sup> The March of Dimes reports a preterm birth rate of 9.6% in the United States.<sup>2</sup> Currently, the ability to identify women at risk of spontaneous preterm birth (sPTB) is limited and includes a detailed history, transvaginal ultrasound (TVU), or symptoms such as preterm contractions.<sup>3,4</sup> We now have several interventions to decrease the risk of sPTB when at-risk women are identified,<sup>1,5</sup> including progesterone supplementation, cerclage placement, and vaginal pessary insertion.<sup>6–11</sup>

Mechanisms underlying sPTB are complex. Cervical tissue, composed of a matrix of collagen fibers, is supported by the cardinal and uterosacral ligaments.<sup>12–14</sup> The cervix experiences pressures from surrounding pelvic organs and withstands forces from the growing uterus. A combination of physiologic pressures and individual anatomy affect the internal os and cervical function.<sup>13,14</sup> Clinical cervical function can be described through cervical structure integrity as is displayed through ultrasonographic cervical length (CL) and uterocervical angle (UCA).<sup>12</sup> A wide, or obtuse, UCA lends a more direct, linear outlet of uterine contents onto the cervix. A narrower, or acute, UCA supports an anatomical geometry that would exert less direct force on the internal os, which may be protective from cervical deformation.

As early as the 1950s, pessaries were thought to create an immunological barrier and mechanically change the

inclination of the cervical canal, thereby distributing pelvic force away from the cervix.<sup>15–20</sup> Altered UCA to a more acute, or narrowed, angle after vaginal pessary placement has been confirmed by magnetic resonance imaging.<sup>15,21–26</sup>

Pelvic angles can be visualized and measured during TVU examination performed in pregnancy. Sochacki-Wojcicka et al<sup>27</sup> suggested that angles between the uterus and cervix may be related to gestational age at delivery. In many practices, second-trimester universal TVU screening for CL is offered to identify women at increased risk of preterm birth.<sup>3,4,28</sup> Our objective was to evaluate whether UCA can predict risk of sPTB in a general population of singletons and to evaluate its performance for predicting sPTB relative to CL.

## Materials and Methods

This retrospective cohort study was designed to evaluate the performance of UCA measurement during routine TVU

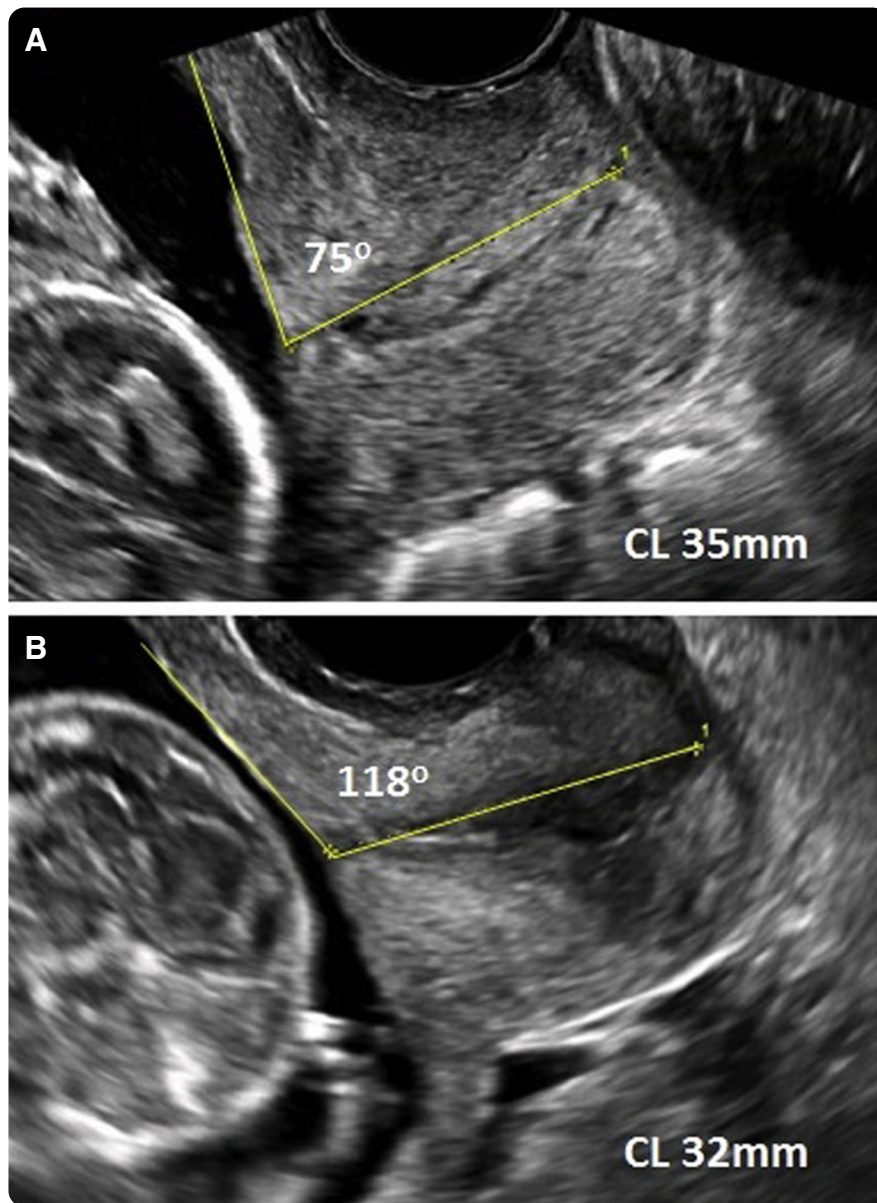
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**FIGURE 1**  
**Transvaginal ultrasound measurement of uterocervical angle (UCA) technique**



Measure triangular segment between lower uterine segment and cervical canal: **A**, 18 5/7 weeks UCA 75 degrees, cervical length (CL) 35 mm; **B**, 16 5/7 weeks UCA 118 degrees, CL 32 mm.

Dziodosz et al. Uterocervical angle screen. *Am J Obstet Gynecol* 2016.

screening for CL in singleton gestations. Institutional review board approval was obtained with exemption prior to initiating the study. Consecutive women who delivered at our institution from May 1, 2014, through May 30, 2015 by university-associated practitioners were eligible. Women were identified from institutional computerized lists of

deliveries by provider and date of delivery.

TVU CL screening is routinely performed in all women with singleton gestations who are scheduled for an ultrasound between 16 0/7–23 6/7 weeks' gestation<sup>4,28</sup> in our practice. TVU CL was performed in a uniform fashion according to CL Education and Review

criteria by Registered Diagnostic Medical Sonographer—accredited sonographers monitored by maternal-fetal medicine attending staff.<sup>29</sup> Transvaginal images were obtained with 4- to 9-MHz IC5-9D (Voluson e8; GE Healthcare, Milwaukee, WI) or 4- to 8-MHz C8-4v (IU22; Philips Healthcare, Andover, MD) wide-view transducers. Images used to report CL from visits for anatomical survey studies were accessed and remeasured for UCA.

The UCA is the triangular segment measured between the lower uterine segment and the cervical canal, yielding a measurable angle (Figure 1). The first ray was placed from the internal os to the external os. The calipers were placed where the anterior and posterior walls of the cervix touch the internal and external os along the endocervical canal. If the cervix was curved, the first ray was also drawn from the internal os to the external os as a straight line. A second ray was then drawn to delineate the lower uterine segment. This ray was traced up the anterior uterine segment to a distance allowed by the preloaded image. Ideally, the second ray would reach 3 cm up the lower uterine segment to establish an adequate measurement. The anterior angle between the 2 rays was measured with a protractor.

In the presence of funneling, the first ray was placed to measure the length of remaining cervix. The second caliper was placed from the innermost portion of measurable cervix and extended to the lower uterine segment. In the event that the lower uterine segment was found to be irregular, the second caliper was placed centrally along the segment. In the event of a retroverted uterus, the angle should be measured in a similar fashion with the first ray along the measurable cervix and the second ray traced along the lower uterine segment. Unlike in an anteverted or axial positioned uterus, however, the posterior side of the angle closer to the intrauterine contents should then be measured. Interobserver and intraobserver UCA measurements were compared for variability.

Women were included in the analysis if they were between the ages of 18–50 years; carrying a singleton gestation;

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