Preterm birth affects one in ten pregnancies worldwide and is associated with increased risk of developmental delays, early childhood death, and adverse health outcomes throughout life. Researchers and clinicians have called for early pregnancy biomarkers of preterm delivery, especially in the uterine cervix, a crucial component in the timing of delivery. Our goal is to refine quantitative ultrasound methods to characterize the remodeling microstructure of the cervix throughout gestation. First-order speckle statistics analysis is a quantitative ultrasound technique that can be used to make inferences about acoustic scatterers smaller than the image resolution. Challenges for speckle analysis of the cervix include high, spatially heterogeneous attenuation, system-dependence, and a lack of models for elongated components of the microstructure like fibrillar collagen– a prominent acoustic scatterer responsible for maintaining cervical strength. Therefore, methods for overcoming these challenges are developed and tested to compensate received signals for the expected power loss from attenuation and diffraction, to reduce the dependence of speckle statistics estimates on device-specific focal properties, and to establish a method for interpreting speckle statistics estimates from fibrous scatterers. Finally, speckle statistics analysis was performed in an in vivo human cohort in a longitudinal study of the cervix throughout pregnancy. This work establishes methods that will be beneficial in research and clinical implementation of speckle statistics, and it represents a unique lens into the microstructural remodeling of the in vivo cervix during gestation.