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Longitudinal Placental Softening in Normal Pregnancy Assessed by Strain Elastography: A Prospective Cohort Study

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Objectives

To characterize longitudinal changes in placental stiffness across gestation using strain elastography and to explore associations with maternal factors in uncomplicated pregnancies.

Methods

In this prospective longitudinal study, 80 healthy singleton pregnancies underwent serial ultrasound examinations with strain elastography in the second and third trimesters. Semi-quantitative analysis of color-coded elastographic maps was performed to estimate relative stiffness distribution (red = soft, blue = stiff). Maternal variables, including body mass index, gestational weight gain, and parity, were evaluated for associations with third-trimester stiffness patterns. Paired comparisons and correlation analyses were conducted.

Results

Seventy-seven pregnancies with complete datasets were analyzed. A significant shift toward increased placental stiffness was observed with advancing gestation. The proportion of soft tissue (red) increased from 2.3% to 21.0%, while stiff regions (blue) decreased from 31.0% to 8.1% ($p < 0.001$). Intermediate stiffness categories showed corresponding redistribution, indicating progressive placental compliance. Gestational age-stratified analysis demonstrated a continuous decline in stiffness from early second trimester to term. Greater gestational weight gain was modestly associated with higher residual stiffness in the third trimester ($r = 0.316$, $p = 0.047$). No significant associations were identified for body mass index or parity, although descriptive trends suggested subtle modulation of stiffness patterns.

Conclusions

Placental tissue demonstrates a consistent longitudinal transition toward increased compliance during normal pregnancy. Strain elastography, a widely accessible technique, can capture this biomechanical trajectory *in vivo*. These findings provide preliminary reference data for normal placental mechanical adaptation and support further investigation of elastography as a functional tool for placental assessment, particularly in high-risk pregnancies.

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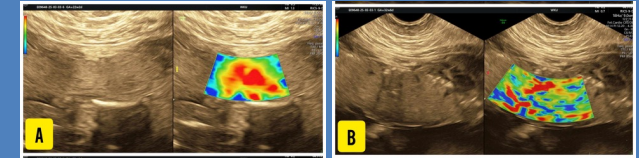


Figure 1. Serial dual-screen ultrasound images of the placenta at 22 and 32 weeks of gestation.

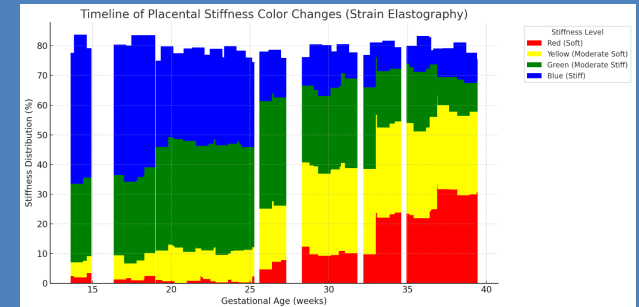


Figure 2. Gestational trends in placental stiffness based on strain elastography color mapping.

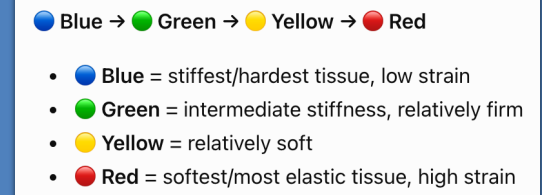


Figure 3. Colors in strain elastography, using the commonly applied color map, the order from stiffest/hardest to softest/most elastic.

