



Automatic fetal Midsagittal Plane detection using Deep learning-based 3D segmentation network in twin pregnancy



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Objective

The increased Nuchal translucency (NT) is related to chromosomal defects and early cardiac failure in first trimester of pregnancy. In multifetal pregnancy, NT can provide a fetus-specific risk of aneuploidy. This is beneficial particularly in higher-order multiples for which there is currently no validated aneuploidy screening test. Detecting the mid-sagittal plane (MSP) is an essential part to measure NT. However, there are many difficulties in measuring NT, such as inappropriate fetal pose, high fetal mobility and maternal abdominal wall thickness. Though there has been an automated system proposed, its clinical use has been limited to singleton pregnancies. In light of this, we present a novel solution for automated NT measurement in twin pregnancies from three dimensional(3D) ultrasound images.

Material and methods

328 3D volume dataset
of fetal head and upper thorax

- 96 normal pregnancies between 11-13 weeks of gestation
- HERA W10 ultrasound system with 1-8 MHz transabdominal probe (Samsung Medison, Seoul, Korea).

Training and validation set
(135 training, 45 validation)

training and testing for 3D auto-labeling system
validation of automated NT detection system

① Deep learning- based 3D segmentation algorithm to segment landmarks.

fetal head, mid-lines, choroid plexus,
nuchal translucency, and diencephalon

② Automatically navigate the mid sagittal plane.

Results

Fig 1. Schematic of algorithm for MSP detection



Table 1. Success rate of NT Measurements by 5D NT™ and 5D NT-AI in twin pregnancy

NT measurement techniques	Success rate (n (%))	Mean NT (mm)±SD	ICC (95% CI)*
5D NT™	28 (21.1)	1.24 ± 0.23	0.29 (-0.13 to 0.54)
5D NT-AI	113 (84.9)	1.21 ± 0.06	0.83 (0.68 to 0.89)

ICC, intraclass correlation coefficients; NT, nuchal translucency; 2D, two-dimensional; US, ultrasonography; CI, confidence interval.*ICC was calculated for each method, using 2D-NT as the reference.

Conclusion

- The proposed method using deep learning-based 3D segmentation and automatic MSP navigation algorithm demonstrated high performance in accurately obtaining fetal MSP.
- MSP was successfully abstracted from the volume dataset in twin pregnancy.