TITLE: An innovative and non-invasive echographic approach for automatic Progression Angle evaluation

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ABSTRACT BODY:

Objectives: To assess the accuracy of a new intrapartum echographic approach for the automatic measurement of Progression Angle (PA) in a routine clinical context, during the second stage of childbirth labor.

Methods: A group of 48 pregnant women in the second stage of labor, with single pregnancy and fetus in cephalic presentation, were recuited at the Department of Obstetrics and Gynecology of "Santa Caterina Novella" Hospital (Galatina, Lecce, Italy). Each of them underwent the routine labor management and the additional translabial echographic scans. During each scan, an ellipsoidal guide on the screen helped the operator in the correct positioning of the pubic symphysis in the echographic field of view, in order to standardize the image acquisition protocol. PA was measured considering as reference landmark the pubic symphysis centroid, rather than its distal point, in order to enhance reliability and reproducibility of bone repere detection, increasing accuracy and objectivity of labor monitoring. The acquired echographic images were processed both automatically, by a novel automatic algorithm, and manually, by an expert sonographer blinded with respect to the automatic segmentation results. The performance of the automatic approach was evaluated by considering the manual image segmentation as the "gold standard" reference.

Results: A very good and statistically significant correlation was found ($r = 0.99$, $p < 0.001$) between manual and automatic measurements, together with a low residual error: root mean square error (RMSE) = 2°33' (2.2%). The total agreement between the two methods was also confirmed through Bland-Altman analysis, which showed a negligible average difference of 1°2'±4°40' (bias ± 2 SDs) between the two measurement techniques.

Conclusions: The proposed automatic algorithm was shown to be a reliable and accurate method for PA estimation during labor progression assessment. This novel ultrasound approach, being non-invasive, automatic and operator-independent has the potential to reduce invasiveness and human error rates with respect to the transvaginal manual inspections routinely employed for labor monitoring purposes. It will also represent a useful decision taking support for both gynecologists and midwives.