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A Clinical Based Semi-Automatic Algorithm for Developmental Dysplasia of the Hip Assessments in Ultrasound Images

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Abstract: Ultrasonic developmental dysplasia of the hip assessment allows visualization of un-ossified anatomical structures in newborns younger than 6 months. This assessment usually includes manual measuring of the well-defined Graf alpha angle. However; due to the high noise present in ultrasound images that affects the visibility of the required landmarks to draw alpha angle; high inter-observer and intra-observer variation will result. In this paper we are proposing a new semi-automated algorithm to measure alpha angle on 2D ultrasound image. The paper focused on enhancing the image quality which results in clarifying image landmarks for alpha angle assessment and dividing the image into 3 main regions, which then used to draw the base and the bony lines that form the alpha angle. 25 subjects were recruited for our study. 4 subjects were excluded due to the bad image quality and short ilium. The alpha angle measurements was done manually by 2-physicians blinded from each other on raw and enhanced images, and automatically, randomly repeated 10 times, using our proposed algorithm by the first author of the paper. The intra-observer variations were 2.7°, 3° and 2.5° for physician#1, physician#2 and our proposed algorithm readings respectively. The inter-observer variations were 5.2° and 4.5° for the physicians' readings on raw and processed images respectively. The inter-observer variations were 4.5° for the physicians' readings on raw with algorithm results and 4.2° for physicians readings on processed images with algorithm results respectively. From the results we can notice that our proposed algorithm has slightly decreased the inter-observer and intra-observer variations. Nevertheless it is fast and repeatable algorithm ($r = 0.89$) to measure the bony angle, alpha, with minimal experiences required, which make using ultrasound for developmental dysplasia of the hip assessment easy to be applied by those who are not experienced with this type of images.