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ARTIFICIAL INTELLIGENCE FOR PEDIATRIC BONE AGE ASSESSMENT OF HAND X-RAY IMAGES: A CONVOLUTIONAL NEURAL NETWORK

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ABSTRACT

Introduction: The development of the human skeletal system is a continuous and phased process, with each stage characterized by distinct morphological features. As a result, bone age assessment (BAA) serves as a reliable indicator of growth, onset of puberty, disease identification, and overall maturity. However, clinical BAA is often time-consuming, highly subjective, and lacks consistency.

Our aim to develop an automated method for bone age assessment

Method: Three expert pediatric radiologists performed bone age assessments for 612 hand radiographs based on the Greulich-Pyle atlas to develop a reference standard. Then, we utilized a Convolutional Neural Network (CNN) called You Only Look Once (YOLO) version 4, by using 162 convolutional layers. We applied two sets of data, one of them with augmentations, and split them by 70%, 20%, and 10% for training, testing, and validation, respectively.

Results: A total of 612 hand radiographs ranging from 4 months to 204 months (17 years) of age was used. (323 male and 289 female; mean age ± standard deviation = 113 ± 48.5 months) from a single institution. The model achieves a mean absolute error of 10.5 and 6.8 months on the validation and testing sets, respectively, and with an average precision range between 60% to 75.19% and an average IoU of 65.25% achieved the best results within this limited batch of training data. In addition, the recall was 0.80 in the training process.

Conclusion: The AI model exhibited a strong initial performance in utilizing CNN to enhance BAA, significantly improving clinical efficiency by reducing interpretation time and increasing inter- observer reliability. However, it is essential to conduct a comparative analysis with other CNN- based models to further evaluate its effectiveness.

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