

Detection of Little Leaguer's Elbow by Ultrasonography with Deep Learning

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INTRODUCTION: Little leaguer's elbow is a common elbow disorder among school-aged baseball players, and it was reported that more than half of young baseball players had some type of deformity on the medial epicondyle of the humerus. Medial epicondyle deformity is detectable using ultrasonography (Figure 1), but the accuracy of diagnosis depends on the technical proficiency of the examiner. In this study, we proposed an artificial intelligence (AI) model based on an object detection algorithm to detect medial epicondyle abnormality.

METHODS: The participants consisted of 40 young baseball players (mean age, 10.7±0.9 years; range, 9-12 years). Ultrasound images of their elbows were used, including 20 elbows with irregularity of medial epicondyle and 20 normal elbows. Movies of a long-axis view of the medial epicondyle were obtained, and cropped ten still images per case; a total of 400 still images were prepared (80% for training data, 20% for validation data). A model for detecting the medial epicondyle and irregularity in ultrasound images was constructed by transfer learning based on You Only Look Once (YOLO) object detection algorithm (Figure 2). Furthermore, interclass correlation coefficients were evaluated between an orthopaedic surgeon with 14 years of experience in ultrasonography and a novice orthopaedic surgeon and the AI model. Each examiner diagnosed the presence of irregularity on the medial epicondyle in the medial elbow long-axis videos of 20 baseball players (mean age, 10.1±0.9 years; range, 9-12 years), including 10 elbows with irregularity and 10 normal elbows. The kappa coefficients were calculated from the diagnosis of each examiner.

RESULTS: For the detection of the medial epicondyle and irregularity lesion, a mean average precision (mAP) of 0.991 for the medial epicondyle detection and 0.969 for irregularity. There was a high degree of correlation between the experienced orthopaedic surgeon and AI model ($\kappa = 1.00$), while the correlation between AI or experienced and novice orthopaedic surgeon was moderate ($\kappa = 0.513$).

DISCUSSION: This AI model showed high values of mAP for both detections of the medial epicondyle and irregular lesions. The detection accuracy of this AI model was comparable to the accuracy of the experienced surgeon.

SIGNIFICANCE/CLINICAL RELEVANCE: We consider this AI model could be used to assist detection of little leaguer's elbow using ultrasonography.

IMAGES:

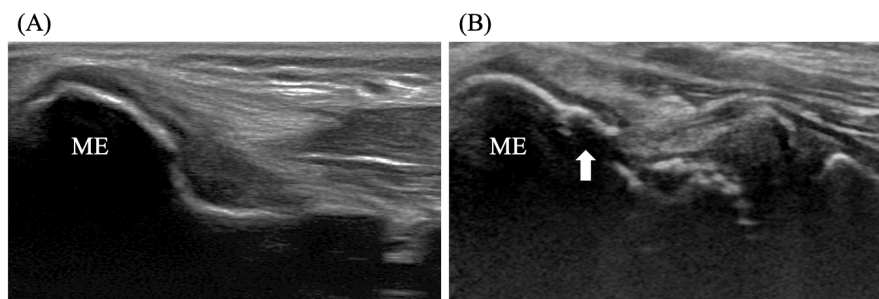


Figure 1. Ultrasound images of a long axis view of the medial elbow: (A) Normal (B) Irregular lesion (white arrow). ME, medial epicondyle

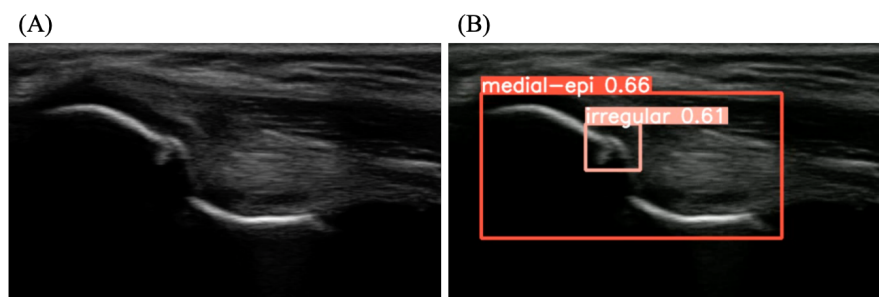


Figure 2. Automatically detection of the medial epicondyle and irregular lesion applied the learned YOLO model: (A) Original image (B) Predicted image