Detection of Distal Radial Fractures Using an Open Access Convolutional Neural Network (CNN)

Koen Daan Oude Nijhuis, BS*; Jasper Prijs, BS; Charlotte Louise Laane, MD; Britt Barvelink, MD; Zhibin Liao, PhD; Job N. Doornberg, MD; Frank Ijpma, MD, PhD; Joost Colaris, PhD; Mathieu Wijffels, MD, PhD; Machine Learning Consortium (Group)*
University Medical Centre Groningen, Groningen, NETHERLANDS

Purpose: Distal radius fractures (DRFs) are among the most common fractures seen in emergency departments. Preliminary assessment is often performed by junior doctors under time constraints with limited 24/7 supervision, while a missed diagnosis can have significant consequences for patients. Artificial intelligence (AI), specifically convolutional neural networks (CNNs) can be of help to diagnose fractures. Although CNNs are capable of recognizing fractures, for DRFs, however, algorithms that can detect fractures are lacking. Furthermore, external validation is lacking for many algorithms. The aim of this study is to validate an open access AI algorithm (CNN) for automatic recognition of DRFs.

Methods: Radiographs of adult patients with a suspected acute DRF, who presented at the emergency room of a Level I trauma center between 2016 and 2020, were included. The key features of the radiographs were annotated, including the outline of the radius and ulna, and a rectangle and polygon surrounding the fracture (Figure 1). These annotations have been performed by a panel in consensus agreement: junior doctors, supervised by a senior researcher and a consultant trauma surgeon. The data set was divided into a training set (80%) and a test set (20%).

Results: A total of 281 non-DRF and 245 DRF images were included. The accuracy of the algorithm for detecting DRFs is good, with sensitivity of the algorithm being 100%. The specificity of the algorithm is 94.44%. The area under the receiver operating characteristic curve (AUC) is 100.

Conclusion: This study presents an AI algorithm that is capable to detect DRFs with high accuracy. The algorithm will be made public for other researchers, to either improve upon it or externally validate it.