Clinical Application of AI technology to Trauma Surgery

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Artificial intelligence (AI) has been utilized for various medical technologies. We have attempted to apply AI to fracture diagnosis and three-dimensional surgical simulation.

One attempt is the development of AI diagnosis of distal radius fracture. For the Neural network library, we used VGG 16, which is a learned model of Keras and TensorFlow. 729 fracture images and 254 normal images of wrist joint simple X-ray were expanded to 3,245 images and 3,210 images respectively, and training and validation were carried out. A training data set was input into the network, validation was performed using the validation data set, and weighting was repeated so that the output approaches the correct value, and an AI was constructed to judge fractures. The diagnostic yield for distal radius fractures was 97.2% with a sensitivity of 98.7% and a specificity of 94.4%. The AUC for fracture diagnosis in the optimal parameters was 0.993 - 0.956. Although the amount of data used in the study was relatively small compared with previous reports, the sensitivity of our program for the diagnosis of distal radius fractures was as good as that in those reports, suggesting that it is also useful as a screening tool for the initial diagnosis.

Another of our attempts is to generate 3D bone models from 2D images using AI. 3-D bone models have been widely used for diagnosis, planning, and disease state understanding, such as computer navigation and preoperative simulation. In the past, research has been carried out to construct 3D images from 2D images, but we have developed 2D-3D reconstruction technique using AI. The paired data of plain X - ray and CT images of 181 wrist joints of healthy adults were expanded 40 times and learned by TL - network. As a result of estimating and constructing the simple X-ray image by converting it to the pseudo X-ray image, it became possible to reconstruct the high-precise 3D bone model with the mean intersurface error of 0.92 mm for the radius and 1.14 mm for the ulna compared with the 3DCT image. In the future, we will advance the learning so that the accuracy of both radius and ulna is 1 mm or less, and will try to estimate and construct the whole upper and lower limbs, and to apply it to malunion cases.