

# Deep Learning for Midfacial Fracture Detection in CT Images

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**Abstract.** This study deploys the deep learning-based object detection algorithms to detect midfacial fractures in computed tomography (CT) images. The object detection models were created using faster R-CNN and RetinaNet from 2,000 CT images. The best detection model, faster R-CNN, yielded an average precision of 0.79 and an area under the curve (AUC) of 0.80. In conclusion, faster R-CNN model has good potential for detecting midfacial fractures in CT images.

**Keywords.** Facial trauma, midfacial fracture, artificial intelligence, deep learning

## 1. Introduction

Misdiagnosis of midfacial fracture due to failure to interpret the radiographs, including pre-operative CT midfacial bone images, is one of the major causes of malunion leading to long-term morbidity and poor quality of life of facial trauma patients [1]. Deep learning (DL) has been successfully applied to detect bone fractures of various areas in radiographic images [2]. The purpose of this study is to deploy and evaluate the DL-based object detection models for detecting midfacial fractures in CT images.

## 2. Methods

This study was approved by the University Ethics Board (COA 007/2565). Object detection models were adopted by the two-stage detector, faster R-CNN, and the one-stage detector, RetinaNet, using CT midfacial bone images containing fractures of 1,000 images and without fractures of 1,000 images, which was randomly assigned to the training, validation, and test sets (70:10:20). The hyperparameter included learning rate of 0.025, 312 and 1,882 epochs and a batch size of 64 and 128 images for faster R-CNN and RetinaNet, respectively. The detection accuracy was evaluated by precision, recall, F1 score, average precision (AP) and AUC of precision-recall curves.

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3. Results

The examples and results of detection models are shown in Figure 1 and Table 1.

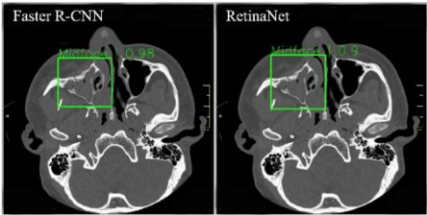


Figure 1. Examples of true positive output of faster R-CNN and RetinaNet.

Table 1. The performance of object detection models for detection of midfacial fractures in CT images.

Models	Precision	Recall	F1-score	AP	AUC of precision-recall curve
Faster R-CNN	0.72	0.85	0.78	0.79	0.80
RetinaNet	0.94	0.48	0.64	0.47	0.46

4. Discussion

The accuracy performance in detecting the midfacial fractures in CT images of faster R-CNN was considerably greater than that of RetinaNet and was higher than the study of Moon G. et al. [3], which adopted the one-stage object detector, YOLOX-S, to detect maxillofacial fractures in various maxillofacial regions. The detection result was indicated that the two-stage object detector might be more appropriate for fabricating the DL-based object detection model for detecting midfacial fractures in CT images.

5. Conclusions

This study showed that the two-stage object detector, faster R-CNN, has good potential and was a good candidate for detecting midfacial fractures in CT images.

Acknowledgements

We gratefully acknowledge the Dental Clinic, Saraburi and Sakon Nakhon Hospital.

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