

Abstract

Bone metastasis is a common and serious complication in cancer patients, often affecting treatment decisions and prognosis. Whole-Body Bone Scan (WBBS) is widely used for detecting skeletal metastases due to its high sensitivity and cost-effectiveness. However, manual interpretation of WBBS images is time-consuming and prone to diagnostic errors. This study aims to develop an automated bone metastasis hotspot detection system using the latest version of the You Only Look Once model, YOLOv11, and the publicly available BS-80K dataset. The dataset consists of 3,247 pairs of anterior and posterior bone scan images, each annotated with bounding boxes and labels for abnormal regions. To assess the effectiveness of the proposed approach, two object detection models—YOLOv11 and Faster R-CNN—were trained using the same hyperparameter configuration and evaluated using mean Average Precision at IoU thresholds of 0.5 (mAP50) and 0.5–0.95 (mAP50–95). The results demonstrate that YOLOv11 outperforms Faster R-CNN in both accuracy and inference speed, the best YOLOv11 model (yolov11s, learning rate 0.01) achieved mAP50 of 0.564 and mAP50–95 of 0.236, with a total training time of 5.811 hours and an average inference time of 3.6ms per image. In contrast, Faster R-CNN model (ResNet50 backbone, learning rate 0.0001) achieved mAP50 of 0.389 and mAP50–95 of 0.156, with total training time of 10.782 hours and an average inference time of 37.1ms per image. These findings indicate that YOLOv11 has strong potential for clinical application in automatic WBBS analysis, offering improvements in diagnostic consistency and reducing clinician workload.

Keywords: Whole-Body Bone Scan, Metastasis, YOLOv11, Faster R-CNN