Kilic *et al*[13] evaluated a Faster R-CNN method for detecting and numbering of primary teeth on 421 pediatric panoramic radiographs and reported that the sensitivity, precision, and F1 score were 0.9804, 0.9571, and 0.9686, respectively. Although this study showed similarity with our study due to the use of pediatric panoramic images and the high success performance of the CNN method on detecting and numbering according to the FDI notation, the number of images was low and only primary teeth were detected and numbered. This present study was the first to use a CNN algorithm for automated detection and numbering of both primary and permanent teeth on pediatric panoramic radiographs.

All the aforementioned studies used two stage detectors like Mask-RCNN[12], R-CNN[5] and Faster R-CNN[7,13] that achieved great accomplishments in object detection. Although the two-stage detectors are usually more precise, this approach is slower than the one-stage detectors and requires high computation time. YOLO is one example of the one stage detectors that is used for detection and classification of objects with extreme speed and high accuracy. Furthermore, the feature of YOLO as performing real time object detection with its overall good performance in various object classes average values distinguishes it from other CNN algorithms. [14] We used YOLO V4 for tooth detection and numbering because of its speed and high accuracy level for object detection. In a study of Yuksel *et al* [21], YOLO was used to detect five different dental therapy options and number the teeth according to the FDI notation on 1005 panoramic radiographs of adults. Although this study had a significant drawback as a small dataset, the model used for tooth numbering showed satisfactory results with an AP score of 89.1%. Similarly, the mean AP score of our model was 92.22% showing that the model was very successful in automated tooth enumeration. Since we used pediatric panoramic radiographs to train and test the model for primary and permanent tooth numbering and detection, it is not possible to make a full comparison with this study.

CONCLUSION

In this study, we proposed a deep learning algorithm for detecting and numbering the primary and permanent dentition on pediatric panoramic radiographs. Our results showed that the performance of the proposed model was fast and accurate. To the best of our knowledge, this is the first study that used a CNN algorithm for detecting and numbering both primary and permanent teeth on pediatric panoramic images. Combination of deep learning-based models with the practice of dental experts may provide better treatment outcomes and accurate diagnoses of diseases in less time.

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