

## Qualitative Analysis of Radiographs for Deep Learning Model Development

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**Objectives:** This study aimed to perform a qualitative analysis of challenges encountered while developing a deep convolutional neural network (CNN) model for the diagnosis of caries lesions using intraoral radiographic images.

**Methods and materials:** Thirty full mouth series (FMS) radiographs, including periapical and bitewing images, were selected for annotating teeth, caries lesions, and restorations. Images were available through a secure online platform developed by the School of Biomedical Informatics. After completing the annotations, we selected fifteen FMS (50% of the sample) to perform a qualitative evaluation of the radiographs, describing technical and perception errors as reasons why radiographs could not be annotated. Nearly twenty percent of the radiographs were not appropriately annotated because of radiographic technique errors.

**Results:** The most frequent radiographic errors were “cone cuts” 10.4% of cone cuts and “overlap” 19.2% of overlaps. Cone cuts and overlapping are critical radiographic errors resulting in a non-diagnostic image unsuitable for annotation and subsequent inclusion in the CNN model. Adding to this challenge, the platform for radiographic annotation did not allow for contrast adjustment or image enlargement, making it challenging for the annotating examiner to make a final decision if there are or not caries lesions. If the examiner cannot accurately identify the caries, the radiographic annotation is inappropriate, and that consists in a perception error.

**Clinical Implications:** When the AI model is deployed in a dental practice, it will require diagnostic quality radiographs. If diagnostic quality is compromised, it may result in perception and analytical errors.

**Recommendation/Conclusions:** Imaging software and radiographic technique should be optimized to prepare the dental practice for implementing AI technology to assist clinicians in making the most accurate clinical decisions, bringing efficiency to clinical practice, and benefiting clinicians and patients.

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