Characterization of true and false positive locations of spiculated lesions on mammography

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Abstract

The goal of this study is to find features that uniquely characterize the true positive (TP) and false positive (FP) detections identified by our recently developed computer-aided detection (CAD) algorithm. As a first step towards this goal, a two-alternative forced choice observer experiment was conducted in which the TP and the highest-ranked FP locations marked by CAD on 47 cases of spiculated masses were shown to three radiologists. Our primary interest in this experiment was to determine if the FP detections made by our algorithm are easily dismissed by experienced radiologists.

Background

• CAD systems for mammography have been developed to assist radiologists in finding early signs of breast cancer [1-2].

• We have developed a CAD algorithm to assist radiologists in the detection of spiculated masses on mammography [3]. With the current algorithm, we have achieved a sensitivity of 88% at 2.7 false positives per image (FPI).

• The focus of this study is to understand the perception of radiologists in distinguishing the TP and FP marks made by the CAD algorithm.

• Our hypothesis is that understanding radiologists' perception will help us identify key features that characterize TP and FP marks. These features will be valuable for reducing the number of false positives per image.

• As a starting step towards this goal, we conducted a two-alternative forced choice observer experiment to evaluate if the FP detections made by our algorithm are easily dismissed by experienced radiologists.

Materials and Methods

Materials

• For this study, we considered 47 mediolateral oblique view mammograms containing spiculated masses. These mammograms were obtained from the Digital Database for Screening Mammography (DDSM).

• Our CAD algorithm [3] was evaluated on these masses and the algorithm reported the true lesion and highest ranked FP locations for each case.

• The regions of interest (ROI) surrounding the true lesion and FP locations were automatically extracted (e.g., Figures 1 and 2).

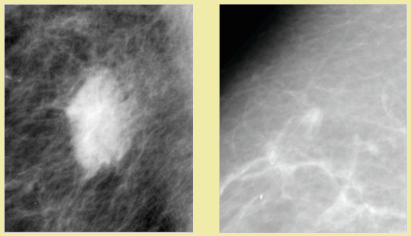

Figure 1. True lesion (L) and false positive (R) location of a spiculated mass

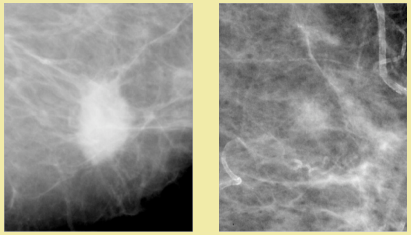

Figure 2. True lesion (L) and false positive location (R) of another spiculated mass

Methods

• A two-alternative forced choice observer experiment with three experienced radiologists (observers) was conducted.

• For each case, the true lesion and the highest-ranked FP location reported by the CAD were shown to the observers.

• The observers were not told which ROI corresponded to the true lesion location or the FP location and the order in which these were shown was completely random.

• The observer had to visually inspect these images and select the one that he/she believed corresponded to the true lesion location.

• We compared the decision of the observers with the ground truth to analyze which cases were incorrectly determined.

Results

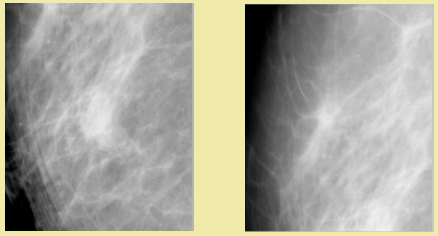

Figure 3. This pair of true lesion (L) and false positive location (R) was deemed the hardest to distinguish by one of the radiologists

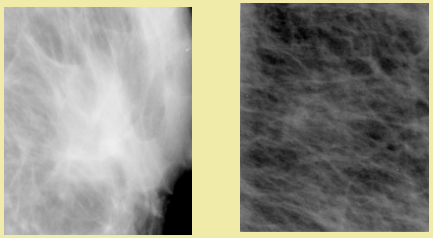

Figure 4. In this pair, the true lesion (L) was not very obvious to one of the radiologists

• Out of the three radiologists, one of them correctly identified the true lesion and FP locations for all the 47 cases.

• The other two radiologists got only one case wrong.

• Figure 3 represents a pair of true lesion and FP location that was deemed the hardest to distinguish by one of the radiologists while in Figure 4, the true lesion location was thought to be the least obvious.

• These results show that the false positives marked by our CAD algorithm could be easily dismissed by experienced radiologists.

Conclusion

• Based on this observer study, we feel that our CAD algorithm marks false positives that can be easily dismissed by an experienced radiologist.

• We plan to extend this study by asking the radiologists to comment on each of these regions of interest to find out how they perceive the true lesion and false positive locations.

• We plan to utilize these comments to analyze the features in the false positive ROI to determine why the CAD marks them as lesion.

References

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