Image enhancement of ultra-low dose CBCT images using a deep generative model

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Objective

The aim of this study is to improve the image quality of CBCT images, obtained on an ultra-low dose (ULD) protocol, using a deep generative model called the pix2pix image-to-image translation1 technique.

Study Design

CBCT images of dry skull and mandible was obtained using preset standard and ULD imaging protocols. We combined the scans into a dataset with 1,412 ULD, and normal dose DICOM image pairs (2,824 scans in total), and randomly select 10% (140) image pairs as the test set. We train a pix2pix deep generative model by first convert the DICOM images to JPG images and then feeding the training set image pairs to the network. We tested the performance of the trained model on the previously unseen test set ULD images and compared the synthesized images with the corresponding normal dose image and ULD images.

A preliminary blind study on the standard, ULD and synthesized images by an OMF radiologist was done and image identification, image quality and edge definition were assessed2,3.

Results

Preliminary results indicate that in the three datasets used for review, all synthesized images were rated as having higher quality and better edge definition compared to ULD images. Analysis also indicated that synthesized images were equivalent to standard images on image quality and edge definition.

Conclusion

CBCT usage market is expected to grow globally by 9.7%4. With the expected growth, reducing radiation dose and improving image quality is of paramount importance to reduce radiation burden on the population. The current study focuses on image enhancement of CBCT images made with ULD protocol. Initial analysis indicates a marked improvement in image quality of the synthesized images when compared to ULD images. With further research and successful implementation, we have an opportunity to reduced radiation risks to patients while improving image quality.

References:

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