Purpose: Neck fibrosis is a common side effect of radiotherapy for head and neck cancer. Currently, physicians use physical examination such as palpation to evaluate its severity. No imaging tool is available in the clinic to visualize and evaluate such injury. The purpose of the study is to develop a reliable ultrasound technology to image and quantify radiation-induced neck fibrosis.

Methods: Eleven post-radiation patients and ten healthy volunteers were enrolled under an IRB approved study. All patients received radiotherapy for their head and neck cancers 12 to 18 months prior to the study. Each participant was scanned using a clinical ultrasound scanner with a 14-MHz linear array transducer. On each side of neck region (4 by 4 cm mid-section), 5 parallel consecutive transverse scans and 5 parallel coronal scans were acquired. Our ultrasound method analyzes the radio-frequency signals and computes three ultrasound parameters to quantify the physical conditions of the neck tissues. Skin thickness was used to measure skin fibrosis; while spectral intercept and midband fit were used to measure subcutaneous fibrosis. In addition, a comparative study of the transverse and coronal scans was performed.

Results: Significant differences were observed between the normal and irradiated necks in both transverse and coronal scans. Skin thickness value was 2.03±0.03 mm for the normal neck and 2.67±0.04 mm for the irradiated neck. For the underlying tissue, there were significant changes for the irradiated neck in the spectral intercept ($p < 0.05$) and midband fit ($p < 0.05$). Overall, transverse scans showed more consistency when compared with coronal scans.

Conclusions: In the effort to develop a noninvasive imaging technique for evaluating radiation-induced neck fibrosis, we developed quantitative ultrasound methods combining ultrasonic imaging and ultrasound tissue characterization. This study demonstrated its clinical feasibility; future study is warranted for larger clinical trials.

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