Purpose: Intra-operative ultrasound is used to verify the positioning of episcleral eye plaques used to treat ocular melanoma. Ultrasound can be ambiguous because of image artifacts, and plaques may shift position after surgery. Ultrasound verification is particularly challenging for anterior tumors. Post-operative imaging could be used to trigger interventions that would prevent local treatment failure. We investigated if, and under what conditions, the Tomotherapy megavoltage computed tomography (MVCT) system could be used to perform post-implantation verification of eye plaque positioning.

Methods: Plaques were placed on a preserved cow’s eye, and imaged with the megavoltage CT of a Tomotherapy linear accelerator (Accuray, Sunnyvale, CA). The images were visually and quantitatively assessed to determine if they were of sufficient quality to verify tumor coverage and plaque tilt with respect to the sclera. We used the visibility of the lens as a proxy for visibility of a tumor. To test the utility of hypothetical higher beam current Tomotherapy images, we averaged sequential images of the same setup.

Results: The plaque, the lens of the eye, and the globe are visible in the images. The CNR of the lens with respect to the vitreous was 5.6 for a single image. For 10 images averaged, the CNR was 9.2. Estimated dose from a single image was 1.3 cGy (body CTDIvol); even 10 times this dose would be an acceptable image-guidance dose for radiotherapy patients. One limitation of the imaging procedure is the long scan time (up to 240 seconds), during which time any significant patient motion would lead to image artifacts. Human trials on eye plaque patients are planned.

Conclusions: Tomotherapy MVCT imaging could be used to verify tumor coverage and plaque tilt after episcleral plaque implantation. Tumors should be visible in standard Tomotherapy images but higher beam current images would be preferred if available.