

AbstractID: 2782 Title: A method to treat GammaKnife shots otherwise untreatable due to collision

Purpose: To develop a technique enabling Gamma Knife shots deemed untreatable because of collision to be delivered using an appropriately shifted stereotactic frame placement without requiring re-imaging of the patient.

Method and Materials: A Leksell stereotactic frame with a CT fiducial box was applied to a head phantom. The assembly was imaged (1 mm slice thickness), allowing localization of its stereotactic space. Using GammaPlan, the (x,y,z) coordinates of the centers of four 0.5-mm diameter steel spheres positioned as targets within the frontal, temporal, and occipital regions of the head phantom were recorded. A Leksell biopsy arc was then attached to the stereotactic frame and the (r, θ, φ) coordinates of 6 points marked on the phantom surface were recorded. The stereotactic frame was removed from the phantom and re-attached in a different position. The biopsy arc was then used to determine the new (r, θ, φ) coordinates of the same surface points. A transformation algorithm using the two sets of (r, θ, φ) coordinates was applied to the (x,y,z) coordinates of the steel spheres in the original stereotactic space to determine the corresponding coordinates in the second stereotactic space. To test algorithm accuracy, a repeat CT-scan of the phantom was done and the actual (x,y,z) coordinates of the targets in the second stereotactic space were found.

Results: The mean distance between the algorithm-predicted value and actual value of the target coordinates in the second frame placement was 1.03 ($\sigma = 0.3$) mm, demonstrating acceptable accuracy in most clinical situations.

Conclusions: This technique may be used for treating patients with multiple lesions where collisions prevent treatment with a single frame application. Once all treatable shots are delivered, the frame is shifted and a transformation based on the spherical coordinates of surface points is applied to the untreatable shots which are then delivered in the new stereotactic space. Re-imaging is not necessary.