Purpose: To develop a GPU-based interactive multi-volume visualization program in radiotherapy treatment planning (RTP) which is able to show the spatial relationships between patient anatomical data and radiation dose distribution.

Methods: The radiation dose matrix is extracted from commercial RTP systems such as the Eclipse from Varian Oncology Systems (Palo Alto, CA, USA) and the Hi-Art from the TomoTherapy Incorporated (Madison, WI, USA), and is then co-registered with the CT volume such that all three volumes of CT data, dose distribution, and segmented radiotherapy structures share the same geometry, resolution, and position, and show no rotation against each other. A GPU-based multi-volume ray casting technique is developed by using NVIDIA's CUDA framework for simultaneously volume renderings of patient anatomy data and radiation dose distribution. The program is executed on an NVIDIA Tesla C1060 computing processor. Each ray emitted from view point is independently processed by a thread on GPU. The ray transverses both volumes and the visual contributions are mixed for every sample points.

Results: The program has been tested on brain tumor patient data and lung tumor patient data. High quality volume rendering of patient anatomy and dose distribution has been generated interactively. The performance of 8 FPS has been achieved for patient data size of 512x512x188, and view window size of 512x512.

Conclusions:A multi-volume visualization program in RTP has been developed on GPU. The program offers visualization through interactive volume rendering of patient anatomical data and radiation dose distribution. The program can be used to improve the understanding of the spatial relationships between patient anatomical data and radiation dose distribution.