Purpose: To evaluate the dosimetry of 3D CRT, Step-and-Shoot Intensity Modulated Radiation Therapy (IMRT), and Volumetric Modulated Arc Therapy (VMAT) treatment plans with respect to doses to the carotid arteries and spinal cord.

Methods: Data from ten patients who underwent CT scanning for treatment planning was selected for this retrospective study. The spinal cord, carotid arteries, and tissue of neck not involving the target volume called Non-Target-Volume (NTV), and clinical target volumes (CTVs) were contoured. A margin added to the CTVs generated planning target volumes (PTVs). Using 6 MV photon beams, treatment plans with 3-D CRT, IMRT, and VMAT techniques were created for each patient. The prescription dose was 63 Gy in 28 fractions. The evaluation was based on the averaged results of mean doses to PTV, mean doses and doses to the 20% (D20), 50% (D50), and 90% (D90) of the volume of the carotid arteries, and maximum doses to the spinal cord for all three treatment delivery techniques.

Results: Mean doses to PTV were 64.12, 66.44, and 65.64 Gy for 3D CRT, IMRT and VMAT plans respectively. Mean doses to the NTV, were 1.42, 0.91, and 0.94 Gy, to the carotid arteries were 55.23, 31.31, 23.32 Gy, and maximum doses to spinal cord were 2.99, 25.72 and 25.75 Gy, for 3D CRT, IMRT and VMAT plans respectively. The D20, D50, and D90 doses to carotid arteries were 63.23, 62.01, and 30.51 Gy, for 3D CRT, 47.64, 35.54, and 3.47 Gy for IMRT, 36.23, 24.30, and 3.13 Gy for VMAT plans respectively.

Conclusions: All three techniques achieved conformal doses to the PTV. Doses to spinal cord were lower with 3D CRT technique, but doses to the carotid arteries were substantially reduced with VMAT plans. This is important to minimize the risk of atherogenesis and consequent cerebrovascular complications.