

Purpose: The objective of this study was to analyze the relationships of dose and volume coverage in the comparison of a single shot (SS) and multiple shot (MS) Gammaknife treatments. The diseases studied were arteriovenous malformation (AVM), meningioma (MN), brain metastasis (BM), pituitary tumor (PT), vestibular schwannoma (VS), and trigeminal neuralgia (TN) (n=10 for each disease).

Method and Materials: The relationships between dose and volume coverage were measured at 90%, 80%, 70%, 60%, 50%, 40%, and 30% of the maximum doses using dose-volume histograms (DVHs). We set the control volume covered by the prescribed dose (=50% of maximum dose) as unity. Then, volumes covered by different percentages of the maximum dose were divided by the control volume. This method was used for the analysis of four helmet sizes (4, 8, 14, 18 mm) and six diseases. The impact of plug patterns was analyzed for TN.

Results: Average volume ratios (AVRs) covered by SS using four helmets were 0.31, 0.47, 0.61, 0.77, 1.36, and 2.06 times the control volume while AVRs covered by MS in the first five diseases were 0.03, 0.14, 0.34, 0.62, 1.47, and 2.23, at 90%, 80%, 70%, 60%, 40%, and 30% of the maximum dose, respectively. The mean doses for six diseases were 18.7, 15.1, 17.2, 15.0, 12.4 Gy to 50%, and 72 Gy to 80%, respectively. AVRs of MS to those of SS were 0.11, 0.30, 0.55, 0.81, 1.08 and 1.08, respectively. Plug patterns did not affect much on the relationship of dose and volume coverage in TN.

Conclusions: Greater volumes were covered by the higher percentage isodose lines in SS than in MS. TN had the highest volume ratios covered by doses greater than 50% of the maximum dose; and PT and VS had higher volume ratios than AVM, MN, and BM in this study.