The relationship between target volume and adverse radiation effects (AREs) at low prescription doses requires elucidation. The development of AREs in three series of patients treated in the Gamma Knife is analysed in relation to prescription dose and target volume.

There were three groups. In group 1, there were of 275 patients with meningiomas; in group 2, 132 patients with vestibular schwannomas; and in group 3, 107 patients with arteriovenous malformations (AVMs). The minimum follow-up for each group was more than 24 months. All patients were followed up at six monthly intervals. The patients with tumours received a prescription dose of 12 Gy, which was varied to protect normal structures but not in relation to tumour volume per se. The desired AVM prescription dose was 25 Gy, but this was also reduced to protect normal structures and to keep the total dose within certain pre-defined limits. All AREs refer to intra-parenchymal increased perilesional T2 signal on MR irrespective of clinical correlation.

There was no relationship between tumour volume and the development of ARE in the tumour groups. There was a highly significant relationship between target volume and the development of ARE for the AVMs with their much higher dose. Radiation-induced clinical trigeminal and facial nerve deficits with both vestibular schwannomas and meningiomas were always associated with an increased T2 signal in the neighbouring brainstem parenchyma.

The relationship between target volume and the risk of adverse radiation effects may not apply with lower prescription doses. Individual radiosensitivity may explain why a minority suffer AREs unrelated to target volume. It is possible that radiation-induced brainstem parenchymal damage with concomitant cranial nerve deficits may be commoner after radiosurgery than is usually thought. If tumour control with lower doses is adequate, radiosurgery could be safely considered for larger targets associated with a high risk from microsurgery [1)].

1)
Ganz JC, Reda WA, Abdelkarim K. Adverse radiation effects after Gamma Knife Surgery in relation to dose and volume. Acta Neurochir (Wien). 2009 Jan;151(1):9-19. doi: 10.1007/s00701-008-0174-4. Epub 2009 Jan 8. PubMed PMID: 19129961.