Gamma knife: an evidence-based analysis

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Authors' objectives
The objective of this technology review was to assess the efficacy of gamma knife stereotactic radiosurgery (SRS) in the treatment of arteriovenous malformations, acoustic neuroma, cerebral metastases and trigeminal neuralgia, the latter representing a non-invasive approach to precision ablation for benign conditions. The efficacy of gamma knife relative to microsurgery and LINAC-based SRS was a particular focus of this review for all conditions excluding the treatment of trigeminal neuralgia.

Authors' conclusions
Acoustic Neuroma and cerebral arteriovenous malformation (AVM): There is no evidence that there is any difference in effectiveness between gamma knife and LINAC-based SRS in the treatment of AVM or acoustic neuroma. There is level 3 evidence that microsurgery remains the best overall treatment option for AVM and acoustic neuroma. Irrespective of whether SRS is performed using a gamma knife or LINAC, there is level 3 evidence that it is an important technology for surgically inaccessible acoustic neuroma and AVM lesions or for lesions considered to present a significant surgical risk. There is level 3 evidence that, in the treatment of acoustic neuroma, fractionated LINAC-based SRS results in fewer facial nerve complications than gamma knife. Brain Metastases: While SRS is being increasingly employed for treatment of cerebral metastases, there is level 1 evidence that there is no benefit for SRS compared to WBRT when employed as first line radiation treatment. There are no studies demonstrating that surgical excision is better than WBRT alone. There is level 3 evidence that SRS is beneficial in the treatment of recurrent primary brain tumours or metastases following front line radiation therapy. There is level 3 evidence that when employed for recurrent brain metastases, gamma knife SRS provides improved control of local regional progression than LINAC-based SRS. However, the study reporting this observation observed that despite a 13% improvement in symptom control, 22% of patients experienced severe neurotoxicity which was irreversible in 42% of cases, and 3% all cases died as a result of neurotoxicity attributed to SRS. SRS in Non-Invasive Treatment of Benign Conditions: Side effects from Gamma knife treatment of trigeminal neuralgia are minimal, attesting to the precision of this treatment modality. There is level 3 evidence that gamma knife SRS results in improvement in pain associated with trigeminal neuralgia in over 90% of cases, irrespective of whether patients have undergone previous other treatment or not. It is assumed that gamma knife will be increasingly employed for the non-invasive ablative treatments of benign neurological conditions.

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