

## Repeat Stereotactic Radiosurgery for Incompletely Obliterated Arteriovenous Malformations: An International Multicenter Study

Hideyuki Kano; Nathaniel Sisterson; Dale Ding; Jason Sheehan; Roberto Martinez-Alvarez; Nuria Martinez-Moreno; Paul Huang; Amparo Wolf; Douglas Kondziolka; Inga Grills M; Kevin Blas; David Mathieu; L. Dade Lunsford

### Introduction

To evaluate the outcomes and risks of repeat stereotactic radiosurgery (SRS) for incompletely obliterated cerebral arteriovenous malformations (AVM).

### Methods

Six participating centers of the International Gamma Knife Research Foundation (IGKRF) identified 335 patients who had incompletely obliterated AVMs at a median follow-up of 45.6 months after initial SRS (range, 15-283 months). The median AVM target volume at initial SRS was 4.3 cc but was reduced to 1.4cc at the time of the second procedure. The median margin dose at both initial SRS and repeat SRS was 20 Gy. The median follow-up after repeat SRS was 64 months (range, 6-218 months).

### Results

The actuarial rate of total obliteration by angiography or MRI after repeat SRS was 31%, 50%, 61%, and 80% at 3, 4, 5, and 10 years, respectively. Factors associated with a higher rate of AVM obliteration were smaller residual AVM target volume, and > 50% of volume reduction after the initial procedure. The cumulative actuarial rates of new AVM hemorrhage after repeat SRS were 1.8%, 4.5%, 6.6%, 8.9% and 14.9% at 1, 2, 3, 5, and 10 years. Factors associated with a higher risk of hemorrhage after repeat SRS were a larger number of a prior hemorrhages, larger AVM target volume, and initial AVM volume reduction < 50%. Symptomatic adverse radiation effect (ARE) developed in 29 patients (8.6%) after initial SRS and 27 patients (8.1%) after repeat SRS.

### Conclusions

Repeat SRS for incompletely obliterated AVMs increases the eventual obliteration rate but patients remain at risk of hemorrhage until obliteration occurs. The best results for incompletely obliterated AVMs were seen in patients with a smaller residual AVM volume and no prior hemorrhages.

### Learning Objectives

By the conclusion of this session, participants should understand risks and benefits of repeat stereotactic radiosurgery for incompletely obliterated AVMs.

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