

A multicenter retrospective study of frameless robotic radiosurgery for intracranial arteriovenous malformation

Eric K Oermann BS; Brian T. Collins MD; Deanna Mary Sasaki-Adams MD; Kevin M. McGrail MD; Vikram V. Nayar MD;

David Morris; Matthew G. Ewend MD

Departments of Neurosurgery and Radiation Oncology, The University of North Carolina at Chapel Hill, Chapel Hill, NC

Departments of Neurosurgery and Radiation Medicine, Georgetown University, Washington, DC



Learning Objectives

By the conclusion of this session, participants should be able to: (1) describe the outcomes and complications of frameless radiosurgery for intracranial AVM and (2) understand the technique and planning of a frameless approach.

Introduction

CT-guided, frameless radiosurgery is an alternative treatment to traditional catheter-angiography targeted, frame-based methods for intracranial arteriovenous malformations (AVMs). Despite the widespread use of frameless radiosurgery for treating intracranial tumors, its use for treating AVM is not well described.

Methods

Patients who completed a course of single fraction radiosurgery at The University of North Carolina or Georgetown University between 4/1/2005 – 4/1/2011 and received at least one follow-up imaging study were included. All patients received pre-treatment planning with CTA ± MRA and were treated on the CyberKnife (Accuray) radiosurgery system. Patients were evaluated for changes in clinical symptoms and radiographic changes evaluated with MRI/MRA and catheter-angiography.

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Table 1

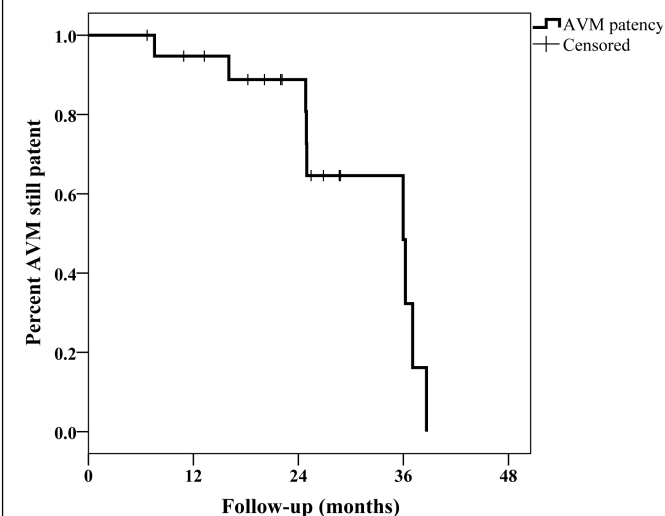
Variable	Endpoint		
	Stable (n=5)	Partial Closure (n=6)	Complete Closure (n=9)
Median months follow-up	17	26	25
Spetzler Martin Grade			
I	2	1	2
II	3	3	5
III	0	2	1
IV	0	0	1
Median Pollock-Flickinger Score	2.44	4.3	1.57
Median Maximum Nidus Diameter (mm)	1.8	2.0	1.10
Intervention			
SRS only	4	3	5
SRS+Embolization	1	3	3
SRS+Clipping	0	0	1

Summary of AVM characteristics and outcomes.

Results and Discussion

Of 36 patients treated, 20 patients were eligible for the study with a median age of 45 years (range, 15-75). Median nidus volume was 14.1 cm³ (range, 0.1-49 mm³) with a range of Spetzler-Martin Grades (Table 1) and a median Flickinger-Pollock Score of 2.7 (range, 0.6-22.3). 12 patients had radiosurgery alone, 7 had radiosurgery + embolization, and 1 had surgery followed by radiosurgery. A median dose of 20 Gy (range, 15-23) was delivered to a median isodose line of 80% (range, 62-85%). The median follow-up was 25 months (range, 7-42). 9 (45%) patients had complete closure with an average time to closure of 27 months (range, 8-39), 6 (30%) patients had partial closures, and 5 (25%) patients had no changes. 9 (45%) patients reported improvement in neurological symptoms. 64% of patients with greater than 2 years of follow-up had complete obliteration. No acute treatment related toxicity and one post radiosurgery hemorrhage occurred. These results are comparable to the only other study of frameless radiosurgery for AVM by F. Colombo and colleagues which reported an obliteration rate of 63.7% in all patients, 71.5% in patients undergoing MRA without confirmation by catheter angiography, and 81.2% in patients who underwent catheter angiography (1). These results with frameless radiosurgery are comparable to the results obtained with frame-based radiosurgery (2),(3).

Figure 1: Kaplan-Meier of AVM Patency



AVM patency decreases sharply after 24 months and compares favorably to other studies of radiosurgical treatment for intracranial AVM

Conclusions

Frameless radiosurgery can be targeted with non-invasive MRI/MRA and CTA imaging. Despite the difficulty of treating AVM without catheter angiography, early results with frameless, CT-guided radiosurgery suggest that it can achieve similar results to frame-based methods at these time points.

References

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