Journal of Clinical and Biomedical Sciences

Case Report

# A Case Report Of Cerebral Arterio Venous Malformation Treated With Frameless Stereotactic Radiosurgery

**Vijay Kumar Kontham[1]*, Santosh Devarakonda[1]**

1. Department of Radiation Oncology, Apple Cancer Institute, Apple Hospitals and Research Institute Ltd, Kadamwadi, Kolhapur, Maharashtra, India.

**Abstract**

Central nervous system Arterio-venous-malformations (AVM) are relatively rare developmental anomalies in both paediatric and adult populations. It is although not very rare to treat these AVM's with radiosurgery. There has been multiple case series published in literature about the possible treatment options and role of Stereotactic radiosurgery (SRS). Gamma Knife, Cyber knife, Linac based SRS and Proton beam radiosurgery are different options used for the delivery of SRS. We intend to present a case of cerebral AVM in an adult patient, successfully treated with Linac based SRS using simplified setup techniques and advanced planning system.

**Keywords:** Case report, Stereotactic Radio Surgery , Arterio-Venous-Malformations , Acuros, Radiotherapy.

## Introduction

Central nervous system arteriovenous malformations (AVMs) are relatively rare developmental anomalies for both pediatric and adult populations. It is although not very rare to treat these AVMs with radiosurgery.1 There have been multiple case series published in the literature about the possible treatment options and stereotactic radiosurgery (SRS) role. Gamma Knife, CyberKnife, LINAC based SRS, and proton beam radiosurgery are different options used for the delivery of SRS.1 Frameless SRS has been proven to be equally effective as frame-based SRS in clinical practice.2 We describe a successful attempt of SRS in an adult female with cerebral AVM.

## Case Summary

A 28 year old young female, with no known medical co-morbidities presented to our radiation oncology outpatient services, referred by neurosurgeon. She presented with complaints of frequent episodes of headache for the 1 year, which was responding to medication. There were no symptoms of neurological deficit. On MR (magnetic resonance) imaging (Figure 1), a large lobulated tangle of vascular flow voids has seen involving left high front parietal brain parenchyma near the surface. On MR angiogram, Left pericentral gyri superficial pial AVM has diagnosed. The nidus approximately measured 2.2 x 1.4 x 1.8 cm in size, with feeding arteries from the middle cerebral artery and a small branch from the anterior cerebral artery. There are prominent draining veins into superior sagittal sinus. The lesion is Spetzler-Martin AVM grade II (small nidus with the eloquent-sensory motor area). The patient refused the option of surgery due to the risk of potential complications.

This patient was planned for SRS treatment on our Varian Truebeam STx Linac with High definition Multi leaf collimators (HD MLC) and Flattening Filter Free (FFF). We have used simplified setup and immobilisation techniques for this patient. 3 clamp head immobilisation thermoplastic mask prepared with proper head rest and alignment. CT isocentre was marked using collimator rotations at 0 and 45 degree angles at gantry rotations of 0, 90 and 270 degrees. A Planning CT scan with IV contrast was taken with 0.6mm slice thickness and imported to treatment planning system. CT images were registered with MR images and target volumes and organs at

***Corresponding Author**
**Dr . Vijay Kumar Kontham**
Department of Radiation Oncology ,
Apple Cancer Institute, Apple Hospitals and Research Institute Ltd, Kadamwadi,
Kolhapur, Maharashtra, India.
E-mail: vijai2k6@gmail.com
Conflict of Interest: None
Financial Aid: Nil

risk were delineated. A marginal dose of 18Gy was prescribed to PTV volume. Planning was done with Acuros algorithm, a novel and accurate technique for dose calculation using multiple non co-planar arcs. Gross volume of nidus received 100% of dose to 100% volume with Planning target volume receiving 98% of dose to 98% volume. Brain-PTV received 8.75Gy to 12cc and 9.66Gy to 10cc volumes which were under tolerance limits. There was 50% dose fall off within 5mm from PTV margin. Treatment delivered in single fraction after meticulous QA and setup of patient with verification of Manual and automated SSD values at all angles. Pre and Post treatment CBCT was taken to confirm sub mm precision. Plan parameters: Maximum tumour dimension- 2.6cm, volume-9.4cc, conformity index 3.01 and Homogeneity Index 0.11.

On follow up at 12 months, patient was symptomatically improved and MR imaging revealed decrease in size of AVM nidus, measuring approximately 1.3x1.0x1.5 cm. At 24 months MR with Angiography revealed a complete resolution of AVM nidus.

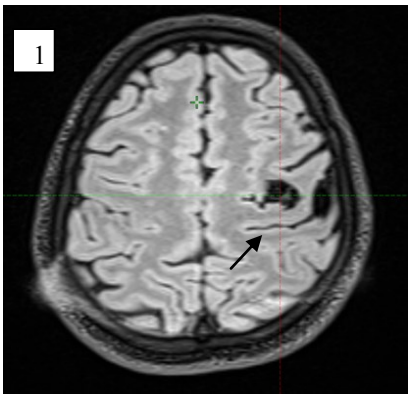


Figure 1: Pre treatment T1 MRI depicting AVM nidus.

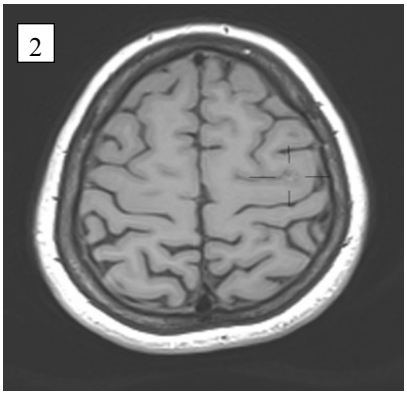


Figure 2: 24 months post treatment T1 MRI image showing complete obliteration of AVM nidus.

**Discussion**

Central nervous system AVM's poses great challenge for the clinicians, as it require skill and intuition for the management. Inoperable or small AVM's and those in eloquent regions are indications for SRS in most of the patients. The treatment of brain AVM's with Linac based SRS is equivalent to other modalities like Gamma knife and Cyber knife based radiosurgery.[1] Treatment outcomes were comparable in both paediatric and adult populations. Age seems to be a poor predictor of outcome. SRS is a reliable treatment option for brain AVM's across the ages.[2] Frameless SRS is an effective and non invasive approach, typically using brain lab immobilisation setup with 3 layered mask.[3] In contrast, we used a simplified approach for patient setup with simple single layered thermoplastic mask with high degree of patient repositioning accuracy. Obliteration of AVMs after SRS has been reported to range from 35% to 92%, with the obliteration rate exceeding 70% in most series.[1] The obliteration rate with small AVMs has exceeded 80% in most series.[4, 5]

Most important predictor of obliteration of AVM was a higher marginal dose of radiation. Potts *et al.*,[6] reported a 52% rate of obliteration with a dose of >18 Gy, while only 16% of AVMs that received <18 Gy were obliterated in a series reporting on the results of Gamma Knife based SRS for AVMs.

The interval-to-obliteration after SRS could be from 1 to 4 years or even longer.[7] New onset neurological deficits after SRS have been reported in 0–17.6% patients in different series of LINAC and Gamma Knife based SRS in AVMs. Permanent neurological deficits after SRS have been reported to occur in 1.5–6% of patients. A higher incidence of radiation induced complications has been reported in children with larger volumes of AVM, Spetzler–Martin grade IV and V AVMs and those located in the brainstem, thalamus, or basal ganglia.[1] Our patient didn't develop any event of neurological deficit or intra cranial haemorrhage during post SRS follow up. Traditionally AAA algorithm would be used for SRS planning on Varian Linacs, but in our centre we used more advanced and accurate Acuros algorithm for dose calculation. Compared to AAA algorithm, plans calculated with Acuros algorithm has lower Conformity index and higher Homogeneity index, dose to 1% PTV volume and R50 (ratio of 50% of prescription isodose volume to PTV). Although these differences are clinically not much significant, Acuros improves the accuracy of radiotherapy dose calculation.[8]

**Conclusion**

In our case report we intend to show, it is possible to execute frameless SRS even without designated

immobilisation devices. With simpler and innovative techniques it is possible to achieve highly accurate results. In Varian platform, though AAA and Acuros offer similar clinical benefits. It is of value to use an algorithm with high degree of accuracy.

**References**


1. Moorthy RK, Rajshekhar V. Stereotactic radiosurgery for intracranial arteriovenous malformations: A review. Neurol India 2015;63:841-51.
2. Chen CJ, Ding D, Kano H, Mathieu D, Kondziolka D, Feliciano C, et al. Stereotactic radiosurgery for pediatric versus adult brain arteriovenous malformations. Stroke 2018;49(8):1939-1945.
3. Minniti G, Scaringi C, Clarke E, Valeriani M, Maurizi R et al. Frameless linac-based stereotactic radiosurgery (SRS) for brain metastases: analysis of patient repositioning using a mask fixation system and clinical outcomes. Radiation Oncology 2011;6 (1):158.
4. Bowden G, Kano H, Caparosa E, Tonetti D, Niranjan A, Flickinger J et al. Stereotactic radiosurgery for arteriovenous malformations of the post geniculate visual pathway. J Neurosurg 2015;122:433-40.
5. Burrow AM, Link MJ, Pollock BE. Is stereotactic radiosurgery the best treatment option for patients with a radiosurgery-based arteriovenous malformation score≤1? World Neurosurg 2014;82:1144-7.
6. Potts MB, Sheth SA, Louie J, Smyth MD, Sneed PK, McDermott MW, *et al*. Stereotactic radiosurgery at a low marginal dose for the treatment of pediatric arteriovenous malformations: Obliteration, complications, and functional outcomes. J Neursurg Pediatr 2014;14:1-11.
7. Zacest AC, Caon J, Roos DE, Potter AE, Sullivan T. LINAC radiosurgery for cerebral arteriovenous malformations: A single centre prospective analysis and review of the literature. J Clin Neurosci 2014;21:241-5.
8. Mynampati D, Kuo H, Yaparpalvi R, Scripes P G and Tome W, SU-E-T-122: Anisotropic Analytical Algorithm (AAA) Vs. Acuros XB (AXB) in Stereotactic Treatment Planning. Med Phys 2015;42(6): 3359.