The Spetzler grading of cerebral arteriovenous malformations on MR DSA compared to conventional catheter angiography.

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Introduction
To develop a MR based dynamic angiographic technique and to compare the Spetzler grading obtained with conventional catheter angiography (CCA) for cerebral arteriovenous malformations.

Methods
25 patients referred for stereotactic radiosurgery (STRS) were assessed with both magnetic resonance (MR) digital subtraction angiography (DSA) and CCA. Both examinations were performed within 24 hours of each other immediately before treatment was commenced.

MR methodology was adapted from Aoki et al [1]. All patients were imaged with a head coil using a 1.5 T superconducting system (Eclipse, Picker International, Cleveland ,Ohio). A single, thick slice was obtained using an RF spoiled FAST sequence at a rate of 1 image per second. 3D FT GE, TR / TE 7/2ms, flip angle 40°, FOV 23 cm, matrix size 256 (read) x 150 (phase), phase sample ratio 1.0, bandwidth 50.0 kHz, single slice thickness 6-10 cm, 60 images obtained per 'projection'. The single thick slice was orientated in such a way as to produce CCA equivalent projections, such as lateral or Townes. An axial slice that produced a cranio-caudal view was also imaged in certain cases.

A set of 60 images was acquired before and then during the passage of a bolus of gadolinium-DTPA (Magnevist, Schering Healthcare AG, Germany). The bolus of 5-10 mls was administered via a peripheral vein using a power injector (Medrad spectris, Medrad Inc, Netherlands). This was followed by a 10 mls saline flush. The size of the bolus was varied according to the size of the nidus of the cerebral AVM, the larger the nidus the smaller the bolus. The first set of images without contrast was subtracted from the second set in each projection to produce a subtracted angiogram.

Post-processing and data analysis was performed by 2 experienced neuroradiologists. Differences were resolved by consensus. All post processing of the data was performed on a Twin Star workstation (Picker International). Both masked and unmasked images were viewed in an inverted cine-loop mode. Measurements were obtained with integral proprietary software present on the workstation.

Patients had a Leskell model G stereotactic coordinate frame Elekta Instruments, Atlanta) fitted before standard trans-femoral CCA was performed. Gammaplan (Elektra Instruments) STRS planning software was used to measure the size of the nidus from the CCAs (this software corrects radiographic magnification for STRS dose planning).

Results
The Spetzler grading on CCA was grade II in 12, III in 9 and IV in 4 cases. MR DSA agreed in 23 cases. One case was upgraded from II to III as MR DSA appeared to show both deep and superficial drainage whereas CCA showed only the latter. One small low flow AVM on CCA was not visualised with MR DSA.

There were 48 arterial feeding vessels in 25 AVMs in 25 patients on CCA. The venous drainage was superficial in 13 and deep drainage was present in the other 12 cases. The nidus was classified as small (<3cm) in 19 and medium (3-6cm) in 6 patients.

The sensitivity of MR DSA for nidus detection was 96% (24 out of 25 AVMs). The size was correctly classified in all the cases that were demonstrated. The sensitivity for the arterial feeding vessels was 88% (42 out of 48), the largest feeding vessel of each AVM seen was correctly identified. The venous drainage assessment agreed between MR DSA and CCA in 23 out of 25 AVMs.

Discussion
This is preliminary data. Further work to optimize arterial and nidal conspicuity is required. The tightness of the bolus is vital as with conventional contrast enhanced MRA (CE MRA). Consequently, poor cardiac function is a confounding variable. The dose of contrast given and size of flush given are important variables, but unlike CE MRA for the carotid for example, cerebral AVMs show huge biological variation. Contrast to noise must be maximised but without obscuring detail against the contrast nidus and draining venous structures.

MR DSA shows promise as a non invasive method of assessment for cerebral AVMs. At present it suffers from insufficient spatial and temporal resolution.

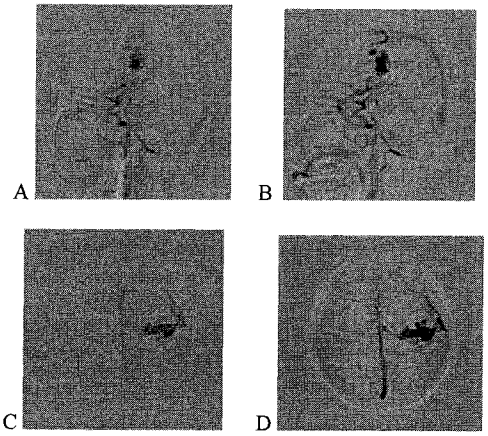

Figure 1. A left frontal lobe cerebral AVM.
A and B are lateral projections, A is early arterial phase and B later. C and D are axial projection of intermediate and later phase of the axial dynamic contrast enhance run.

References
1. Aoki S et al. Proceedings of ASNR, Paper 110: 122 1999