Radiosurgical planning of brain arteriovenous malformations (AVMS): A user interface for the delineation of 3D target from 2D angiographic projections

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Purpose:
A precise delination of the target is a critical part of radiosurgical treatment planning of brain AVMs. This target delineation is performed by drawing the contours of the nidus, the active part of the AVM, on calibrated (using a stereotactic frame) digital subtraction angiography (DSA) projections assuming that DSA remains the imaging gold standard. This manual delineation is a difficult and time consuming task. Inconsistency between the delineations performed in the different views, usually AP and lateral, may led to a wrong target and so on to a poor anatomical result. The aims of this study are 1) to describe an original and helpful user interface to delineate a 3D target by drawing its contours on multiple 2D projections from DSA; 2) to validate the interest of this interface.

Description of the user interface:
This interface can read DSA series in DICOM format. These images have been previously calibrated using a stereotactic frame. The neuroradiologist draws the contours on the different views. At any time he may reconstruct and analyze the resulting 3D target. He can visualize the reprojected contours of this 3D target to compare them to the initial contours and correct these contours if necessary.

Validation of the interface:
The purpose was to demonstrate that on-line 3D target visualization and ensured consistency of the contours improve the performances of the neuroradiologist. This was studied on 7 AVMs treated by radiosurgery . One neuroradiologist delineated the contours twice using the classical method (neither 3D reconstruction nor reprojection of the target) and twice using all the software features. The repeatability of the target delineation using each method was quantified by calculating the similarity index. A ratio above 70% is usually interpreted as a good agreement between volumes. The results were 77.7% in the classical method and 82.4% using the new features of the interface. The score significantly improved by 4.7% (p=0.007). Moreover the subjective expert's feelings concerning the software were quite favourable as it made him more confident in the final target.

Conclusion:
We developed a user interface for AVM delineation from DSA images that provides on-line 3D reconstruction and view-indexed reprojection of the target on the original DSA images. The interest of this interface was proved in a preliminary study and will be analysed on a largest study involving more AVMs and experts.