



# Safety, Efficacy, and Cost of Intraoperative Indocyanine Green Angiography Compared to Intraoperative Catheter Angiography in Cerebral Aneurysm Surgery

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## Introduction

Intraoperative vessel imaging in cerebrovascular neurosurgery can drive the repositioning or addition of aneurysm clips prior to closure. After the introduction of indocyanine green video angiography (ICGA, [Raabe 2003](#)), our institution switched from routine intraoperative digital subtraction angiography (DSA) to routine ICGA. These methods have been compared head-to-head in a technical fashion ([Raabe 2005](#)), but not in terms of patient outcomes. We sought to identify if the rates of perioperative stroke, unexpected postoperative aneurysm neck remnant, or parent vessel stenosis differed in the two eras.

## Methods

We retrospectively identified the first 100 patients treated via open microsurgical aneurysm clipping in the years 2002 (“DSA Era”) and 2007 (“ICG Era”) at our institution and assessed rates of perioperative stroke, aneurysm remnant, parent vessel occlusion, patient cost, and technical difficulties and complications using each modality.

## Results

- In the DSA era, 81% of patients underwent intraoperative DSA; in the ICG era, 79% of patients underwent ICGA, and 13% of patients underwent intraoperative DSA.
- No study-related complications were noted in either era.
- The total clip repositioning rate for neck residual or parent vessel stenosis was not significantly different between the two eras (6% in the DSA era and 4% in the ICG era).
- There were no differences in the rate of perioperative stroke (4% in the DSA era and 3% in the ICG era) or rate of false-negative studies (1% in each).
- The per-patient cost of intraoperative imaging within the DSA era was significantly higher than in the ICG era (\$13,617 vs. \$2,186).

## Conclusions

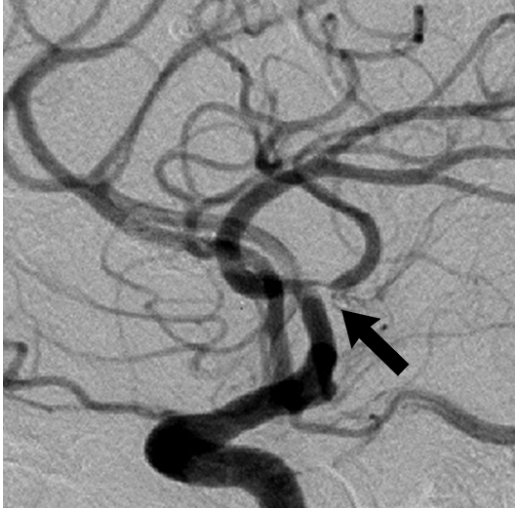
We saw no increase in postoperative stroke or aneurysm residual between the two eras of routine ICGA and routine DSA. The replacement of routine intraoperative DSA with ICGA and selective intraoperative DSA in cerebrovascular aneurysm surgery is safe and cost-effective.

Figure 1



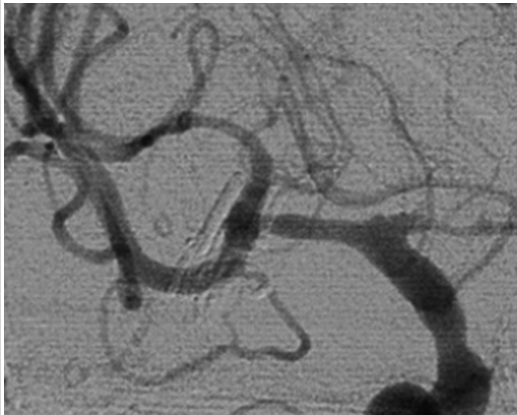
Large ruptured MCA aneurysm, preoperative CTA 3-D reconstruction

Figure 2



Postoperative DSA demonstrated focal MCA stenosis at the site of the aneurysm clip despite a normal intraoperative ICG study (the only false-negative ICG run in the study). The patient was symptomatic and so was taken back to the OR for clip repositioning.

Figure 3



After clip adjustment, the MCA stenosis and the patient's symptoms resolved.

## References

Raabe A, Beck J, Gerlach R, Zimmermann M, Seifert V. Near-infrared indocyanine green video angiography: a new method for intraoperative assessment of vascular flow. *Neurosurgery*. 2003;52(1):132-139.

Raabe A, Nakaji P, Beck J, et al. Prospective evaluation of surgical microscope-integrated intraoperative near-infrared indocyanine green video angiography during aneurysm surgery. *J Neurosurg*. 2005;103(6):982-989.