

Initial Experience With an Image Guided Robotically Positioned Optical Platform for Aneurysm Surgery

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Learning Objectives

- By the conclusion of this session, participants should be able to:
- Describe the optical properties of ROVOT-m,
 Discuss the benefits and limitations of the ROVOT-m,
- 3) Discuss the implications of a larger immersive surgical volume for aneurysm surgery.

Optical Chain



Comparison of Optical Chain (OC) between ROVOT-m and CS-m. The OC consists of 5 components: 1) Optical Payload 2) Light Source 3) Camera 4) Holder, and 5) Display

Introduction

The conventional stereoscopic microscope (CSm) made surgery for intracranial vascular pathology safe. Recently, an integrated image guided robotic optical positioning system (ROVOT-m) has been released for clinical use. We undertook a benchside, cadaveric and clinical study to determine its applicability to aneurysm surgery.

References

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Methods Benchside measurements of field of view (FOV) and depth of field (DOF) were obtained for CS-m and ROVOT-m. The two modalities were compared

during simulated aneurysm surgery. Clinical feasibility of ROVOT-m was demonstrated during for surgery for both ruptured and unruptured aneurysms.

Parameters	CS-m	ROVOT-m
Field of View (FoV)	Restricted Focal Point (x, y coordinate)	Focal Plane = Area
Depth of Field (DoF)	Restricted compared to ROVOT, inversely varied with Mag	3-4X greater than CS- m, inversely varied with Mag
Functional - Viewable and Usable	Useable<< <viewable< td=""><td>Viewable = Usable</td></viewable<>	Viewable = Usable
Lens (Direction of Light)-Numerical Aperture	High Convergence	Low Convergence High Parallelity
Volume of View	Restricted	Full

Optical metrics were measured and compared between CS-m and ROVOT-m

Results

At highest magnification, ROVOT-m has a 25 mm FOV, 40% greater than that of CS-m. At the same FOV of 25 mm and working distance of 250 mm, ROVOT-m has a DOF of 14 mm, more than three times greater than CS-m. Cadaveric dissection confirmed that the volume of view (VOV) for the ROVOT-m was substantially larger than for the CS-m. Five aneurysms were clipped using the ROVOT-m: 4 ruptured middle cerebral artery aneurysms and 1 unruptured anterior communicating artery aneurysm.

Optical Comparison between CS-m and



Cadaveric Image Comparison between CS -m and ROVOT-m. Low magnification, FoV = 38mm. 3 distinct cisterns: Sylvian and Suprachiasmatic (yellow), Prechiasmatic (pink), Interpeduncular (red)

Comparison of Volume of View between CS-m and ROVOT-m



Images are highlighted with three focal planes (circles): Superficial (Blue), Middle (Green), and Deep (Yellow). ON: Optic Nerve, LT: Lamina Terminalis, RB: Residual Bleb on ACom, GR: Gyrus Rectus

Conclusions

- The ROVOT-m has a substantially larger VOV-the volume of surgical anatomy in focus and useable.
- The larger immersive volume of surgical anatomy in focus was especially valuable when temporary clipping in the cases of MCA aneurysms as the VOV extends from proximal ICA to distal M2 branches, and ACom aneurysms where the VOV extends from ipsilateral MCA to contralateral ICA.
- The use of preset positions permits multiple relevant optical trajectories to be viewed rapidly and in sequence which is particularly beneficial for assessing temporary and permanent clip placement.
- Hands free positioning allows for uninterrupted work flow.



