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Technical Aspects of 3D Multifusion Imaging: NVC of Trigeminal Neuralgia and Hemifacial Spasms

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Starting Now

Lecturers report no conflict of interest concerning the materials or methods used in this study.

Objectives

- To visualize the neurovascular contact (NVC) of trigeminal neuralgia (TN) and hemifacial spasm (HFS) for microvascular decompression (MVD), we have developed the 3D multifusion imaging.
- In this imaging, co-registered MRI and CTA images are fused, so that NVC consisting of artery, cranial nerve and brain parenchyma is depicted in a single 3D picture.

Contents

① Pre-operative simulation: Anatomical structure and severity of NVC.

② Post-operative simulation: Elimination of NVC and follow-up evaluation.

③ Comparison of pre- and post-operative simulation: Transposition of offending vessels and restoration of nerve shape.

④ Recurrent cases: Recurrent factors and strategy of re-treatment.

Methods

Cases : ①TN-200, ②HFS-300, ③GPN 10

3D multifusion imaging: Superimposition of 4 images

① 3D MR cisternogram (FSE, FIESTA)
② 3D MR angiogram (SPGR-TOF, ASL)
③ 3D MR angiogram (CE-SPGR-TOF)
④ 3D CT angiogram

Sequence parameters for 3D multifusion imaging

Modality	TR(ms)	TE(ms)	FOV(cm)	Matrix	Thickness(mm)	Voxel(mm3)	Scan time(sec)	Images
FSE-MRC	1900	100	16	356 x 256	0.4	0.4 x 0.4 x 0.6	353	60
FIESTA-MRC	6.4	2.6	16	256 x 256	0.4	0.4 x 0.6 x 0.6	301	96
TOF-MRA	25	3.4	16	288 x 192	0.4	0.4 x 0.6 x 0.8	341	144
ASL-MRA	880	0.016	16	200 x 200	1.0	1.0 x 0.8 x 0.8	768	400
CTA	—	—	16	512 x 512	0.5	0.3 x 0.3 x 0.5	8	201

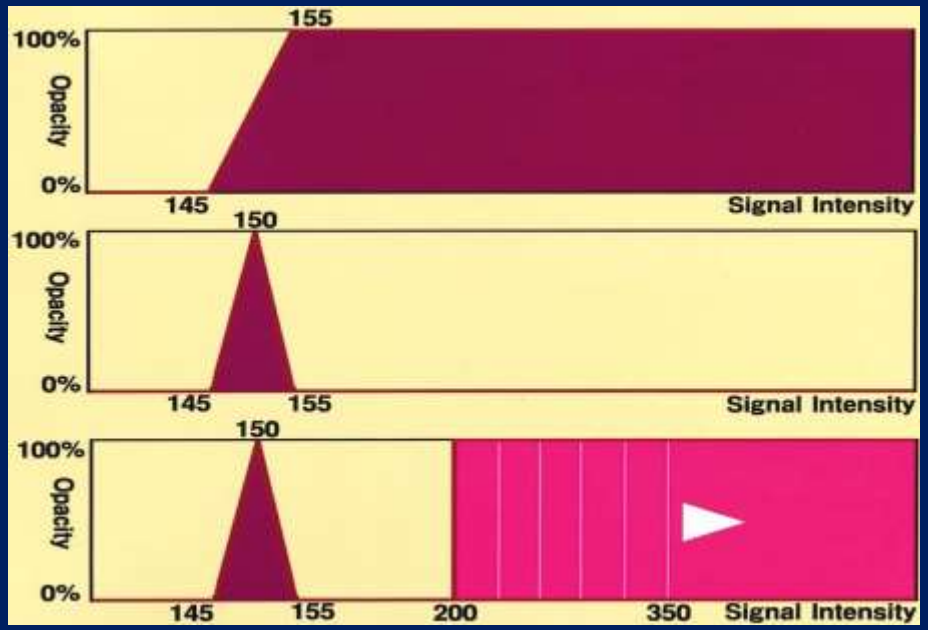
Reconstruction of 3D Images

Data selection from Opacity chart

Visualization of Borderline between Structures

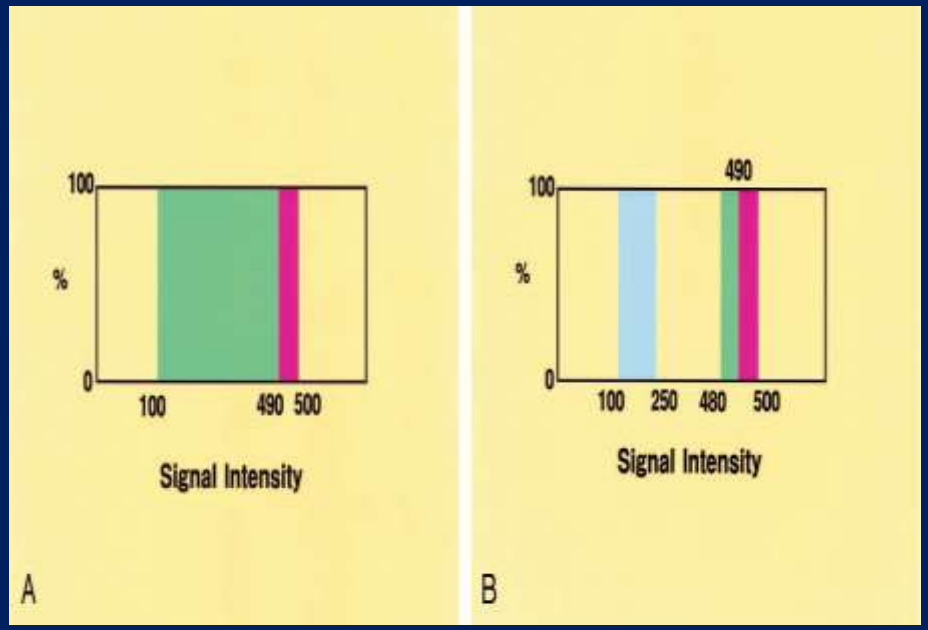
3D MRA・CTA

Upgrade Slope



3D MRC

Downgrade Slope



(Satoh et al. AJNR 26: 313–318, 2005, Satoh et al. AJNR 26: 2010–2018, 2005)

Trigeminal Neuralgia (TN)

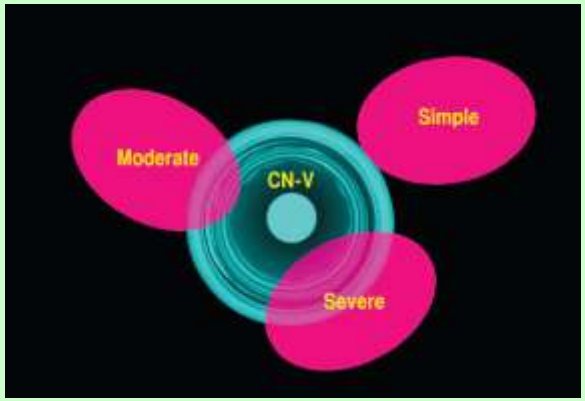
(Satoh et al. Neurosurgery 60:104-114, 2007)

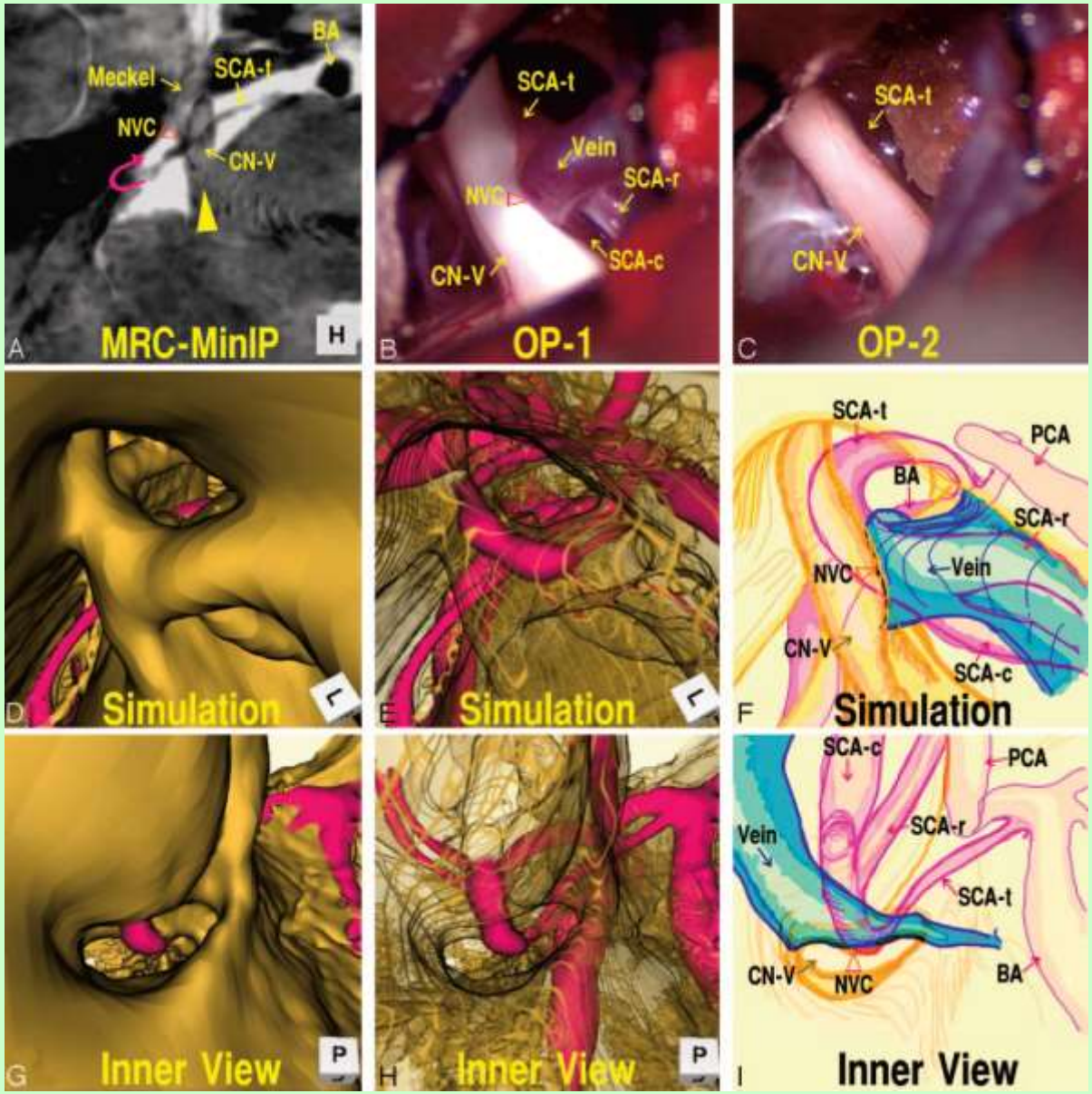
TN: Pre-Op Simulation & Severity Assessment

Lt TN: NVC by SPV pushed by SCA-trunk

Severity of NVC
Assessed by
Intraneural Viewpoint

None
Simple: < 20%
Moderate: < 20-40%
Severe: > 40%

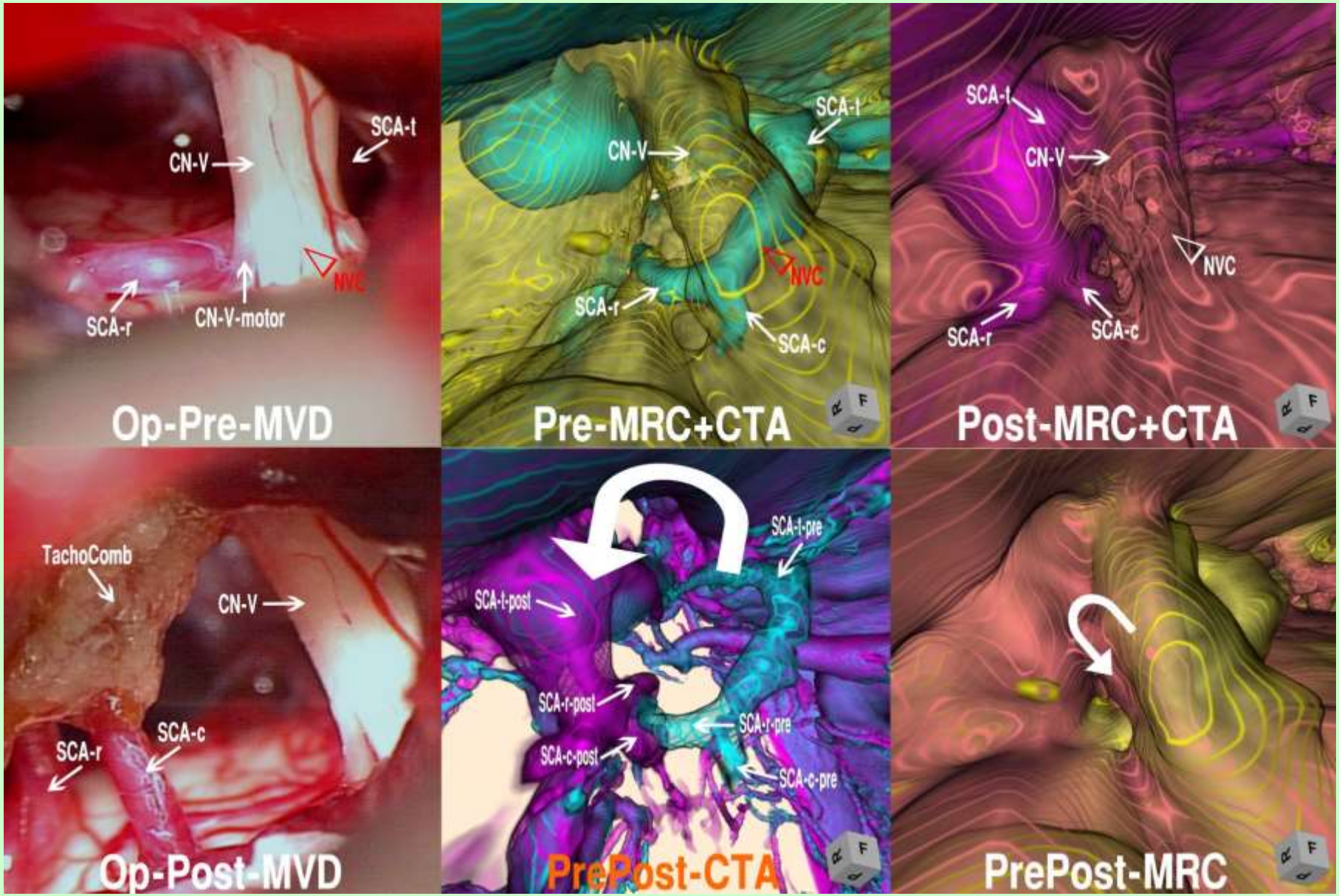




(Satoh et al. AJNR 30: 603-607, 2009)

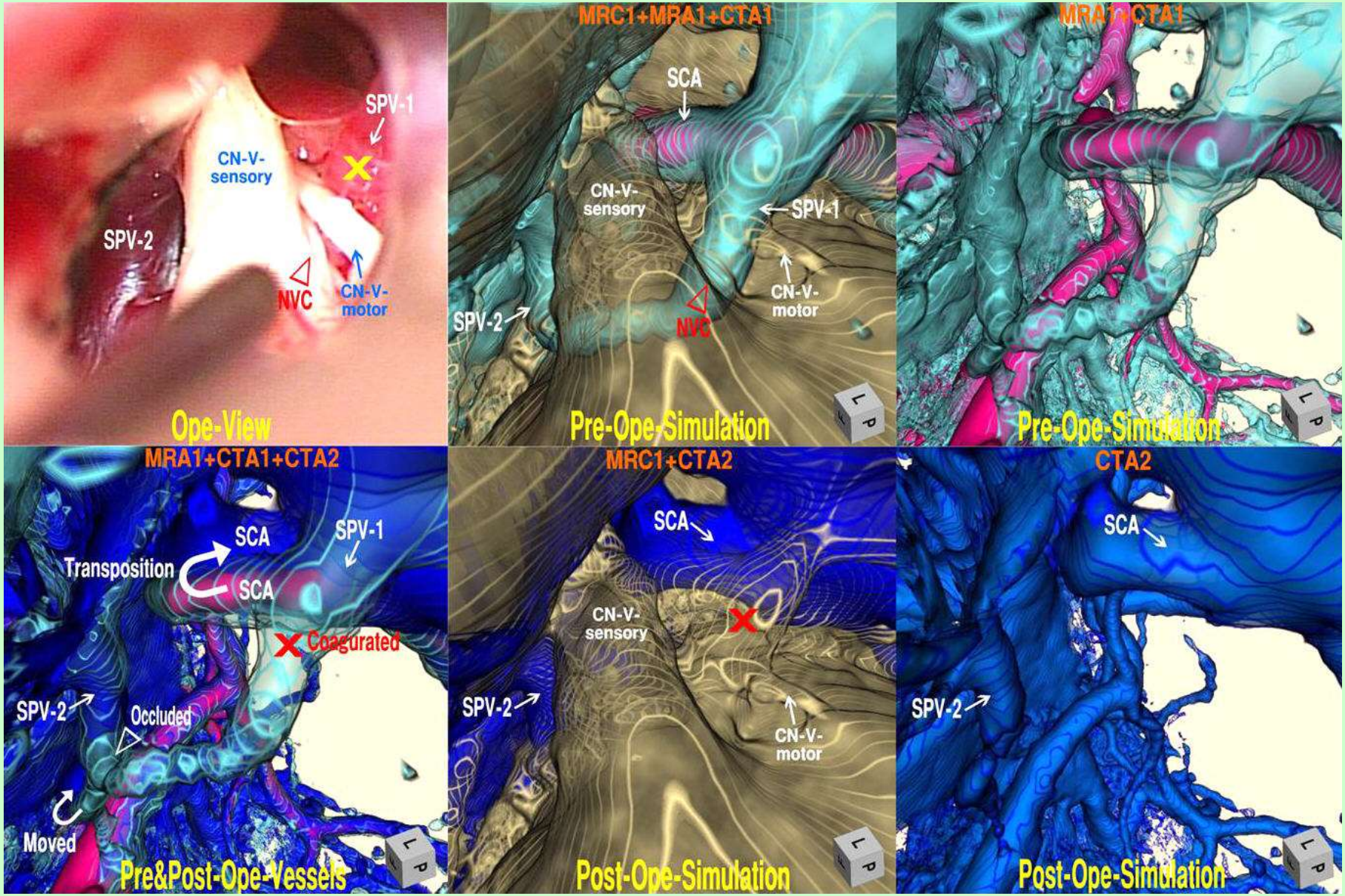
TN: Pre-Post-Operative Simulation

Rt TN: Restration of nerve shape after elimination of NVC



TN: Pre-Op Simulation & Strategy

Lt TN: Intraneural SPV sacrificed and substituted



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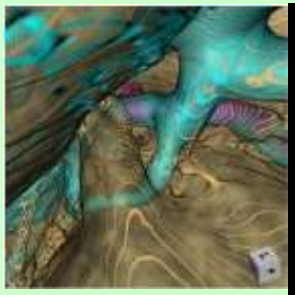
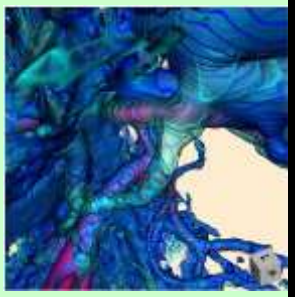
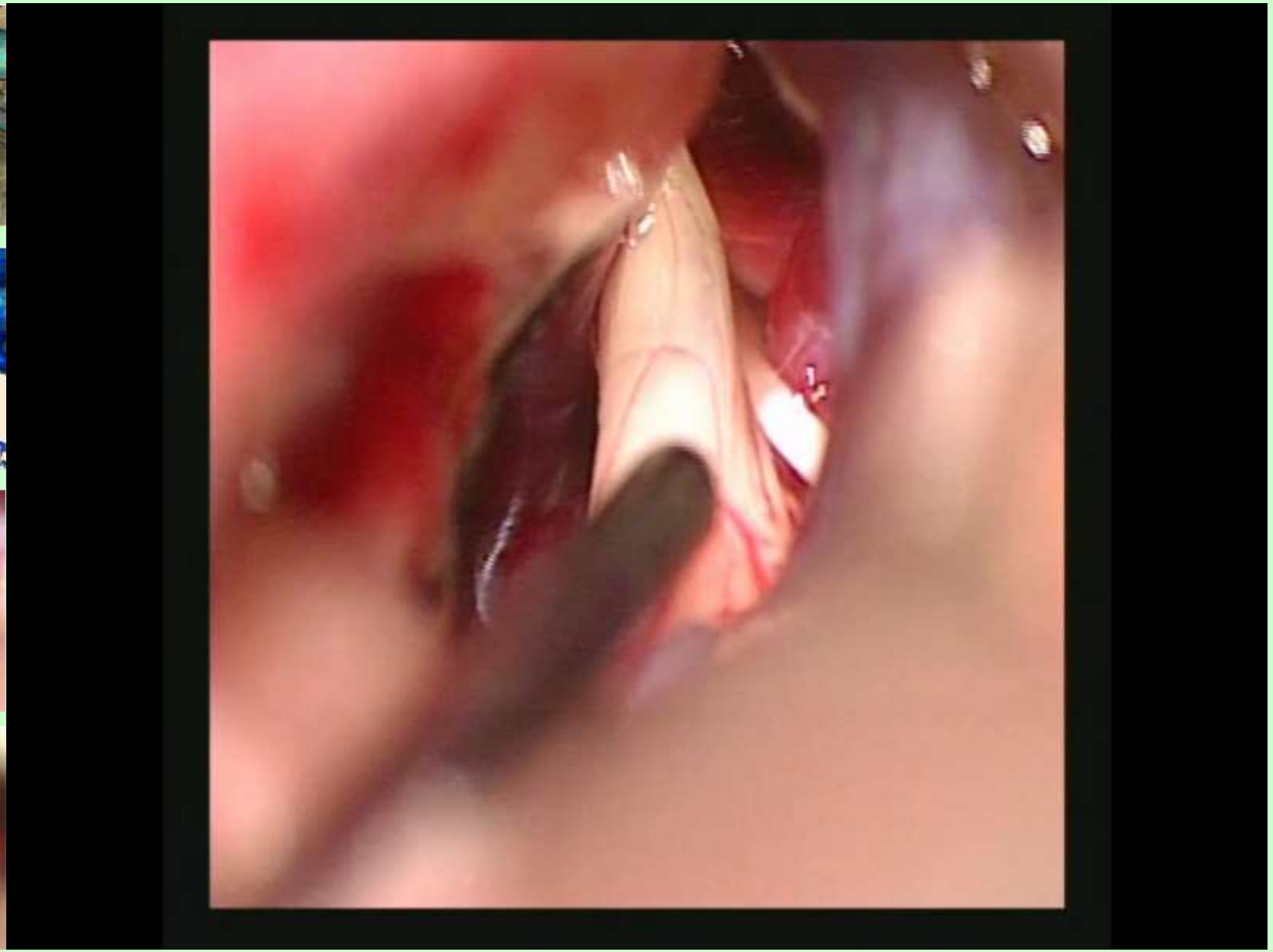
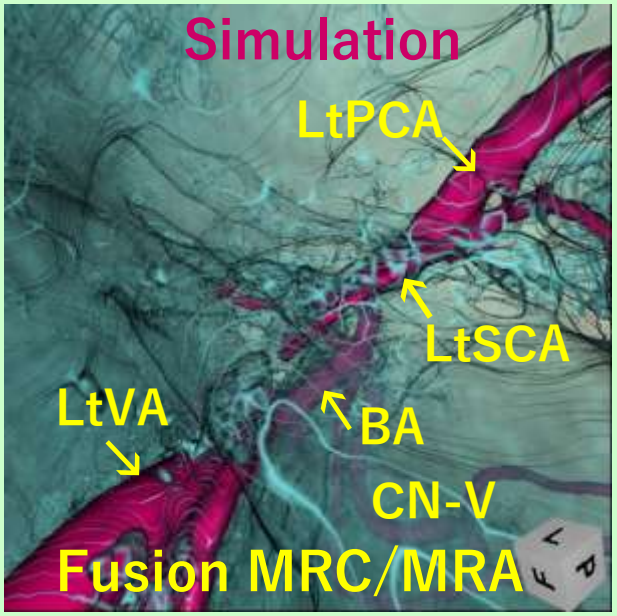


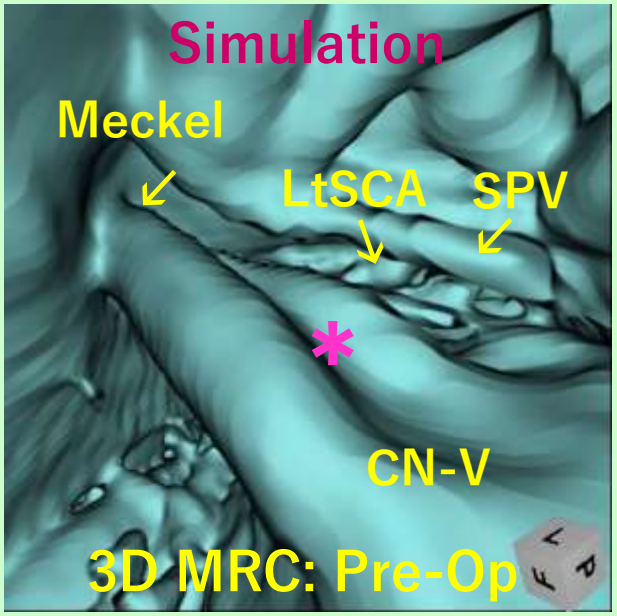


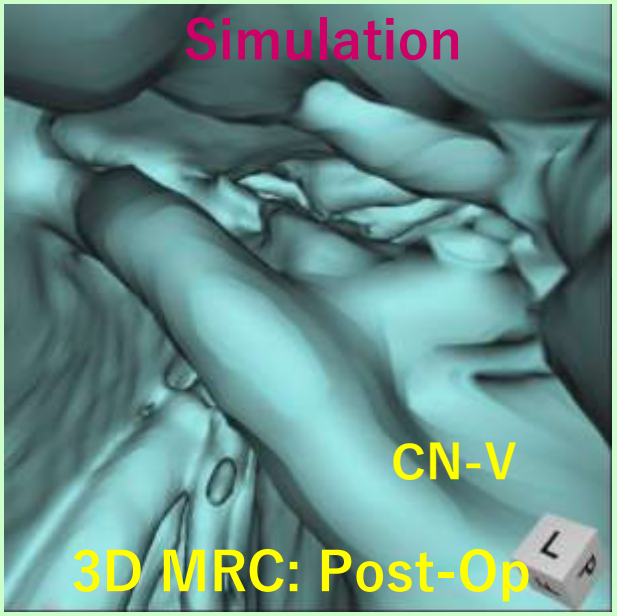


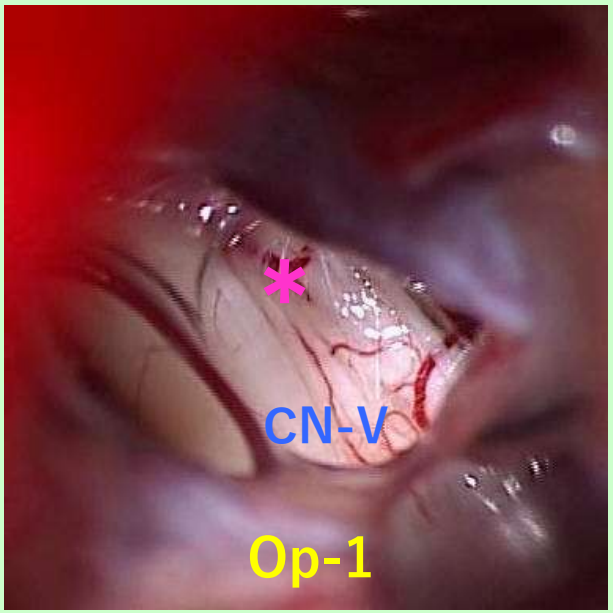
TN: Pre-Operative Simulation for None NVC Case

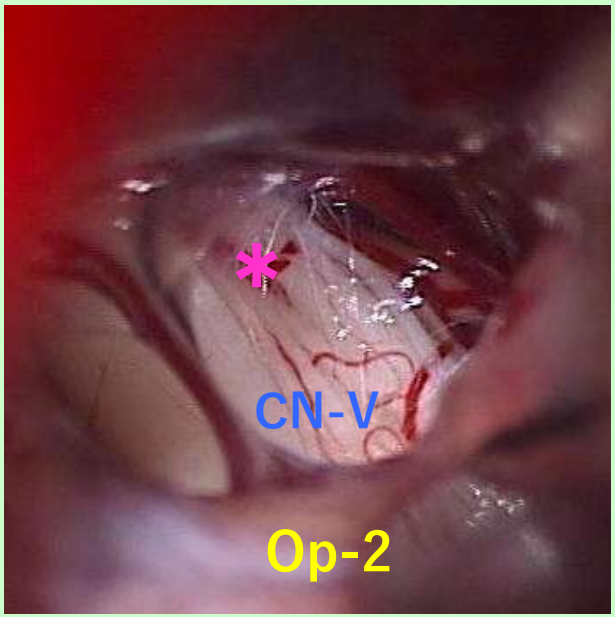
Lt TN: No NVC but adhesive tight arachnoid villi

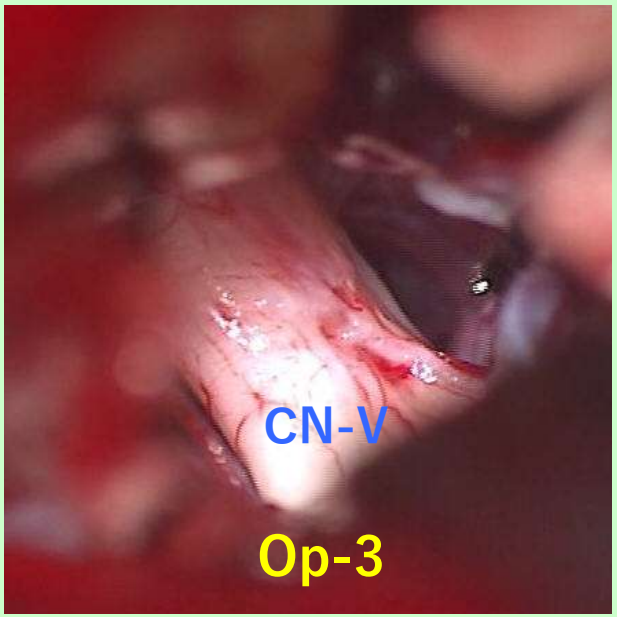










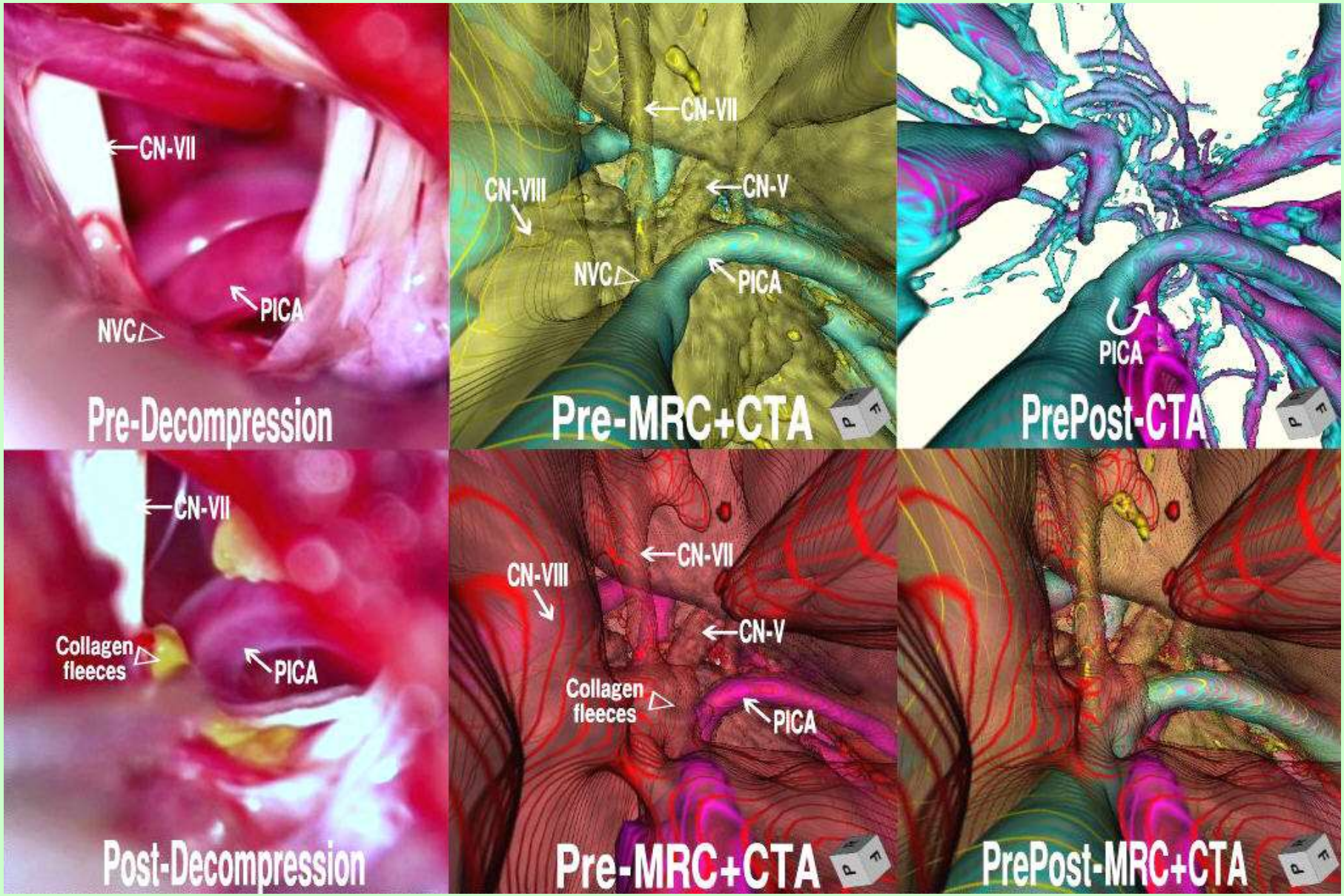


Hemifacial Spasm (HFS)

(Satoh et al. J Neurosurg 106: 82-89, 2007)

HFS with Tinnitus: Pre-Post-Operative Simulation

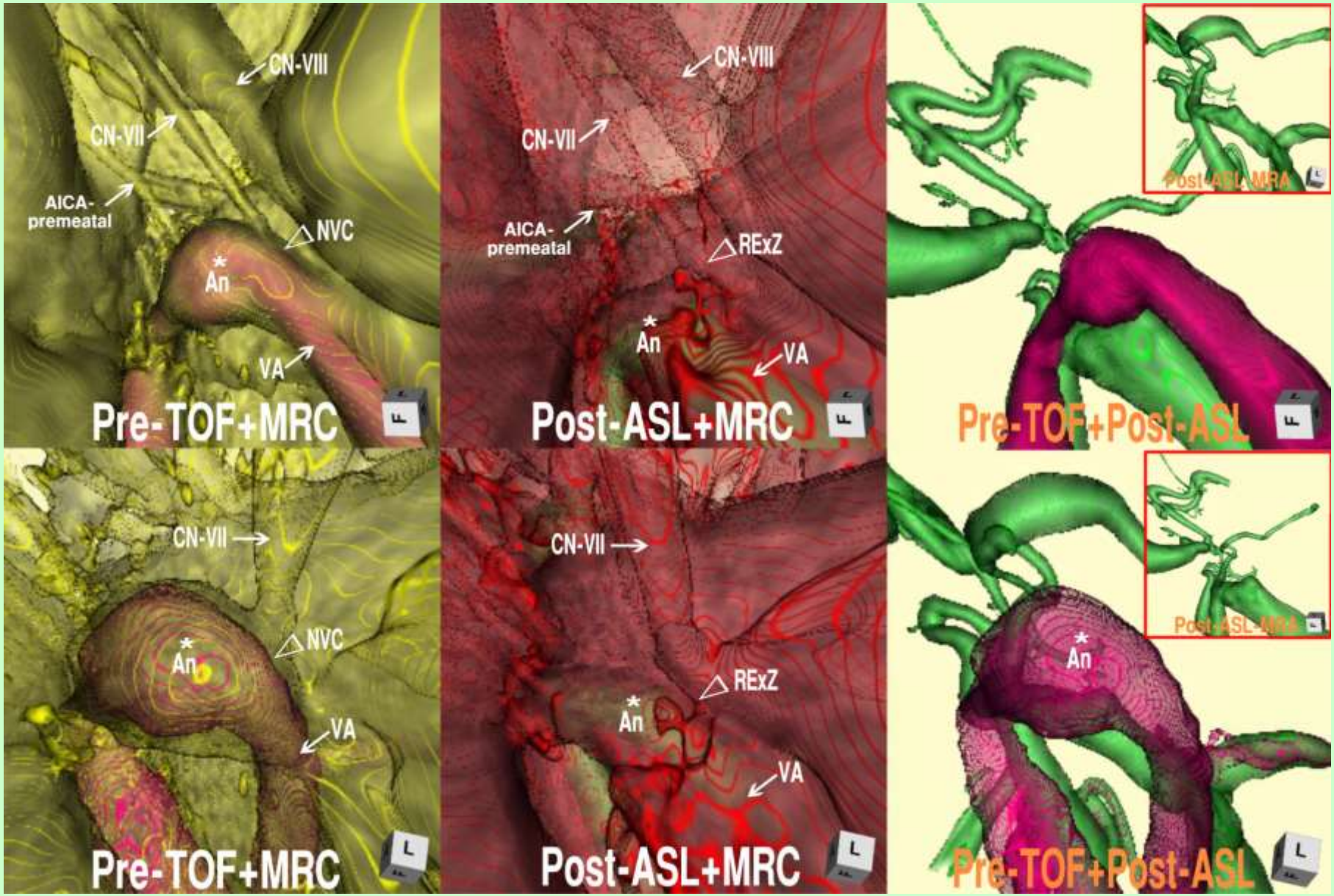
Rt HFS: NVC at VII & VIII REZ by Rt PICA



(Satoh et al. J Neurosurg 106: 82-89, 2007)

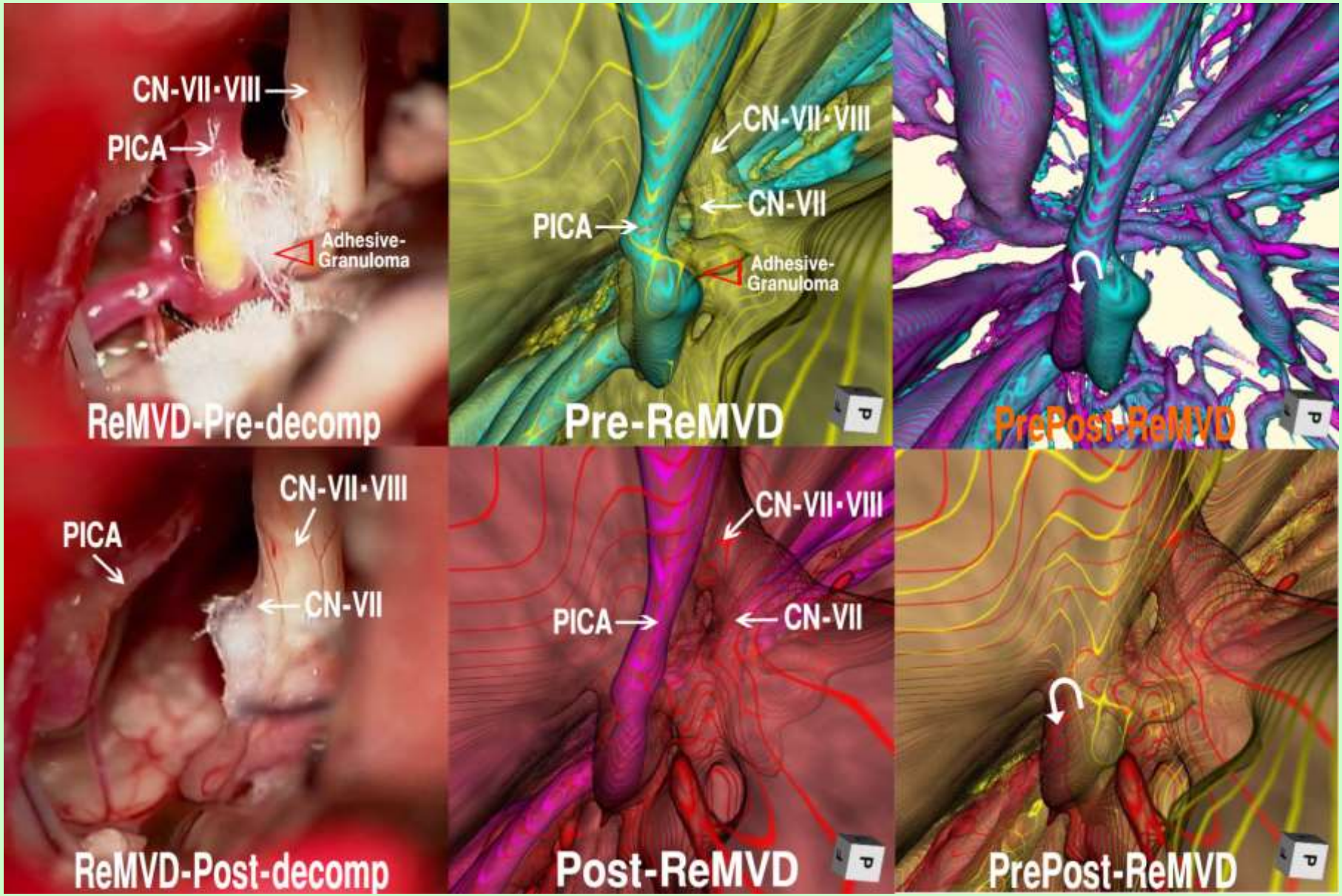
HFS: VA An w/Stent+Coil ASL-MRA Simulation

Lt HFS: VA An caused NVC resolved by stenting+coiling



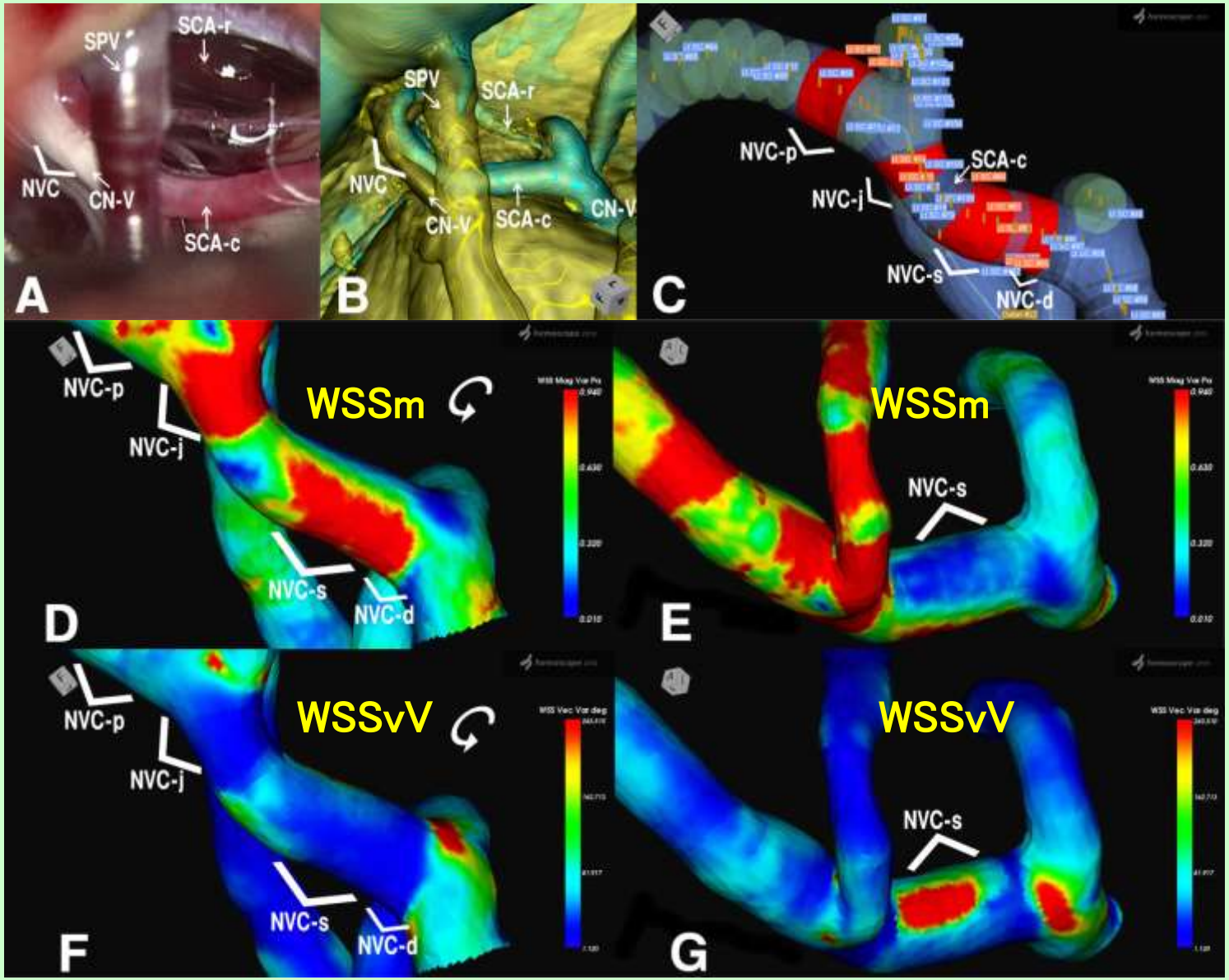
Recurrent HFS: Re-Op Simulation & Strategy

Lt HFS: Granulomatous adhesion resected



TN: CFD Analysis of WSS presumes NVC

Lt TN: High WSSm and Low WSSvV at NVC location



(Satoh et al. J Neurosurg July 6, 1–7, 2018)

Conclusions

① The 3D multifusion imaging can provide clear depiction of the anatomical architecture of the NVC before and after MVD.

② This imaging may be useful for decision making process to execute and follow-up MVD in patients with TN and HFS.

Thank you for your kind attention !

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In Yangon, Myanmar