ΕΛΛΗΝΙΚΗ ΝΕΥΡΟΧΕΙΡΟΥΡΓΙΚΗ ΕΤΑΙΡΙΑ

HELLENIC NEUROSURGICAL SOCIETY

Pediatric Brain Tumor Surgery: where do we stand

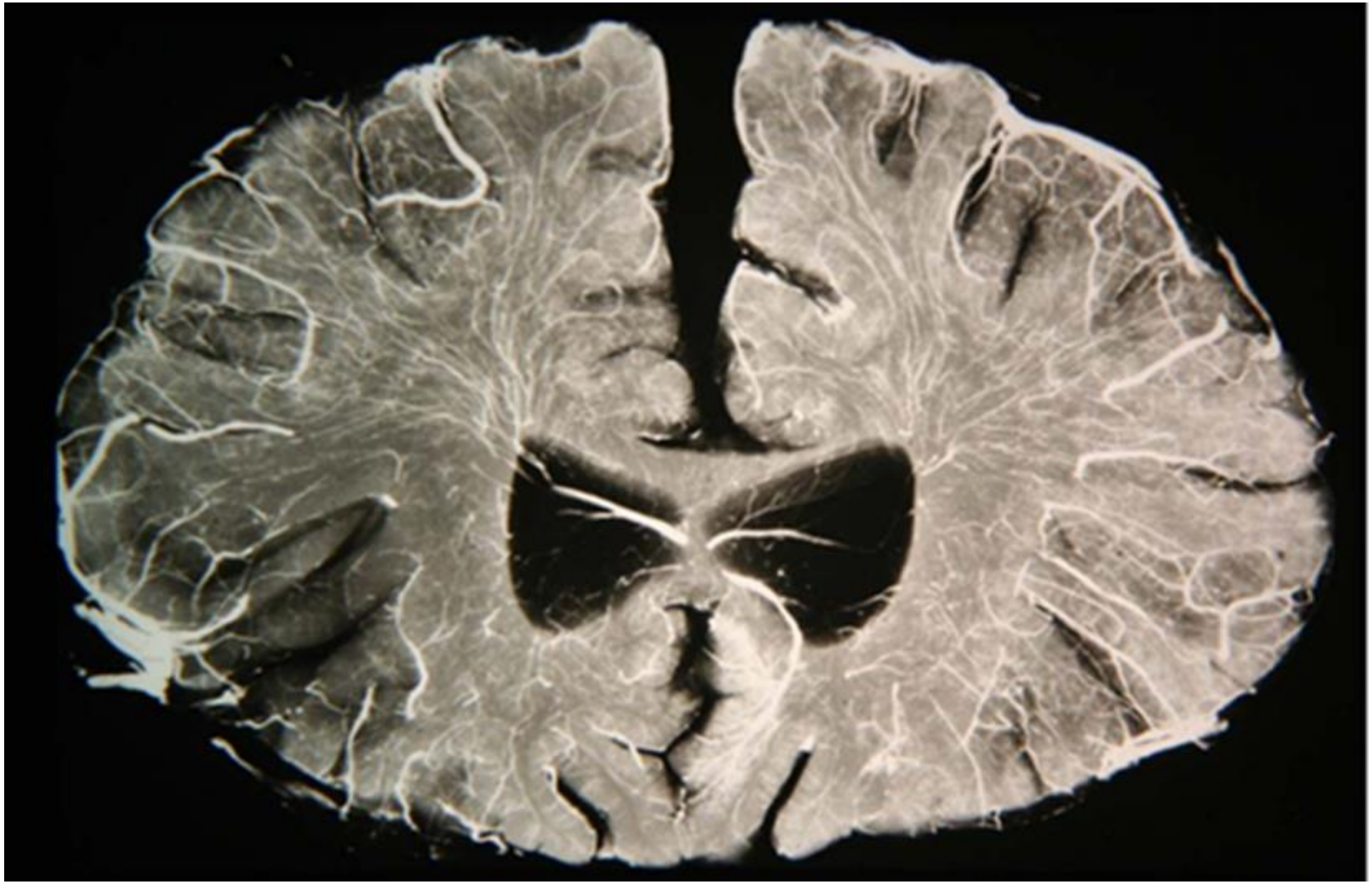
Nicolas Foroglou

Professor of Neurosurgery

Chair Department of Neurosurgery

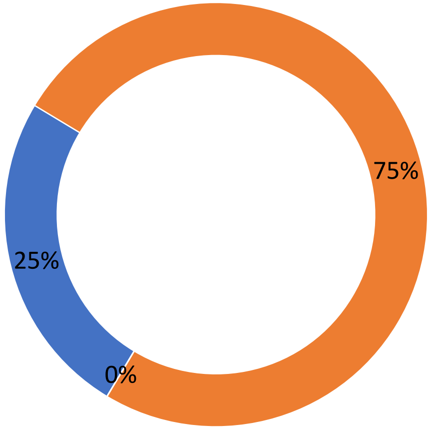
THE EUROPEAN ASSOCIATION OF NEUROSURGICAL SOCIETIES

ARISTOTLE UNIVERSITY SCHOOL OF MEDICINE

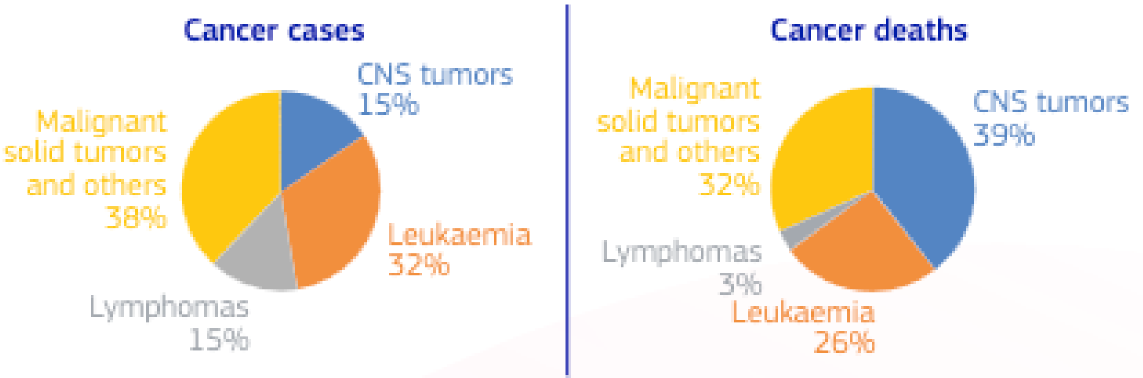


- Rich vasculature with BBB
- Interconnections
- Low mechanical resistance
- Autoregulation systems
- Neuroplasticity – Gray and White matter maturation

Pediatric Brain Tumor



Incidence of pediatric CNS tumors
Mortality and morbidity



Neuroradiological modalities

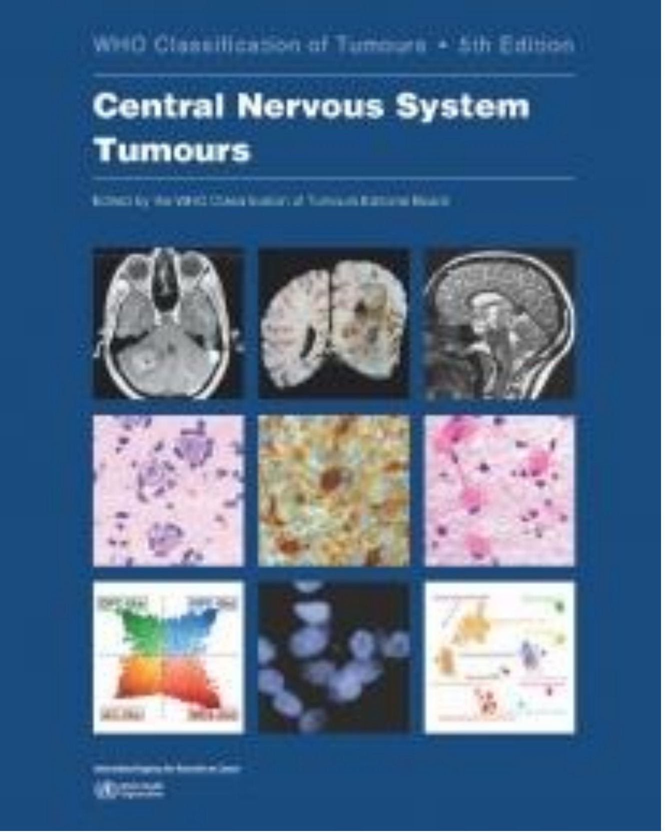
Surgery serves 3 pillars

Biopsy

Brain relaxation

Oncological treatment

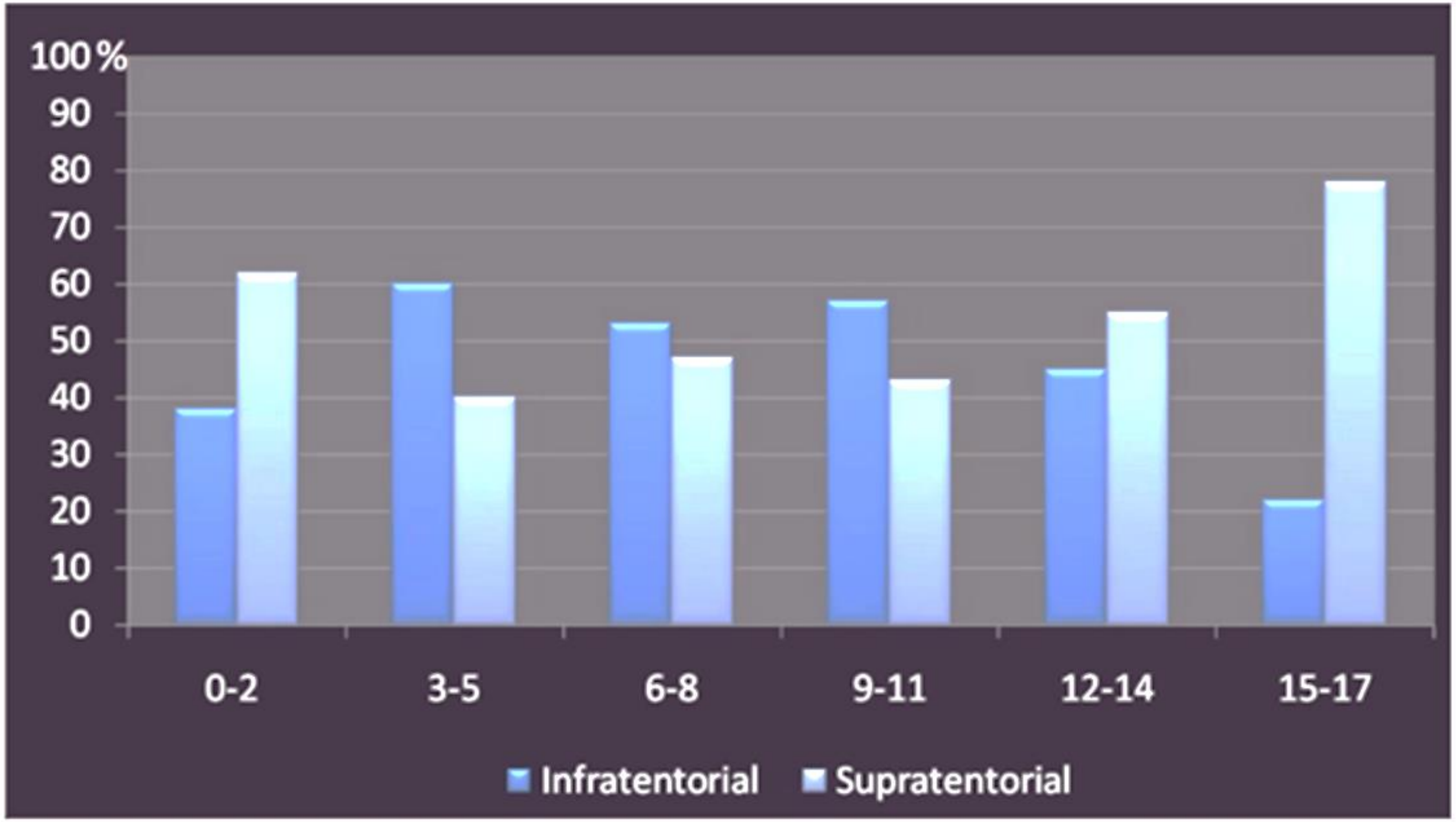
Pathology and molecular markers
Chemotherapy and immunotherapy
Radiotherapy



- Pediatric low-grade gliomas and glioneuronal tumors
- Pediatric-type diffuse high grade gliomas
- Ependymal tumors
- Embryonal tumors
- Mesenchymal tumors

	Subgroup	WNT		SHH				G3			G4		
Clinico-pathological aspects	Subtype	α	β	α	β	γ	δ	α	β	γ	α	β	γ
	Frequency	10–15%		28–30%				25–28%			40–45%		
	Anatomic location	Cerebellopontine angle/Cerebellar peduncle		Cerebellar hemisphere				Midline (filling fourth ventricle)			Midline (filling fourth ventricle)		
	Histology	Mostly classic, rarely LCA		Mostly ND, classic and LCA (less frequent)				Classic (most common), LCA			Classic and LCA (less frequent)		
	Age	6–12	>17	3–17	0–3	0–3	>17	0–10	3–17	0–10	3–17		
	Metastatic disease at diagnosis	8.6%	21.4%	20%	33%	8.9%	8.4%	43.4%	20%	39.4%	40%	40.7%	38.7%
	Prognosis (5-year survival)	97%	100%	69.8%	67.3%	88%	88.5%	66.2%	55.8%	41.8%	66.8%	75.4%	82.5%
Molecular aspects	Genetics	CTNNB1, DDX3X, KMT2D		PTCH1, TP53 KMT2D, DDX3X, MYCN ampl, BCOR, LDB1, GLI2 ampl				MYC ampl, OTX2 gain, SMARCA4, NOTCH, TGF-β			MYCN ampl, CDKN6 apml, SNCAIP duplications		
	Chromosomal abnormalities	Monosomy of chromosome 6		9q deletion; loss of 10q and 17p; gain of 3q and 9p				17q, 1q gain; loss of 5q and 10q			loss of 8, 10, 11; gain of 4, 7, 17, and 18		
	Genetic predisposition	APC (germline), most tumors lack CTNNB1 mutation		SUFU, PTCH1, TP53, PALB2, and BRCA2				PALB2 and BRCA2 (rare)			PALB2 and BRCA2 (rare)		

LCA, large cell/anaplastic; ND, nodular desmoplastic [data from Funakoshi et al. (2023)].



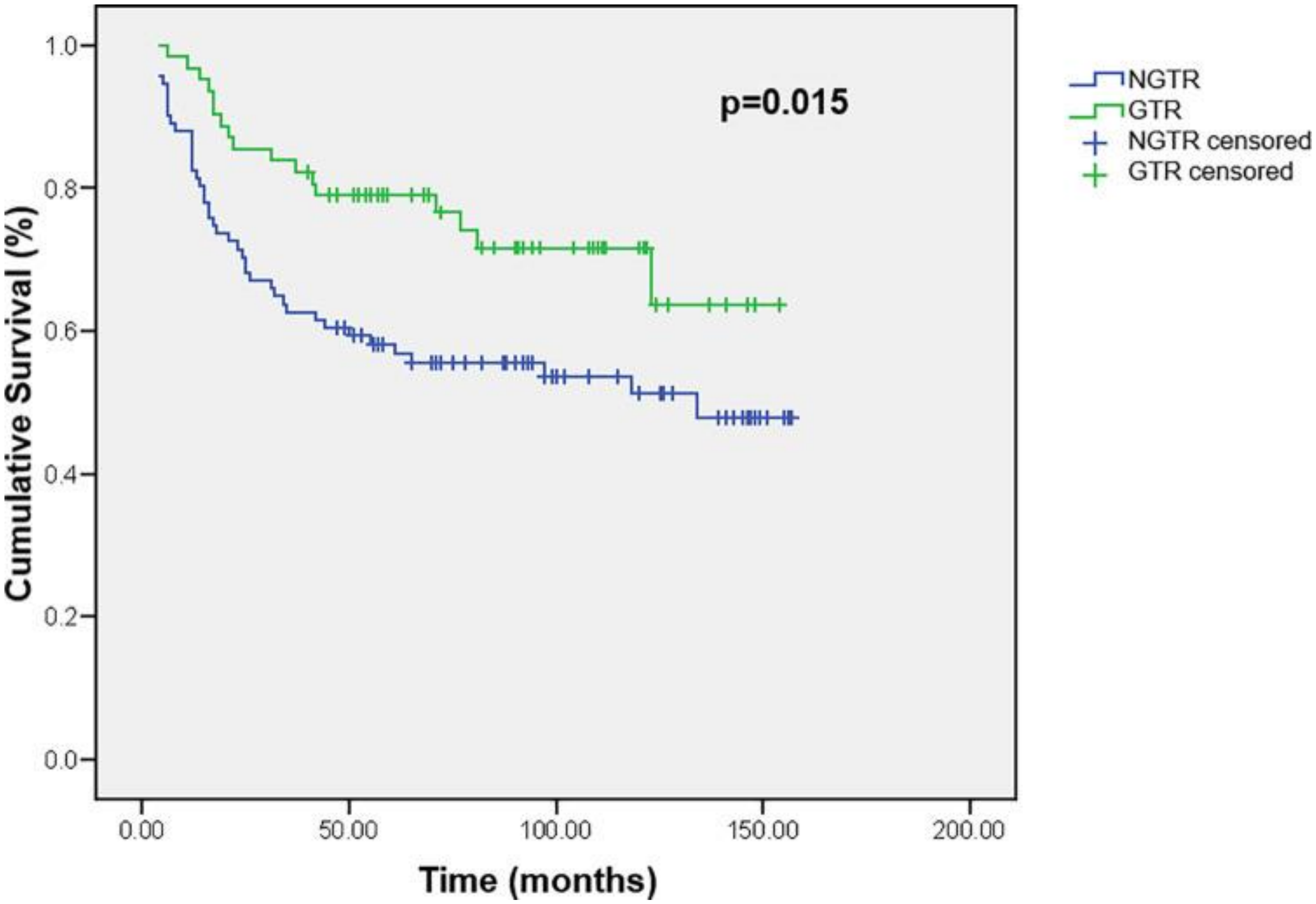
INVITED PAPER

Epidemiology of central nervous system tumors in childhood and adolescence based on the new WHO classification

Neuro-oncological balance (modifiable outcome factors)

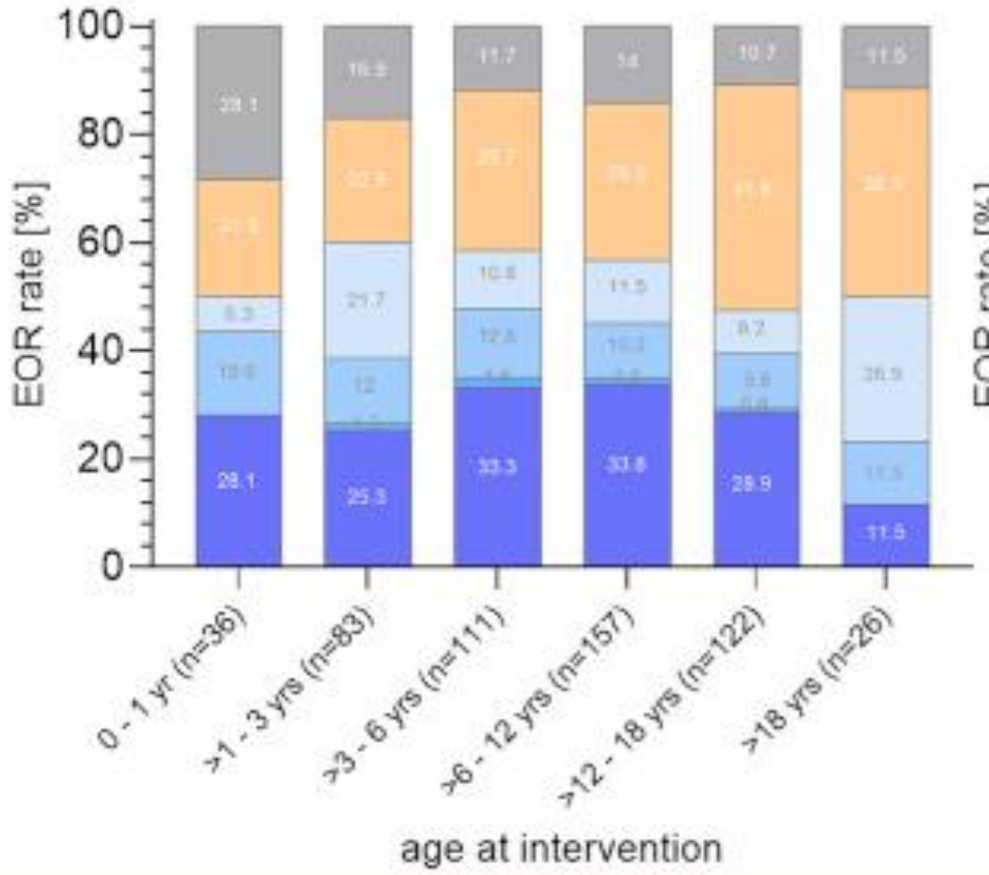
- Importance of degree of resection
- Importance of neurological outcome
- Importance of adjuvant treatments and complications

Importance of degree of resection

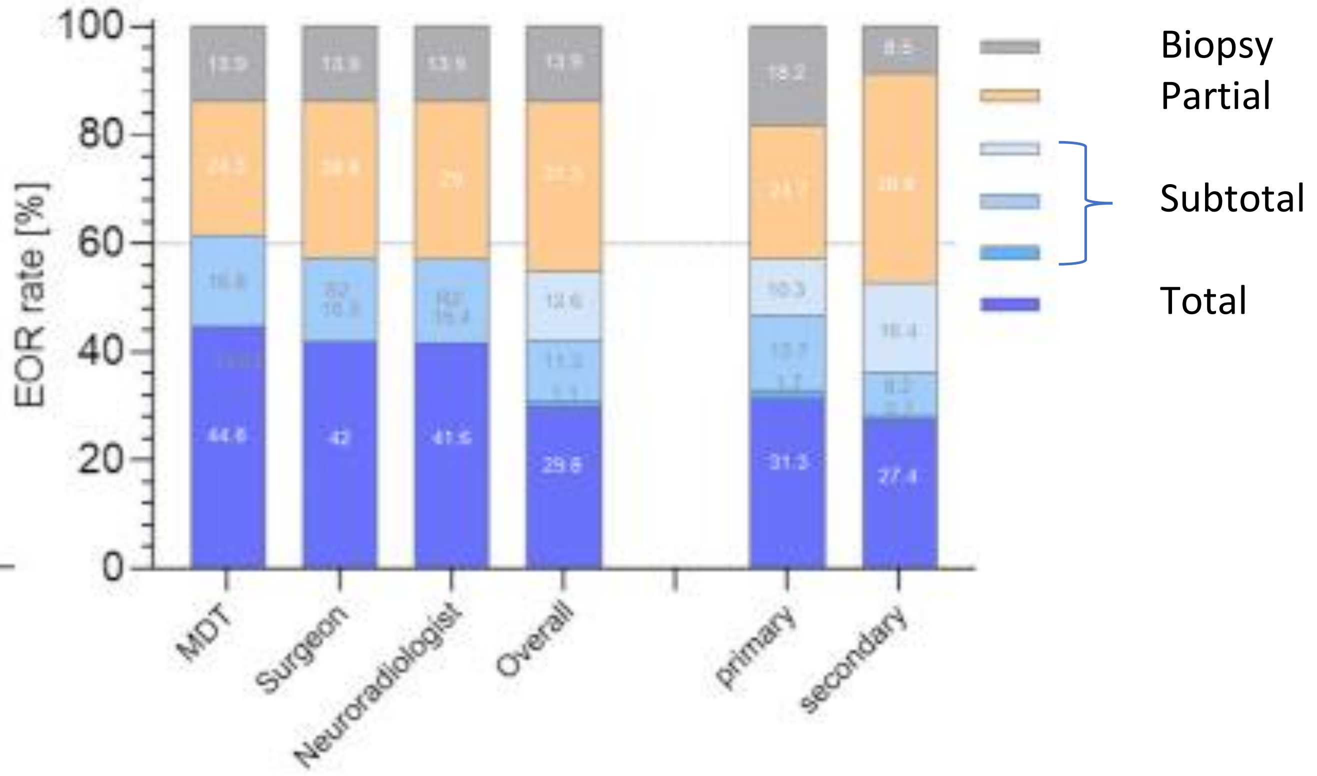


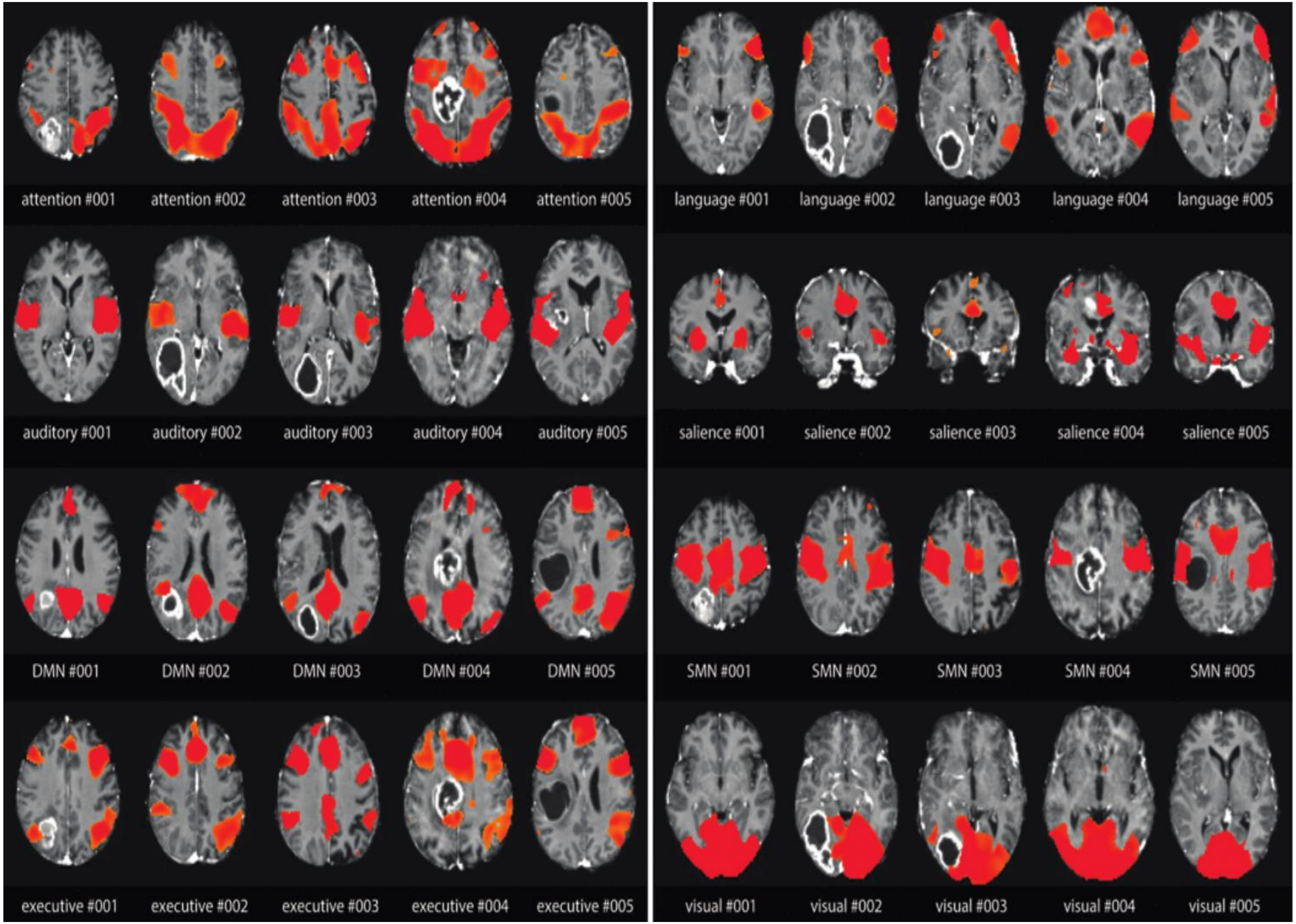
Importance of degree of resection

Extent of resection (EOR) vs age



EOR planning and evaluation

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auditory #004
auditory #005
salience #001
salience #002
salience #003
salience #004
salience #005
DMN #001
DMN #002
DMN #003
DMN #004
DMN #005
SMN #001
SMN #002
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SMN #004
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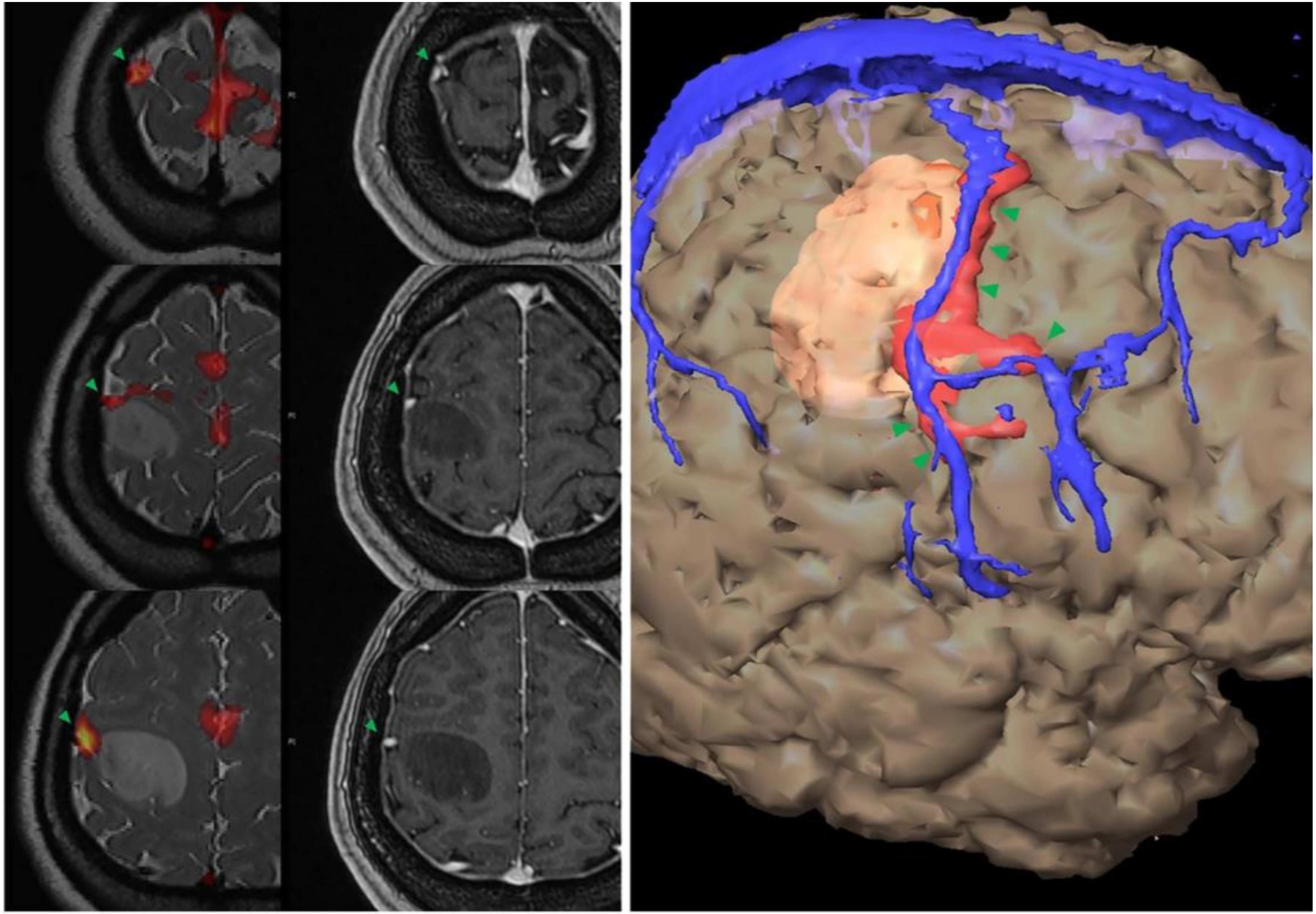
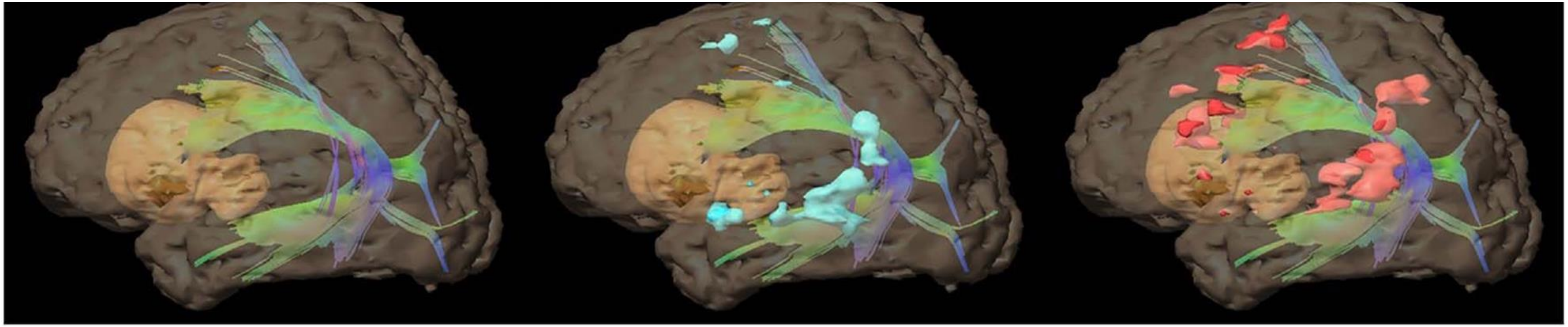
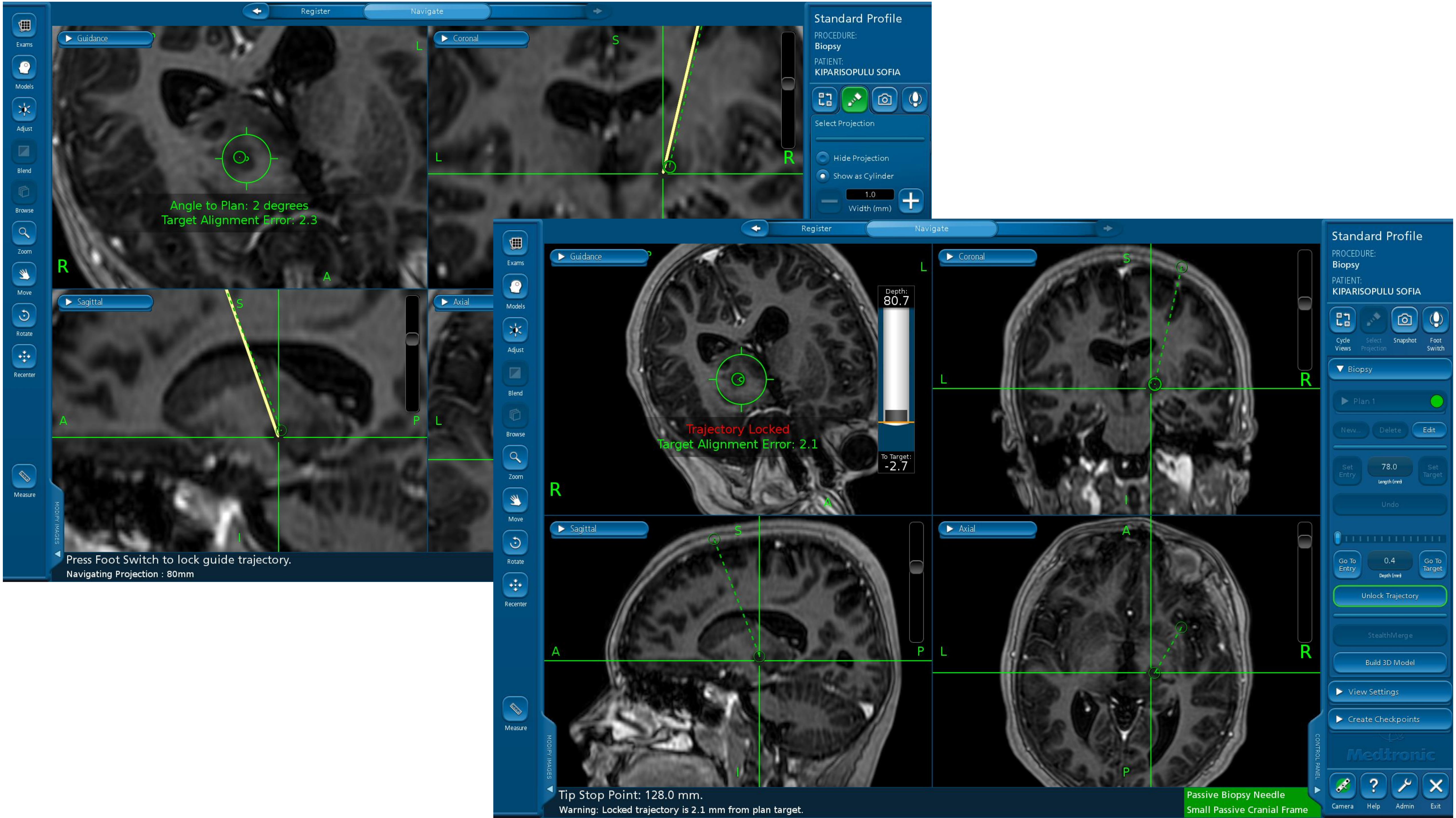
visual #002
visual #003
visual #004
visual #005

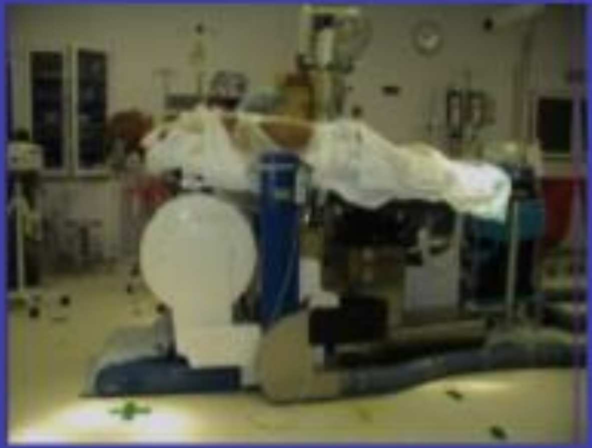


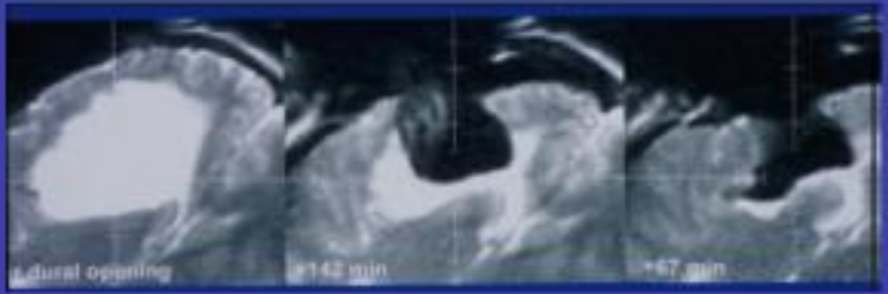


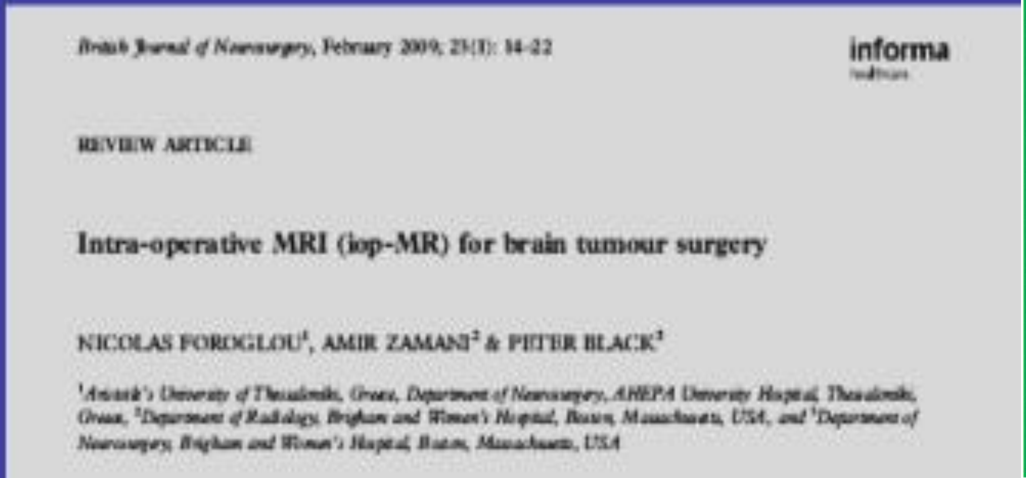


Register
Navigate
Standard Profile
PROCEDURE:
Biopsy
PATIENT:
KIPARISOPULU SOFIA
Select Projection
Hide Projection
Show as Cylinder
1.0
Width (mm)
Exams
Models
Adjust
Blend
Browse
Zoom
Move
Rotate
Recenter
Measure
Guidance
Coronal
Sagittal
Axial
Angle to Plan: 2 degrees
Target Alignment Error: 2.3
Press Foot Switch to lock guide trajectory.
Navigating Projection : 80mm
Depth:
80.7
To Target:
-2.7
Trajectory Locked
Target Alignment Error: 2.1
Cycle Views
Select Projection
Snapshot
Foot Switch
Biopsy
Plan 1
New...
Delete
Edit
Set Entry
78.0
Length (mm)
Set Target
Undo
Go To Entry
0.4
Depth (mm)
Go To Target
Unlock Trajectory
StealthMerge
Build 3D Model
View Settings
Create Checkpoints
Medtronic
Camera
Help
Admin
Exit
Tip Stop Point: 128.0 mm.
Warning: Locked trajectory is 2.1 mm from plan target.
Passive Biopsy Needle
Small Passive Cranial Frame

3D ΥΠΕΡΗΧΟΣ






British Journal of Neurosurgery, February 2009; 23(1): 14–22

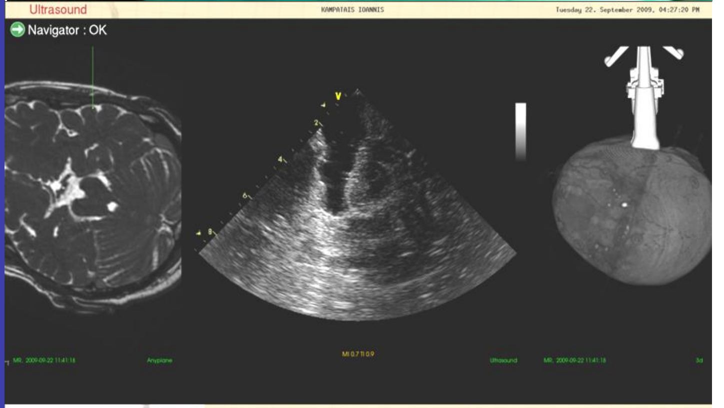
informa

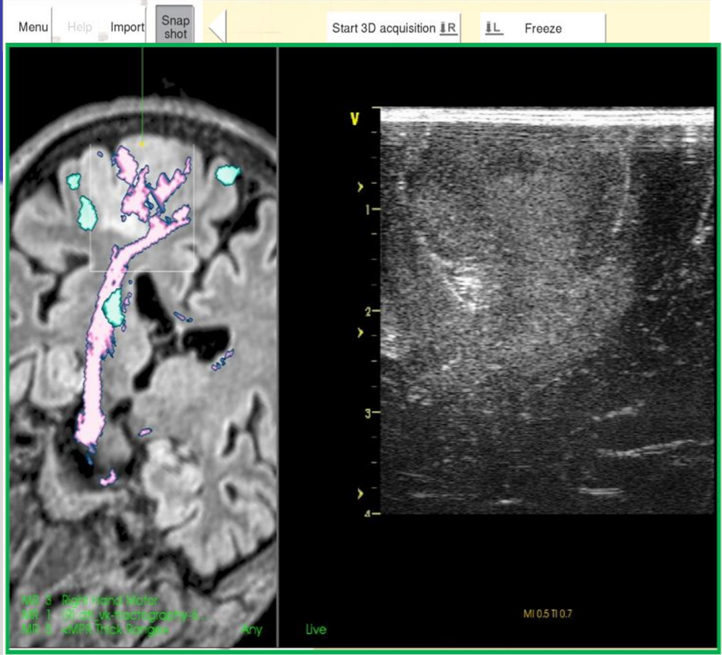
REVIEW ARTICLE

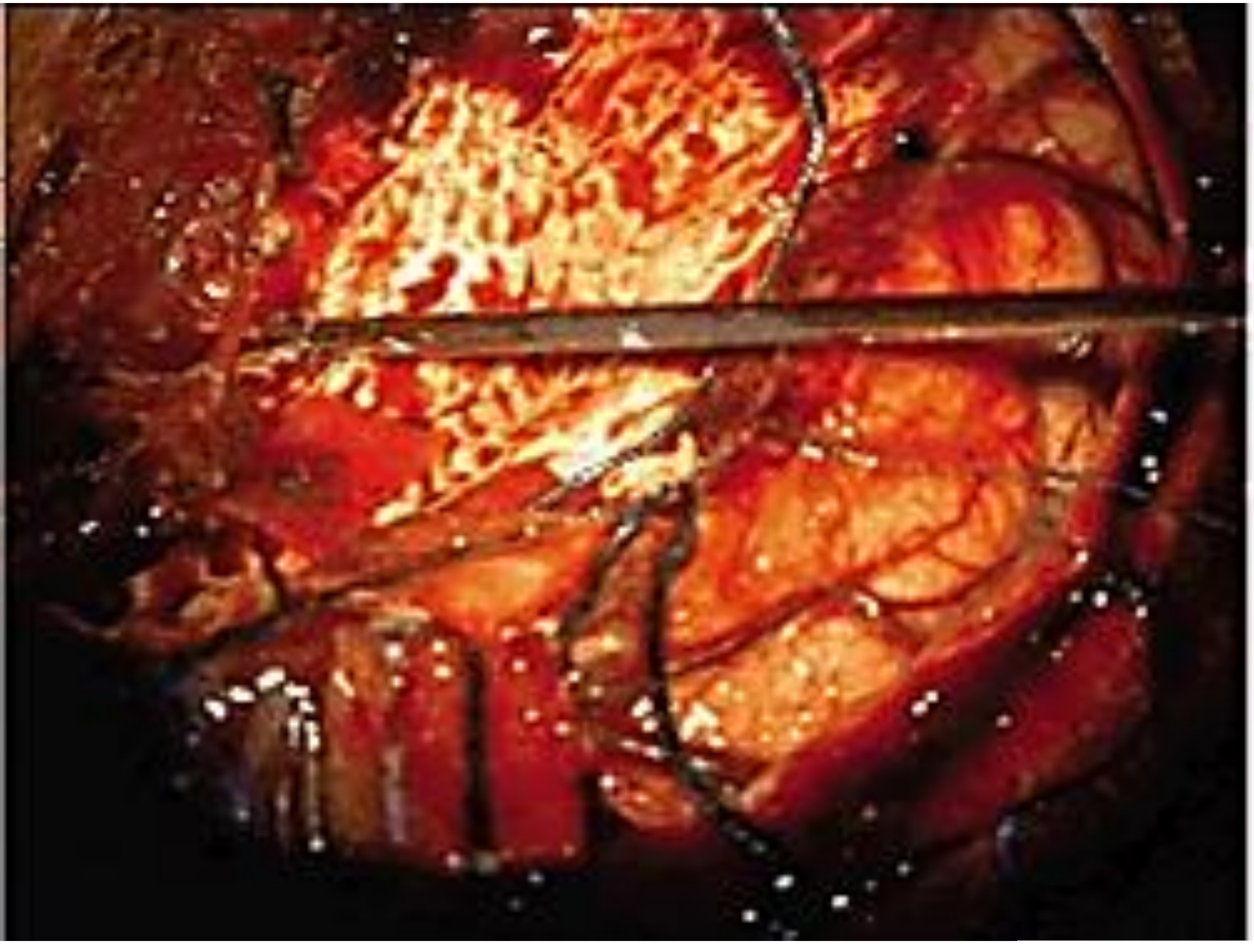
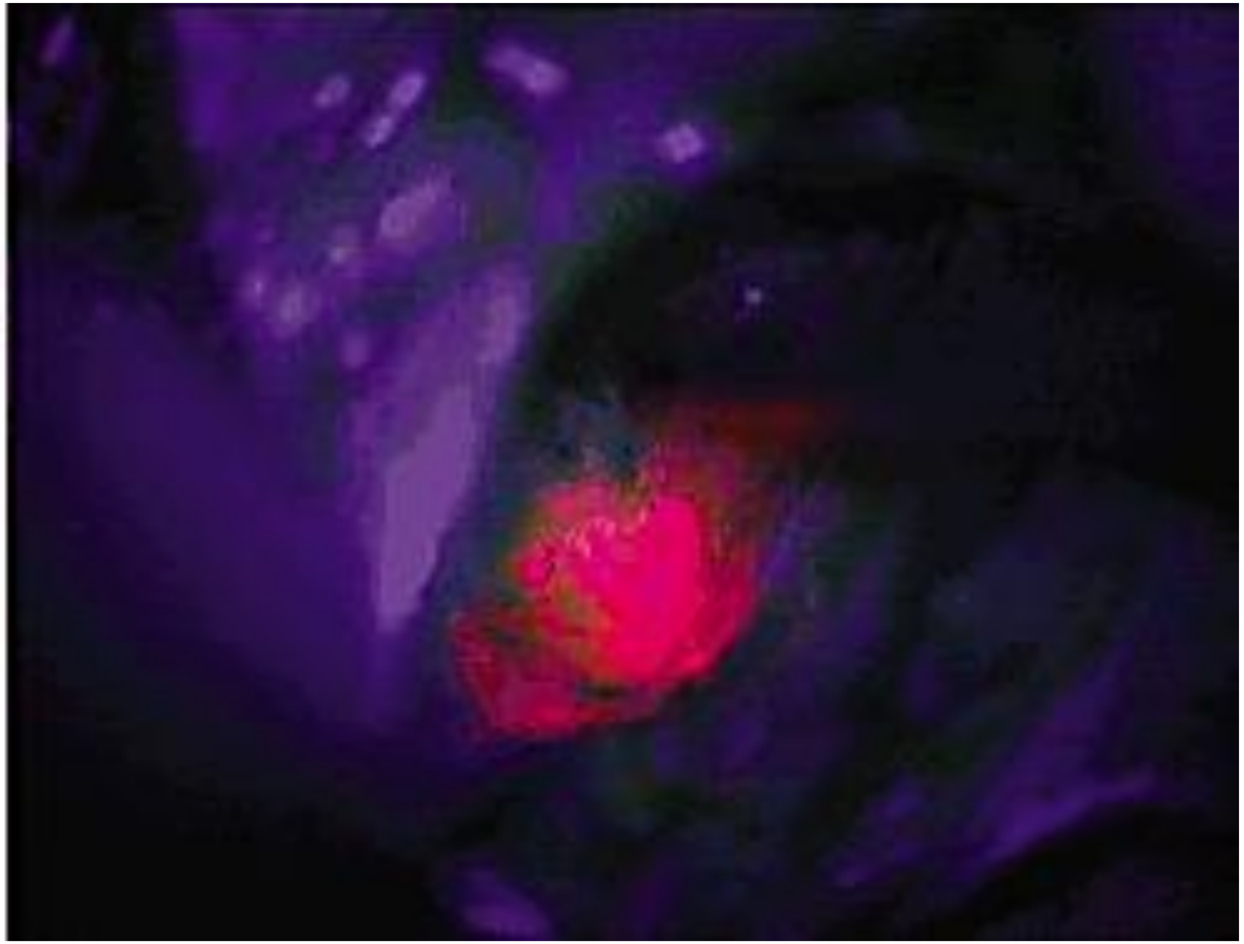
Intra-operative MRI (iop-MR) for brain tumour surgery

NICOLAS FOROGLOU[1], AMIR ZAMANI[2] & PETER BLACK[3]

[1]Aristotle's University of Thessaloniki, Greece, Department of Neurosurgery, AHEPA University Hospital, Thessaloniki, Greece, [2]Department of Radiology, Brigham and Women's Hospital, Boston, Massachusetts, USA, and [3]Department of Neurosurgery, Brigham and Women's Hospital, Boston, Massachusetts, USA





Acta Neurochirurgica (2019) 161:1099–1108
https://doi.org/10.1007/s00701-019-03898-1

REVIEW ARTICLE - PEDIATRIC NEUROSURGERY

5-ALA fluorescence–guided surgery in pediatric brain tumors—a systematic review

Michael Schwake[1] · Stephanie Schipmann[1] · Michael Müther[1] · Michaela Köchling[1] · Angela Brentrup[1] · Walter Stummer[1]

JNS PEDIATRICS

CLINICAL ARTICLE

J Neurosurg Pediatr 27:556–565, 2021

Reporting morbidity associated with pediatric brain tumor surgery: are the available scoring systems sufficient?

Mitchell T. Foster, MRCS, MBChB(Hons),[1–3] Dawn Hennigan, MSc,[1] Rebecca Grayston, MRes,[1] Kirsten van Baarsen, MD, PhD,[1] Geraint Sunderland, MRCS,[1,2] Christopher Paul Millward, MRCS, MSc,[1,2] Harishchandra Lalgudi Srinivasan, FRCS Glasgow (Neurosurg),[1] Deborah Ferguson, FRCS(SN),[1,4] Teddy Totimeh, MPhil, FWACS,[1] Barry Pizer, FRCPCH, PhD,[5] and Conor Mallucci, FRCS(SN)[1]

[1]Department of Paediatric Neurosurgery, Alder Hey Children's NHS Foundation Trust, Liverpool; [2]Department of Neurosurgery, Walton Centre NHS Foundation Trust, Liverpool; [3]Cancer Research UK Brain Tumour Centre of Excellence, The University of Edinburgh; [4]Department of Paediatric Neurosurgery, Royal Manchester Children's Hospital, Manchester; and [5]Department of Paediatric Oncology, Alder Hey Children's NHS Foundation Trust, Liverpool, United Kingdom

TABLE 2. Demographics of the patients and details of the cases included

Variable	Value
No. of operations	477
No. of patients	335
Sex	
Male	188
Female	147
Age at surgery, yrs	
Median (IQR)	9 (9)
Mean (SD)	8.46 (5.16)
Tumor location	
Infratentorial	168
Supratentorial	309
Craniotomies	
Primary	235
Secondary	129
Biopsies	113
Quaternary referrals	75

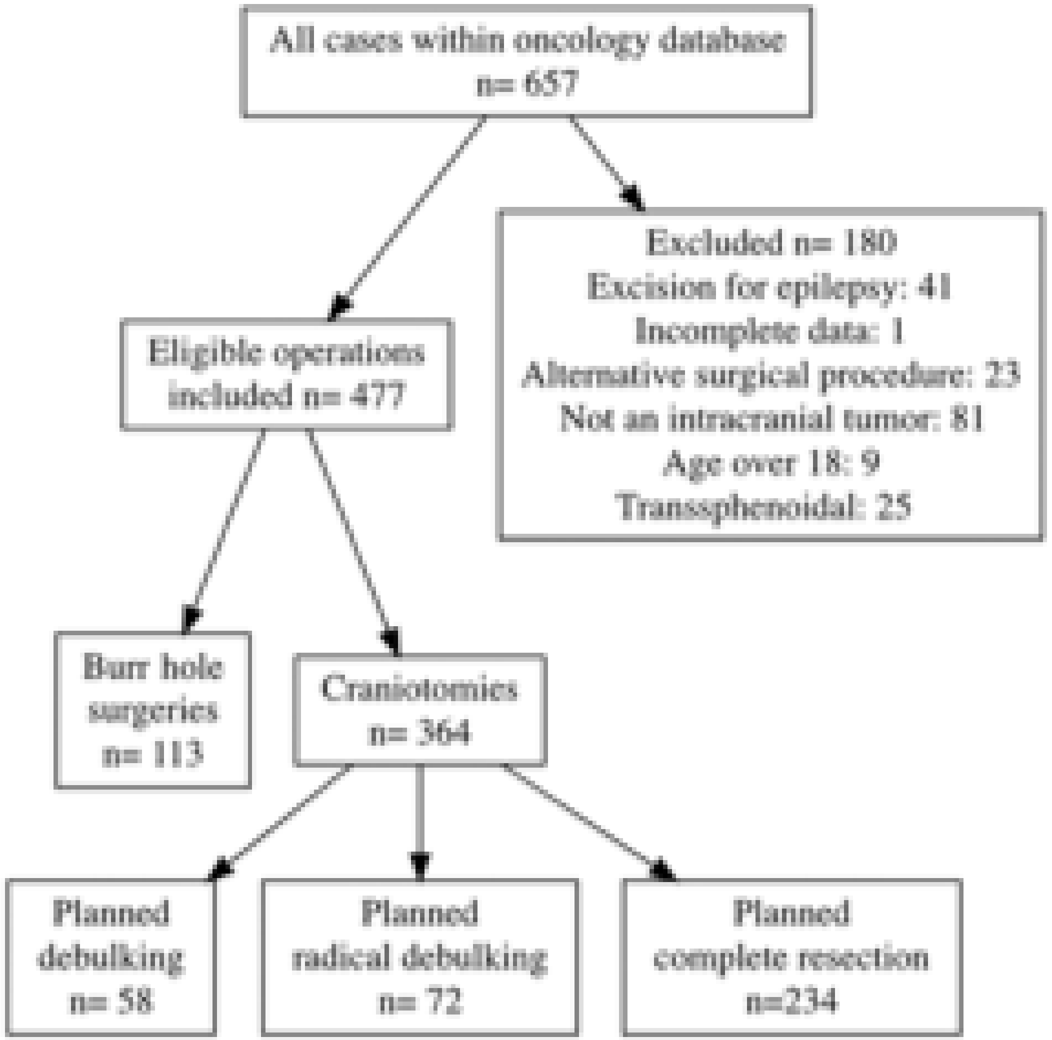
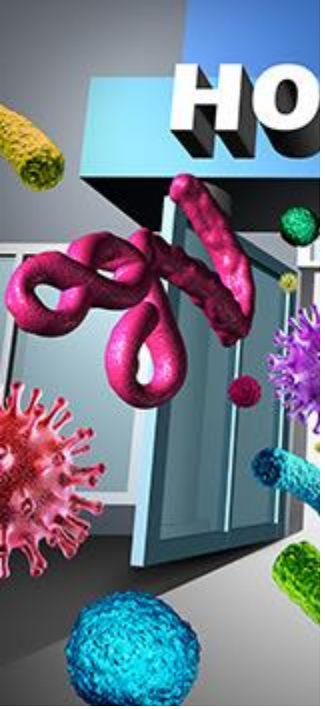


FIG. 1. Flowchart of patient inclusion and exclusion in the study.

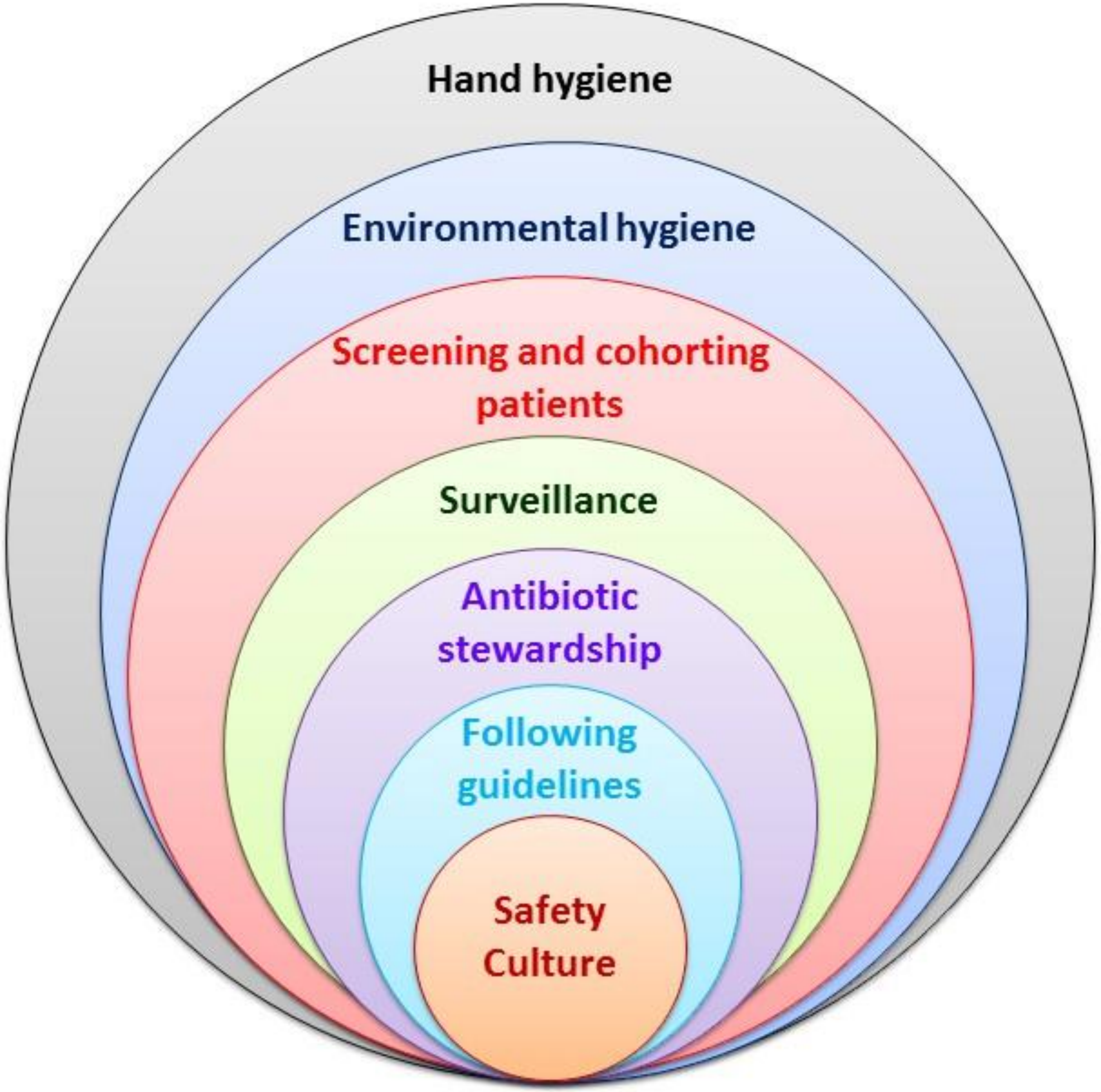
29,14%

TABLE 5. Summary of morbidity as measured by the Drake classification

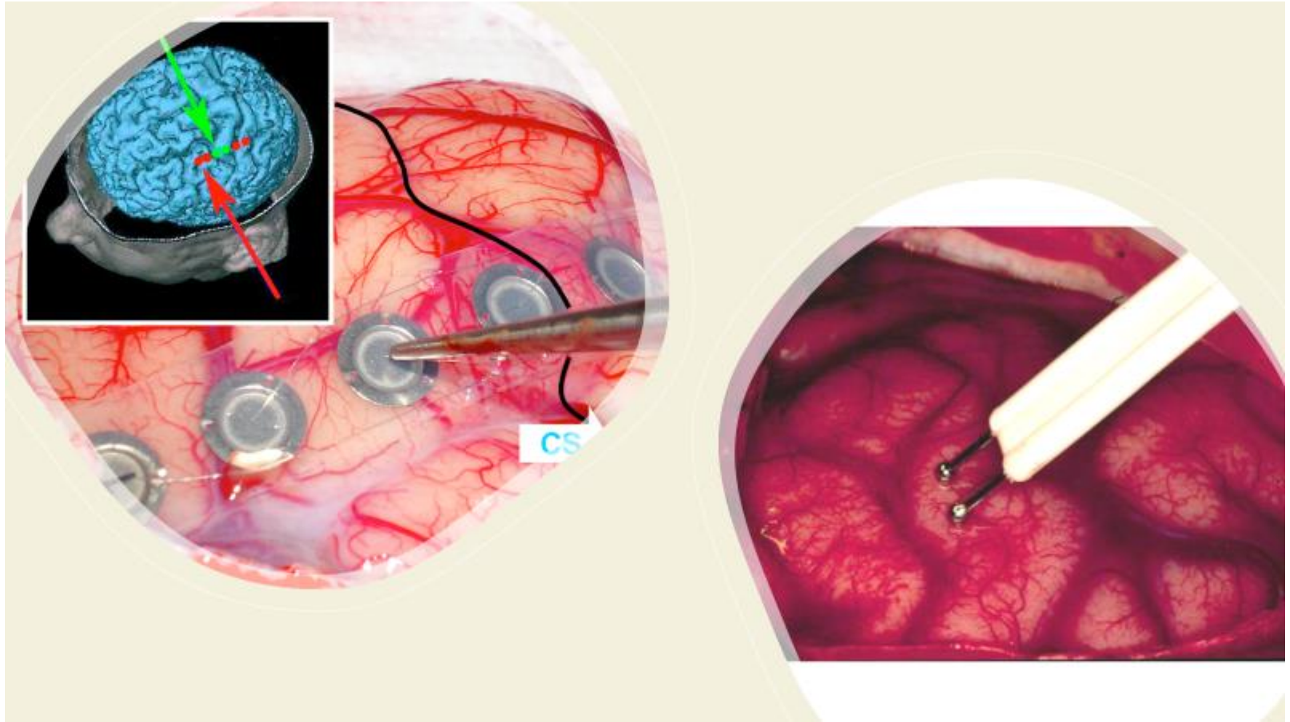
Morbidity	All Cases (%)	Craniotomy (%)	Burr Hole Surgery (%)
Meningitis	18 (3.77)	16 (3.35)	2 (0.42)
Seizures	20 (4.19)	16 (3.35)	4 (0.84)
Neurological deficit (any)	64 (13.42)	50 (10.48)	14 (2.94)
Neurological deficit (that remained disabling at 30 days)	40 (8.39)	36 (7.55)	4 (0.84)
CSF leak	23 (4.82)	21 (4.4)	2 (0.42)
Hemorrhage, managed medically	7 (1.47)	6 (1.26)	1 (0.21)
Hemorrhage, managed surgically	1 (0.21)	1 (0.21)	0 (0)
Wound infection	9 (1.89)	9 (1.89)	0 (0)
Shunt infection	7 (1.47)	6 (1.26)	1 (0.21)
Shunt block	3 (0.63)	3 (0.63)	0 (0)
Other	14 (2.94)	13 (2.73)	1 (0.21)
Medical complications	11 (2.31)	11 (2.31)	0 (0)

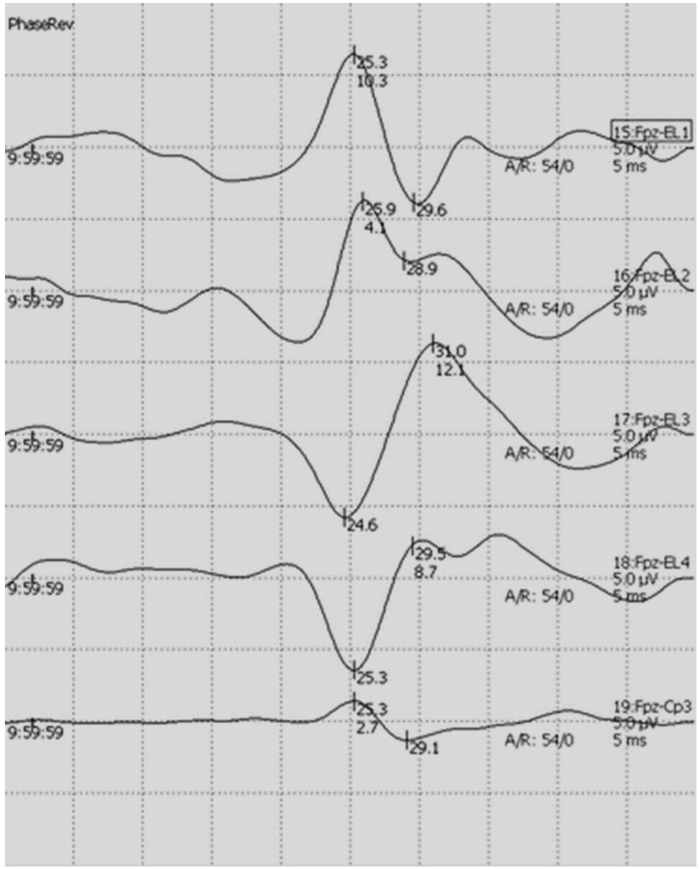


7 strategies to prevent healthcare-associated infections



Importance of neurological outcome and function preservation



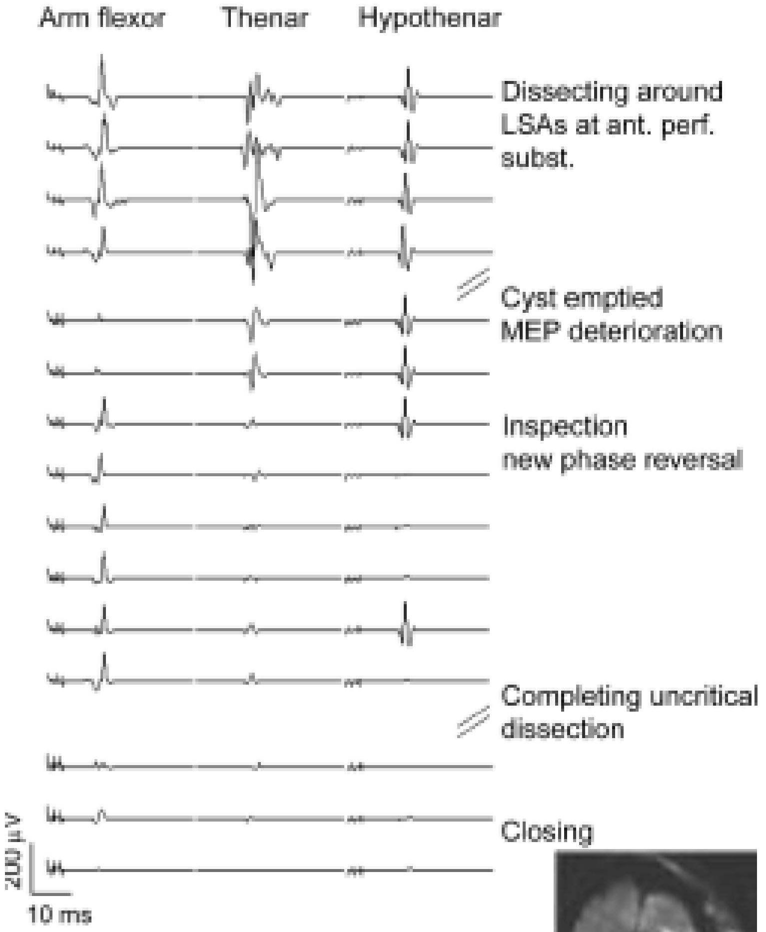


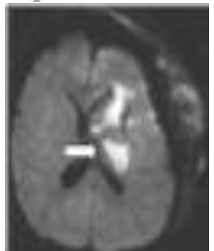
J Neurosurg 106:582–592, 2007

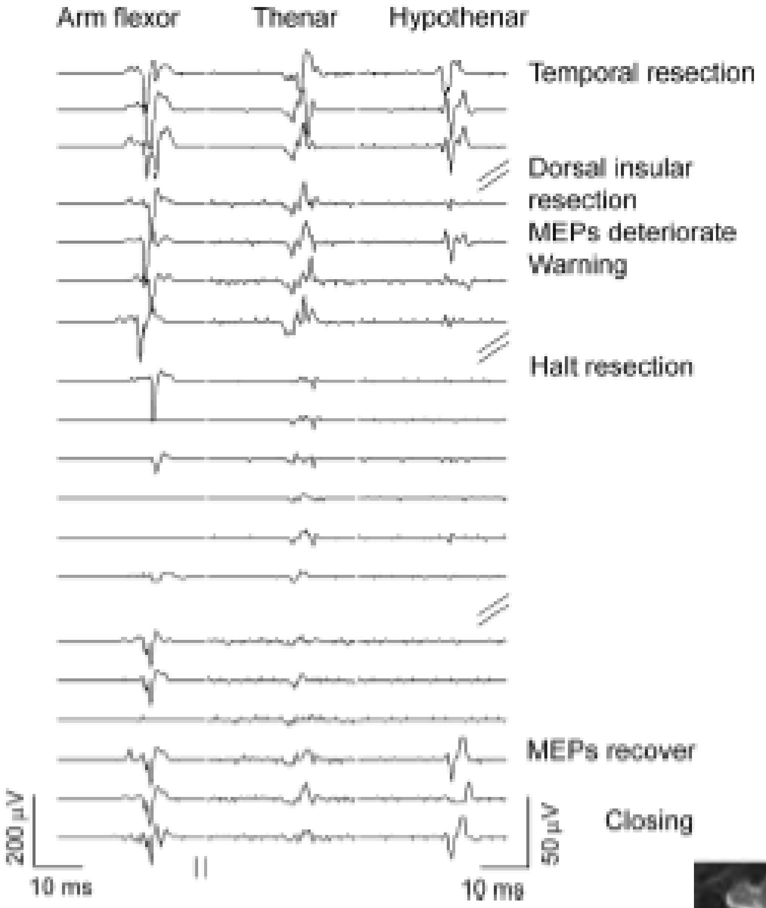
Motor tract monitoring during insular glioma surgery

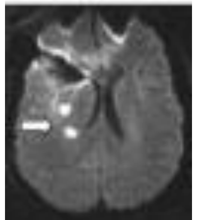
GEORG NEULOH, M.D., ULRICH PECHSTEIN, M.D., AND JOHANNES SCHRAMM, M.D.

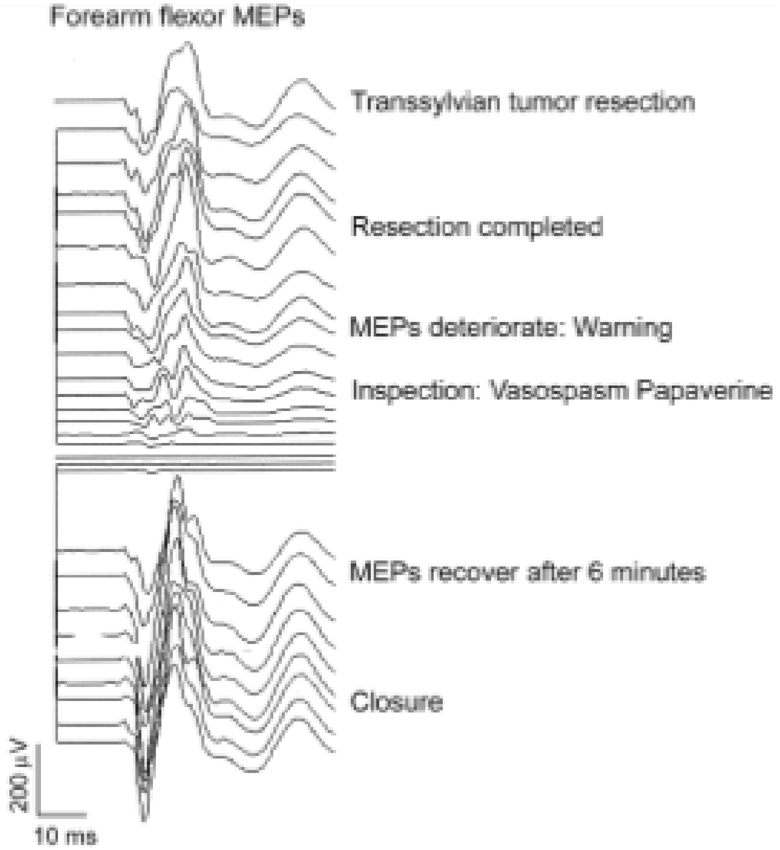
Department of Neurosurgery, University of Bonn, Germany

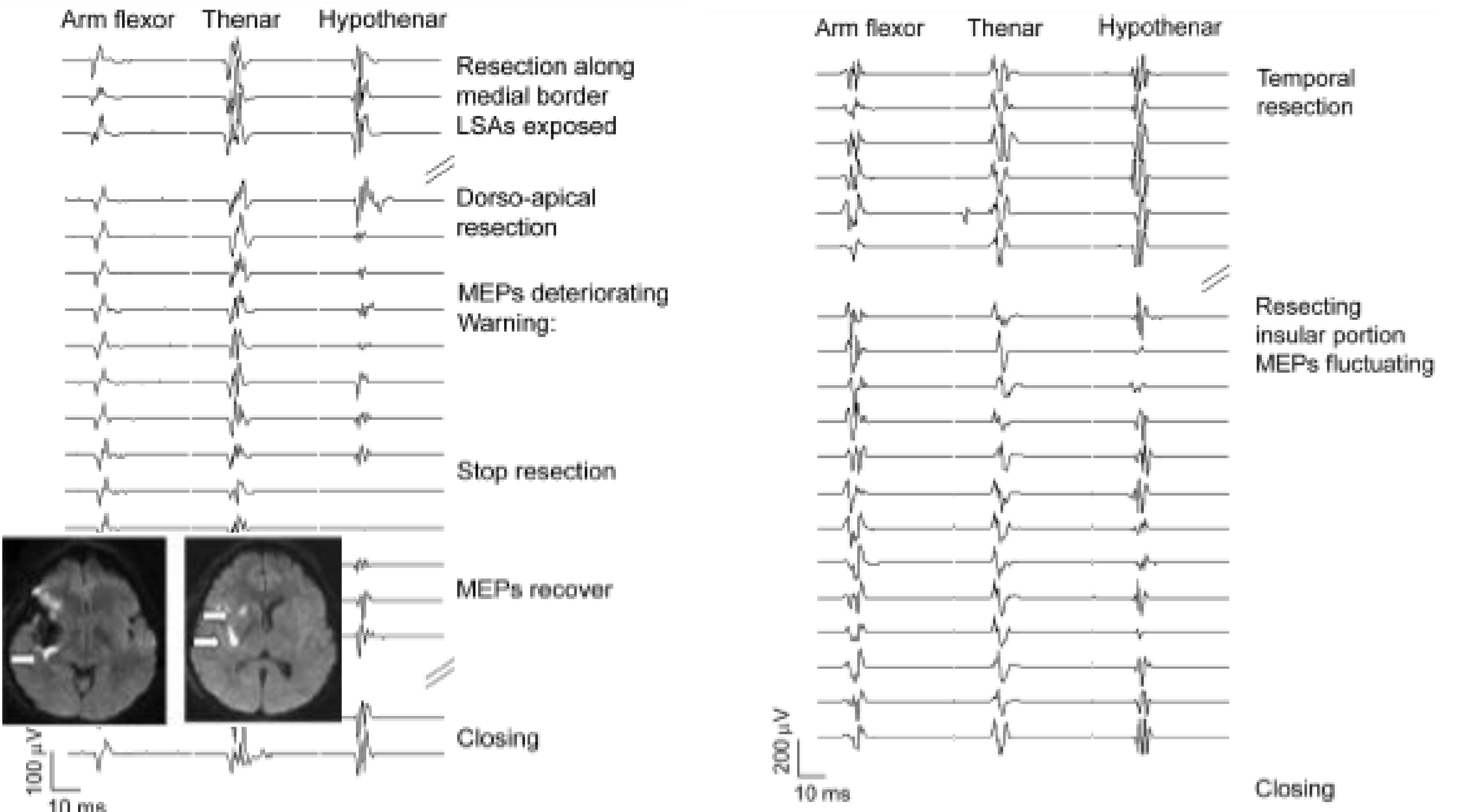




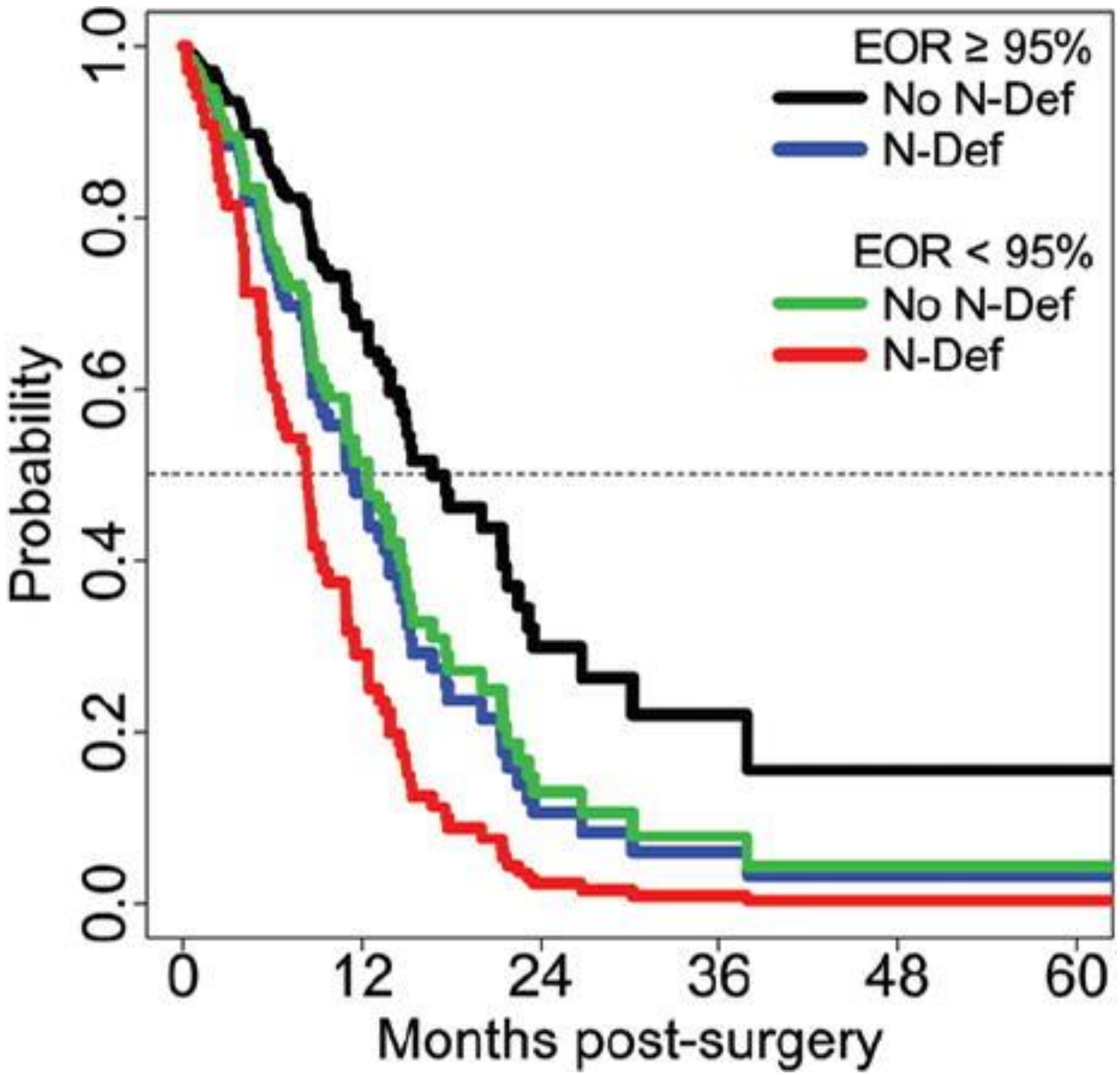




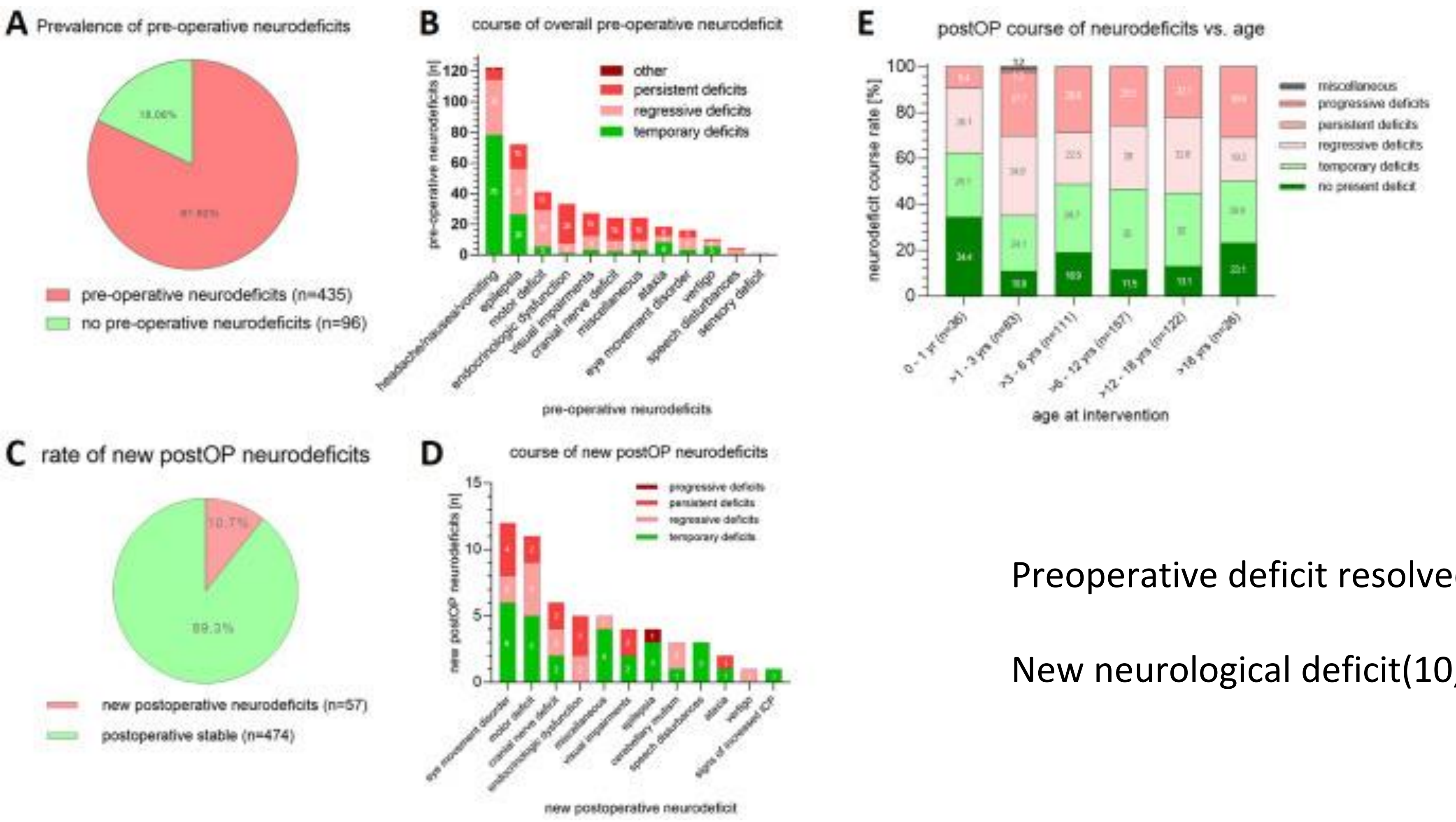



Arm flexor
Thenar
Hypothenar
Resection along
medial border
LSAs exposed
Dorso-apical
resection
MEPs deteriorating
Warning:
Stop resection
MEPs recover
Closing
100 μV
10 ms
Arm flexor
Thenar
Hypothenar
Temporal
resection
Resecting
insular portion
MEPs fluctuating
200 μV
10 ms
Closing

Importance of neurological outcome



Importance of neurological outcome



Preoperative deficit resolved 30,7% + improved 28,6%

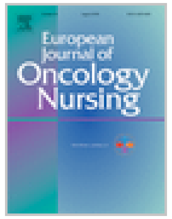
New neurological deficit(10,7%) 80% in 30 d

Importance of adjuvant treatments and complications

ELSEVIER

European Journal of Oncology Nursing

Volume 41, August 2019, Pages 104-109

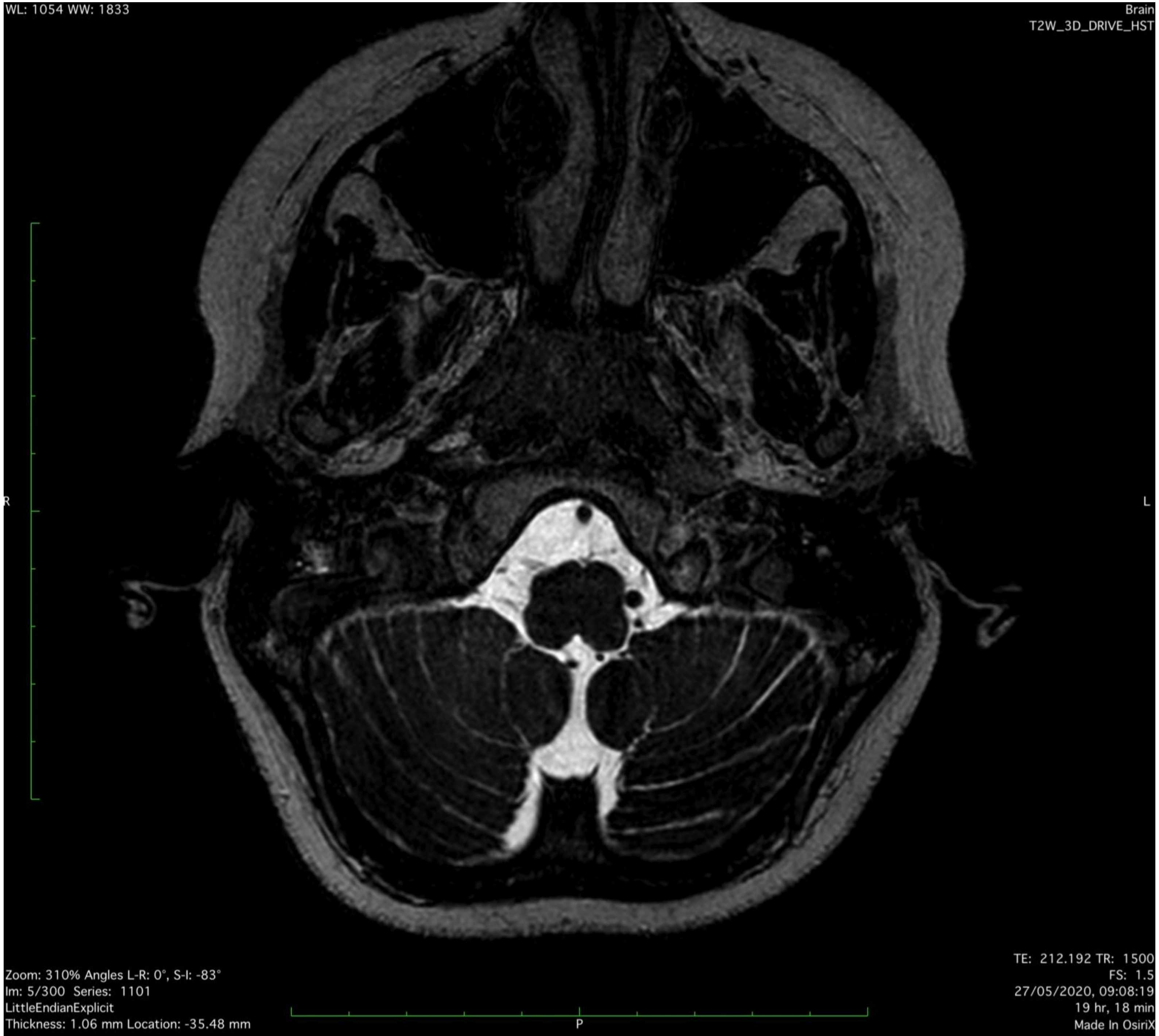


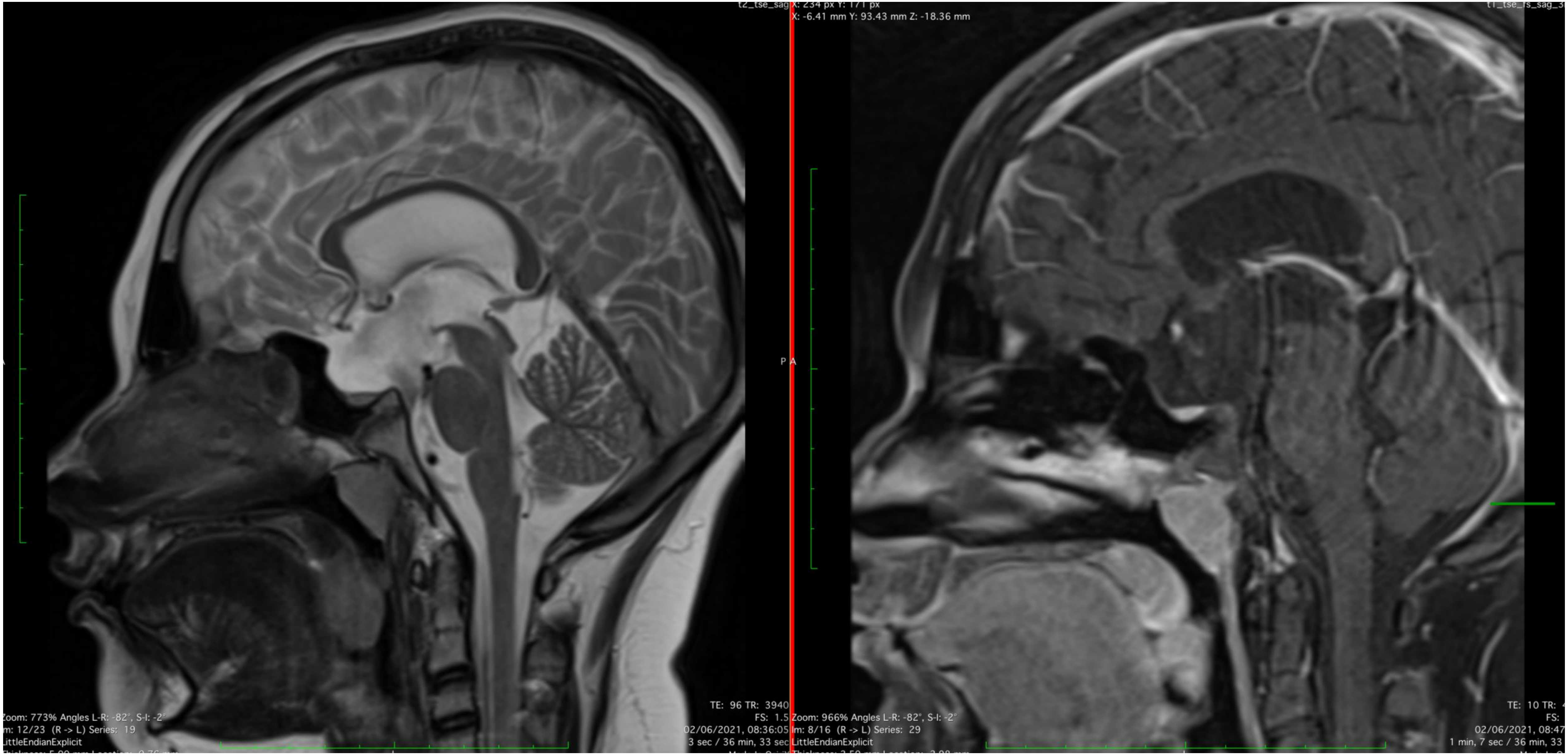
Impact of brain tumor and its treatment on the physical and psychological well-being, and quality of life amongst pediatric brain tumor survivors

Ankie Tan Cheung [a], William Ho Cheung Li [a], Laurie Long Kwan Ho [a], Ka Yan Ho [a], S.Y. Chiu [b], Chi-Fung Godfrey Chan [b], Oi Kwan Chung [a]

Poorer psychological well-being
Depression
Low self esteem
Severely compromised QOL


: 1084 WW: 1881
Brain
sT1W_3D_FFE GD
P
TE: 4.112 TR: 25
FS: 1.5
27/05/2020, 09:03:31
19 hr, 18 min
om: 729% Angles L-R: -83°, S-I: 1°
167/336 (R -> L) Series: 1001
tleEndianExplicit

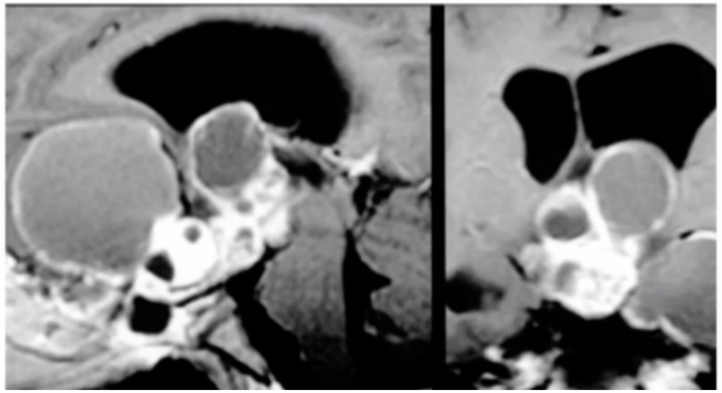

WL: 1054 WW: 1833
Brain
T2W_3D_DRIVE_HST
R
L
Zoom: 310% Angles L-R: 0°, S-I: -83°
Im: 5/300 Series: 1101
LittleEndianExplicit
Thickness: 1.06 mm Location: -35.48 mm
P
TE: 212.192 TR: 1500
FS: 1.5
27/05/2020, 09:08:19
19 hr, 18 min
Made In OsiriX


t2_tse_sag
TE: 96 TR: 3940
FS: 1.5
Zoom: 773% Angles L-R: -82°, S-I: -2°
m: 12/23 (R -> L) Series: 19
LittleEndianExplicit
02/06/2021, 08:36:05
3 sec / 36 min, 33 sec
X: 234 px Y: 171 px
X: -6.41 mm Y: 93.43 mm Z: -18.36 mm
t1_tse_fs_sag_3
P
A
Zoom: 966% Angles L-R: -82°, S-I: -2°
Im: 8/16 (R -> L) Series: 29
LittleEndianExplicit
TE: 10 TR:
FS:
02/06/2021, 08:47
1 min, 7 sec / 36 min, 33

Evolution of treatment strategy
Sparing the hypothalamus

2000-2005

« TOTAL » Resection 30-50% of relapse and risk of MORBIDITY +++	LIMITED Surgery in selected cases to limit sequels



See the corresponding editorial in this issue, pp 1–2.

J Neurosurg (1 Suppl Pediatrics) 106:3–

Pediatric craniopharyngiomas: classification and treatme according to the degree of hypothalamic involvement

Stéphanie Puget, M.D.,[1] Matthew Garnett, F.R.C.S.,[1] Alison Wray, F.R.A.C.S.,[2] Jacques Grill, M.D.,[3] Jean-Louis Habrand, M.D.,[3] Nathalie Bodaert, M.D.,[4] Michel Zerah, M.D.,[1] Mercia Bezerra, M.D.,[1] Dominique Renier, M.D.,[1] Alain Pierre-Kahn, M.D.,[1] and Christian Sainte-Rose, M.D.[1]

Surgical outcomes of endoscopic endonasal skull base surgery of craniopharyngiomas evaluated according to the degree of hypothalamic extension

Shigetoshi Yano, MD, PhD., Takuichiro Hide, MD, PhD., Naoki Shinojima, MD, PhD.

ORIGINAL ARTICLE

Quality of life and growth after childhood craniopharyngioma: results of the multinational trial KRANIOPHARYNGEOM 2007

Kerstin Heinks[1] · Svenja Boekhoff[1] · Anika Hoffmann[1] · Monika Warmuth-Metz[2] · Maria Eveslage[3] · Junxiang Peng[1,4] · Gabriele Calaminus[5] · Hermann L. Müller[1]

ORIGINAL ARTICLE

Endocrine Care

Childhood Craniopharyngioma: Hypothalamus-Sparing Surgery Decreases the Risk of Obesity

E. Elowe-Gruau,* J. Beltrand,* R. Brauner, G. Pinto, D. Samara-Boustani, C. Thalassinos, K. Busiah, K. Laborde, N. Boddaert, M. Zerah, C. Alapetite, J. Grill, P. Touraine, C. Sainte-Rose, M. Polak,** and S. Puget**

REVIEW

Craniopharyngioma adherence: a reappraisal of the evidence

Ruth Prieto[1] · José María Pascual[2] · Verena Hofecker[3] · Eduard Winter[3] · Inés Castro-Dufourn Rodrigo Carrasco[5] · Laura Barrios[6]

Topographic Diagnosis of Craniopharyngiomas: The Accuracy of MRI Findings Observed on Conventional T1 and T2 Images

R. Prieto, J.M. Pascual, and L. Barrios

Pediatric Neurosurgery

Pediatr Neurosurg 2008;44:435–443
DOI: 10.1159/000172965

Received:
Accepted:
Published

Radical Resection of 202 Pediatric Craniopharyngiomas with Special Reference to the Surgical Approaches and Hypothalamic Protection

Yu Qi Zhang[a] Zhen Yu Ma[a] Zhe Bao Wu[b] Shi Qi Luo[a] Zhong Cheng War

Limits of endoscopic endonasal surgery for III ventricle craniopharyngiomas

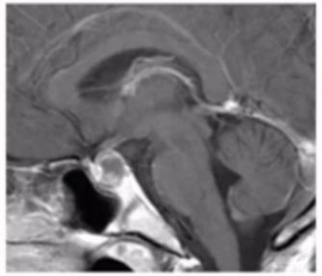
Douglas A. HARDESTY [1,2], Alaa S. MONTASER [1,3], André BEER-FURLAN [1,4], Ricardo L. CARRAU [1,5], Daniel M. PREVEDELLO [1,5]*

Outcome of Radical Surgical Resection for Craniopharyngioma with Hypothalamic Preservation: A Single-Center, Retrospective Study of 1054 Patients

Xiang'en Shi, MD, PhD, Zhongqing Zhou, MD, PhD, Bin Wu, MD, Yongli Zhang, MD, Hai Qian, MD, PhD, Yuming Sun, MD, Yang Yang, MD, PhD, Zaitao Yu, MD, PhD, Zhiwei Tang, MD, PhD, Shuaibin Lu, MD

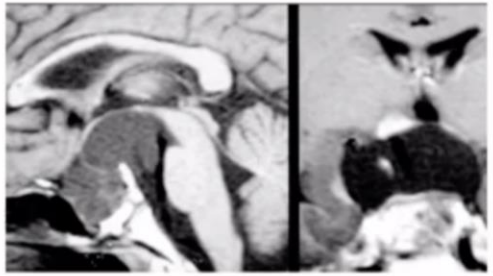
Management based on Preoperative MRI Grading

0



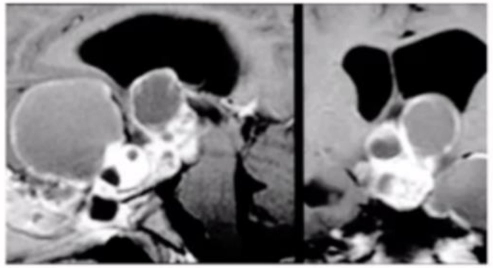
Total resection

1

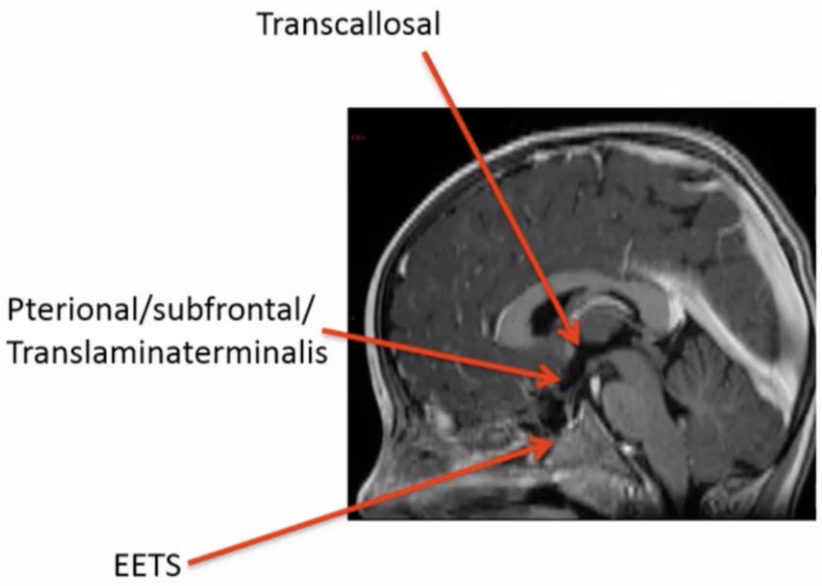


Total/subtotal resection

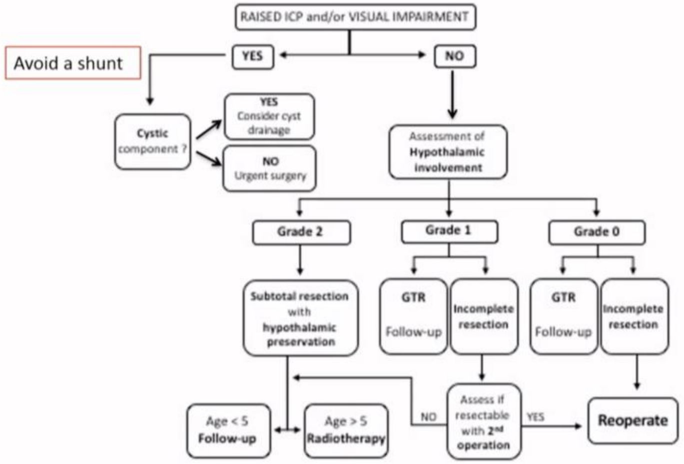
2

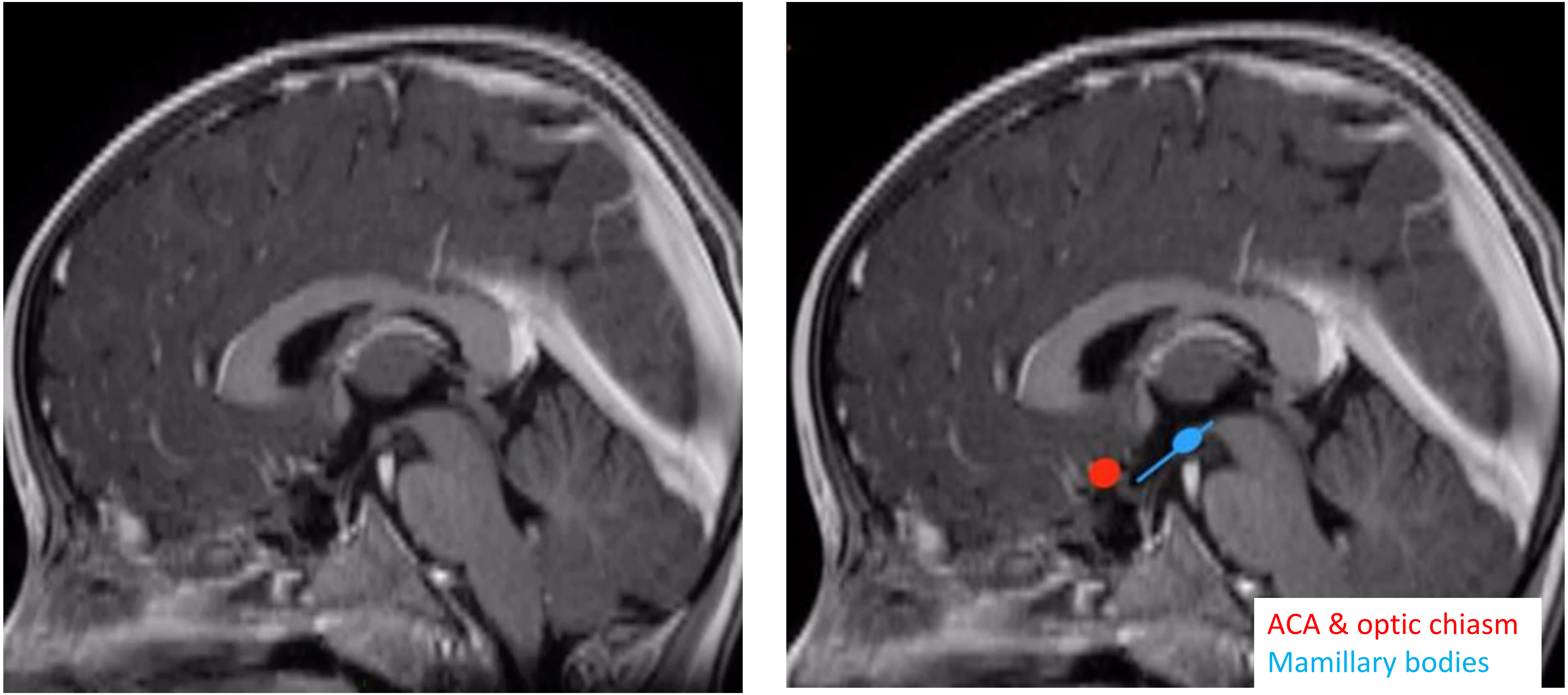


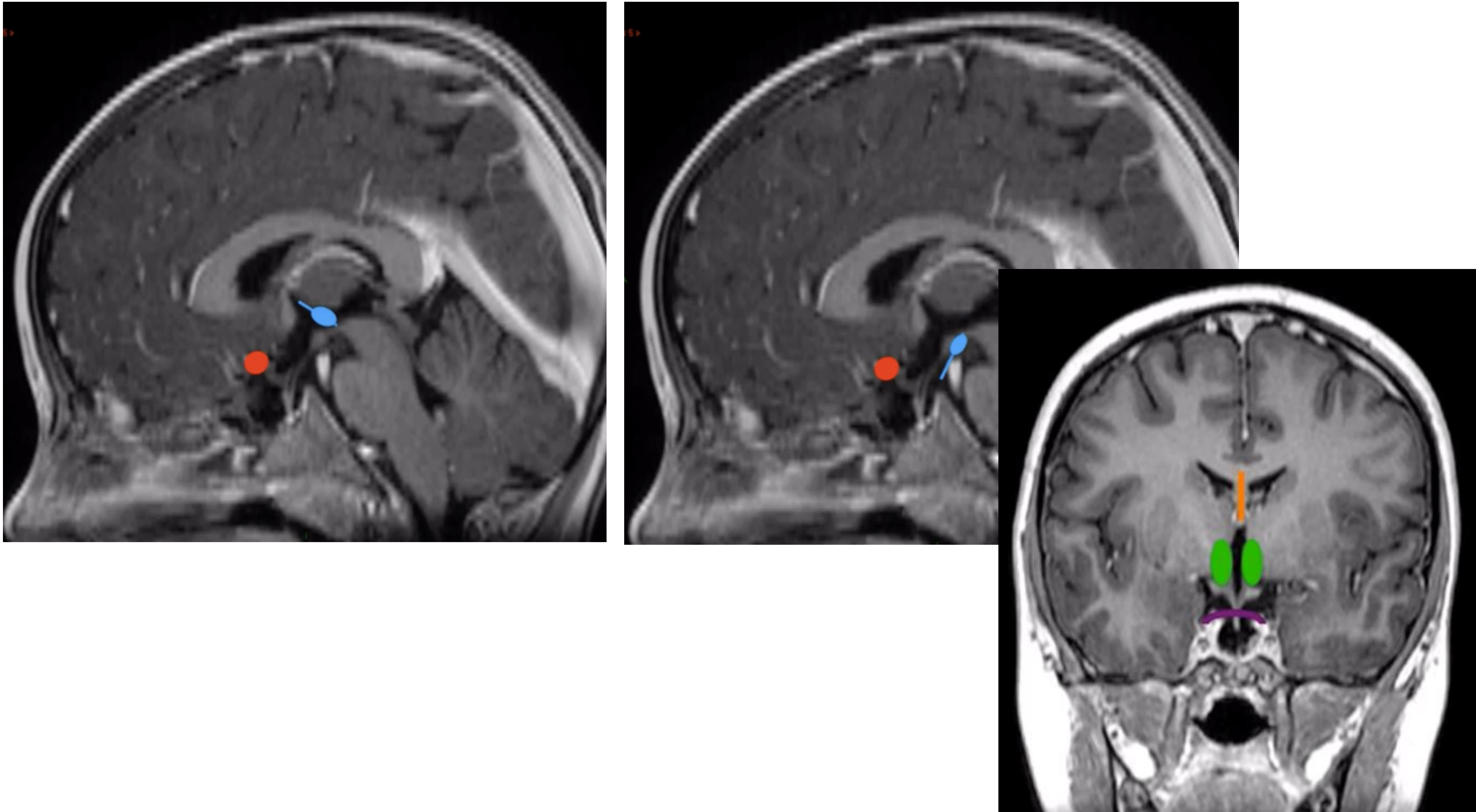
Limited surgery
+
Local irradiation



Treatment algorithm




ACA & optic chiasm
Mamillary bodies

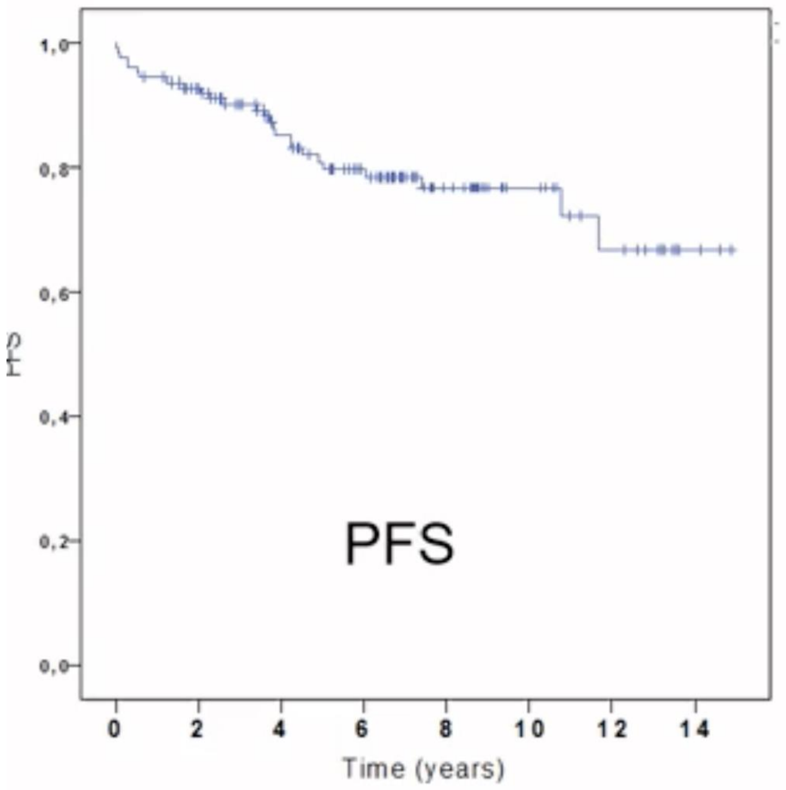


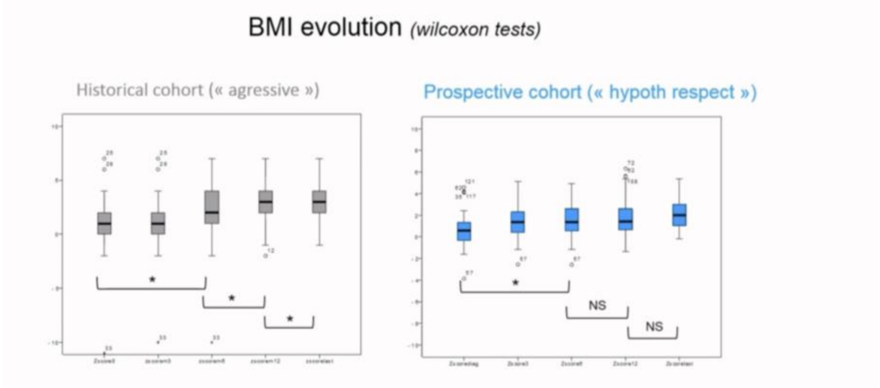
Hopital Necker 2003-2017 prospective study

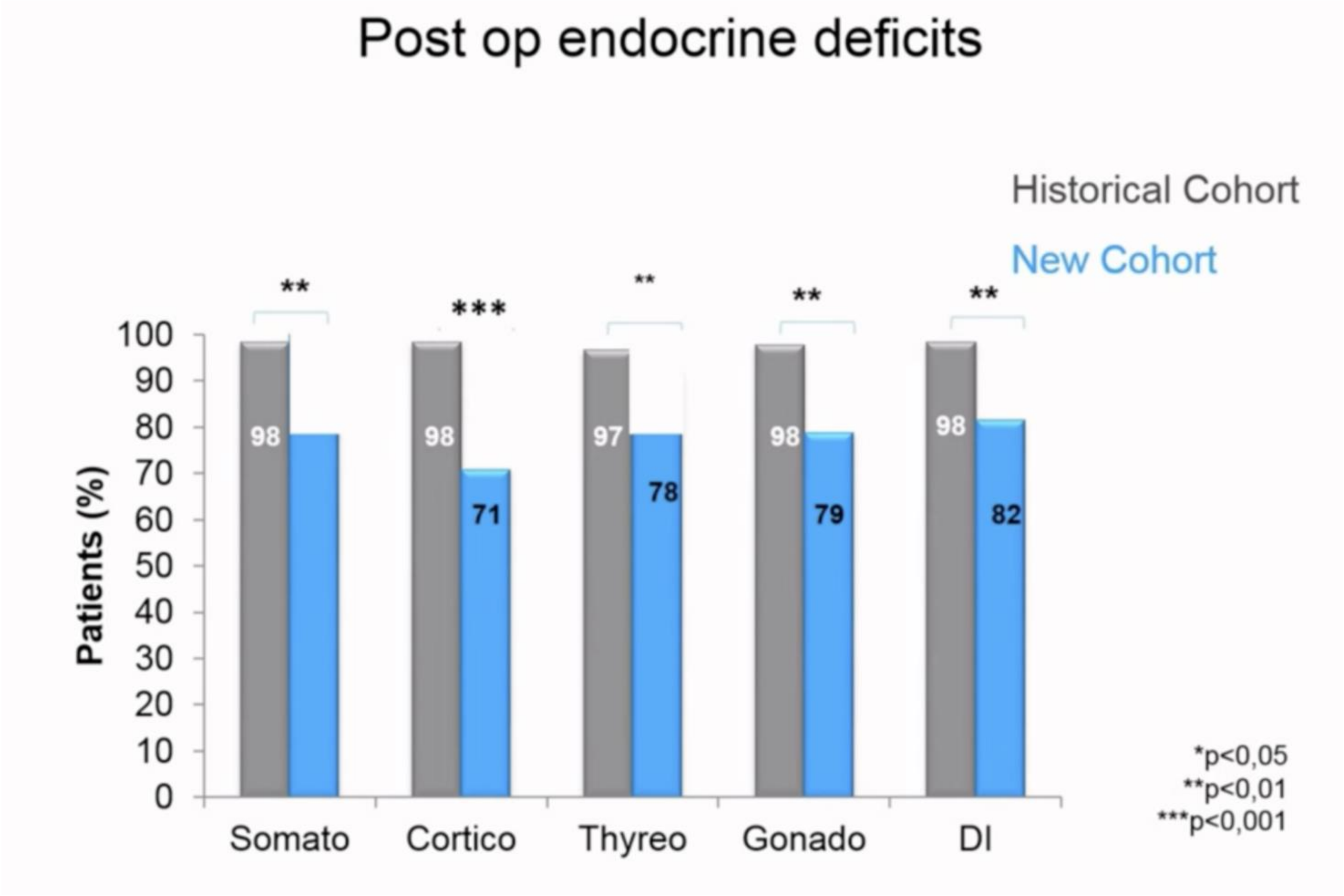
- OS 99,2%
- PFS 72%

- 100 craniotomies και 30 transnasal
- 69% subtotal and Radiotherapy

- Decrease of residual tissue 35,5%
- Increase residual tissue 7,8%



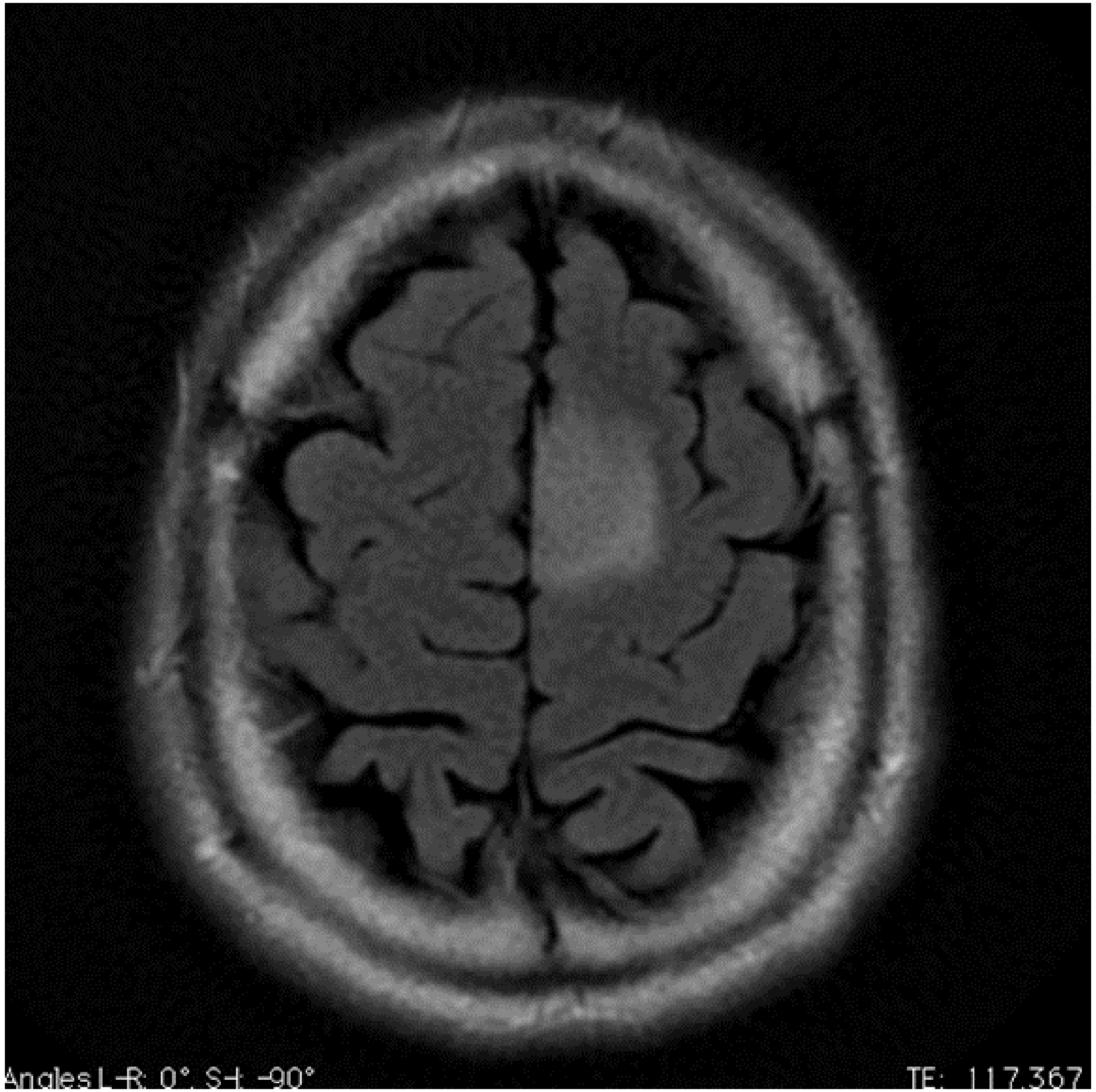

BMI evolution (wilcoxon tests)
Historical cohort (« agressive »)
Prospective cohort (« hypoth respect »)
*
*
*
*
NS
NS


Post op endocrine deficits
Historical Cohort
New Cohort
Patients (%)
100
90
80
70
60
50
40
30
20
10
0
**
***
**
**
**
98
71
97
78
98
79
98
82
Somato
Cortico
Thyreo
Gonado
DI
*p<0,05
**p<0,01
***p<0,001

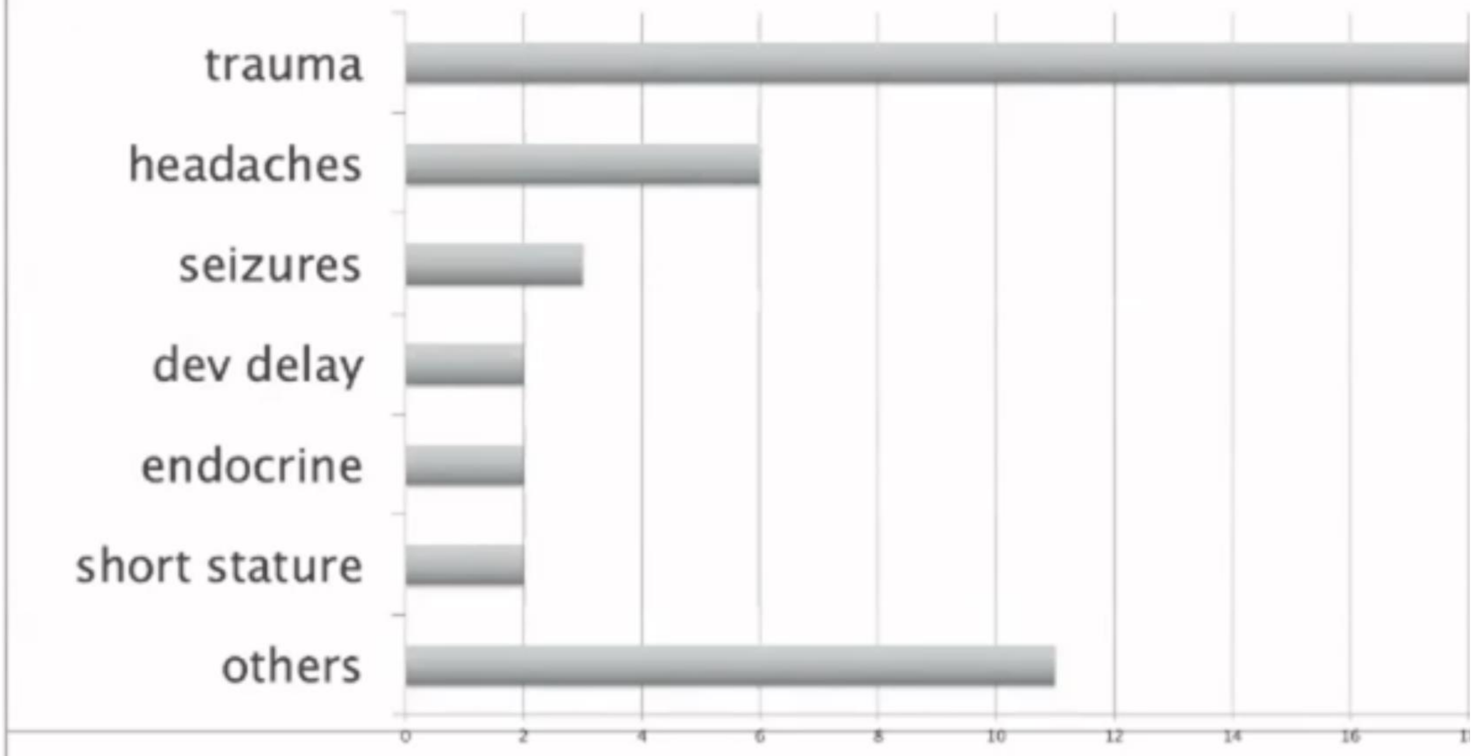
Pediatric Brain incidentalomas

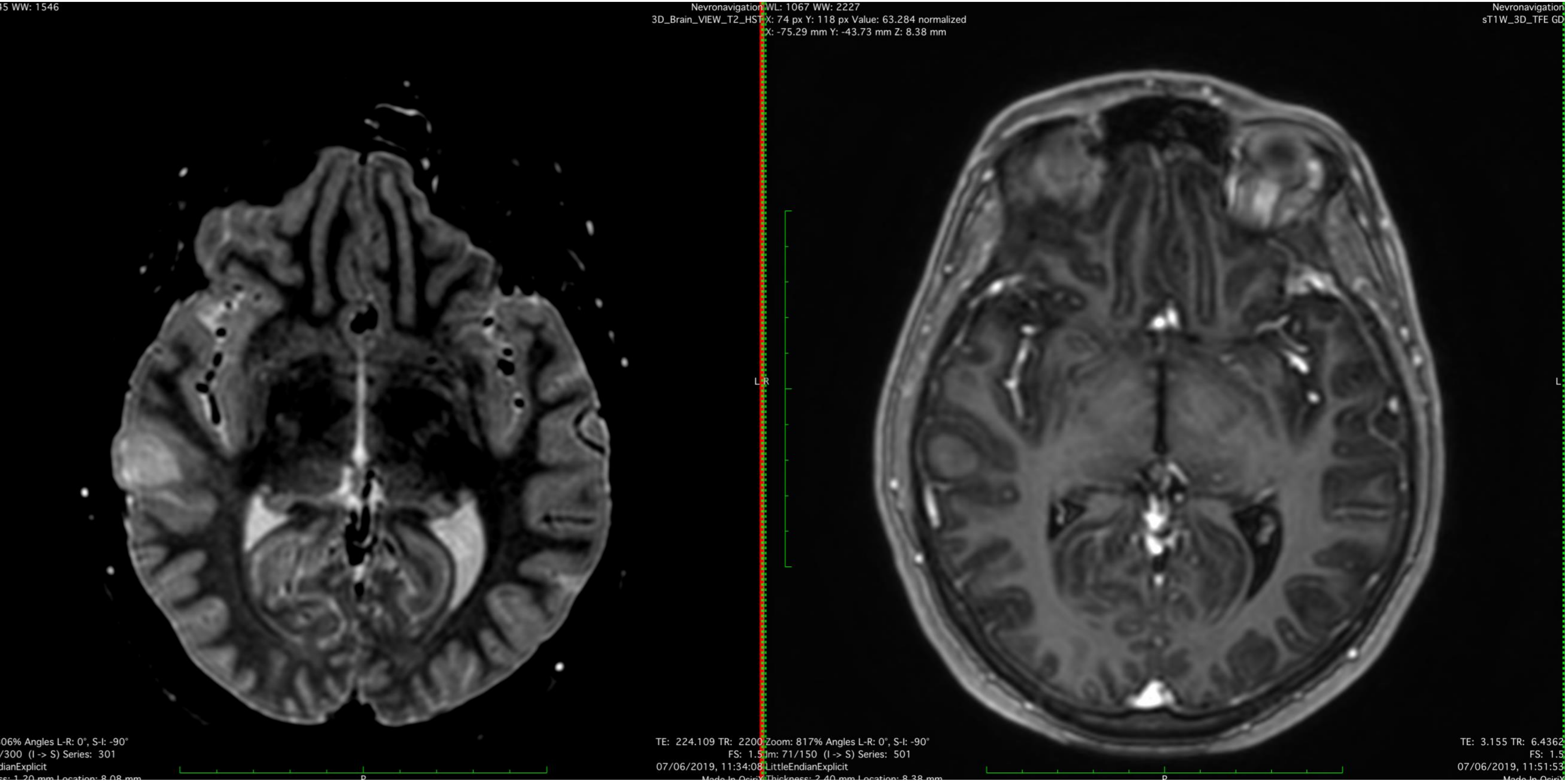
- Wide spread use of neuroimaging in children
- More diagnosis of incidentalomas
- Lesion without a clinical impact
- Often suggestive of LGG*
- Management not defined

*may also be a malignant tumor



Reasons for primary imaging:

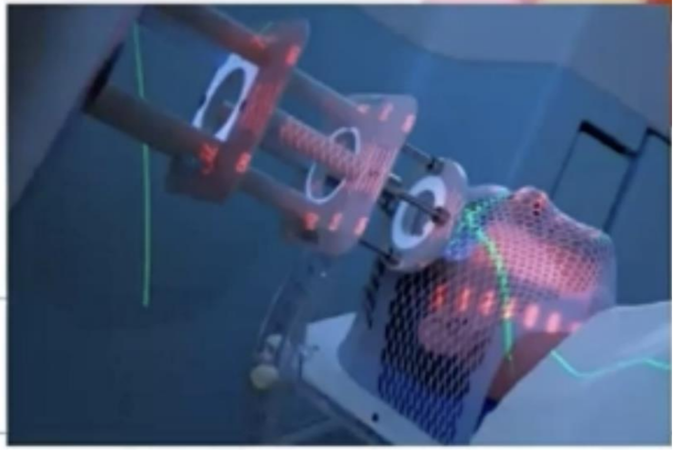




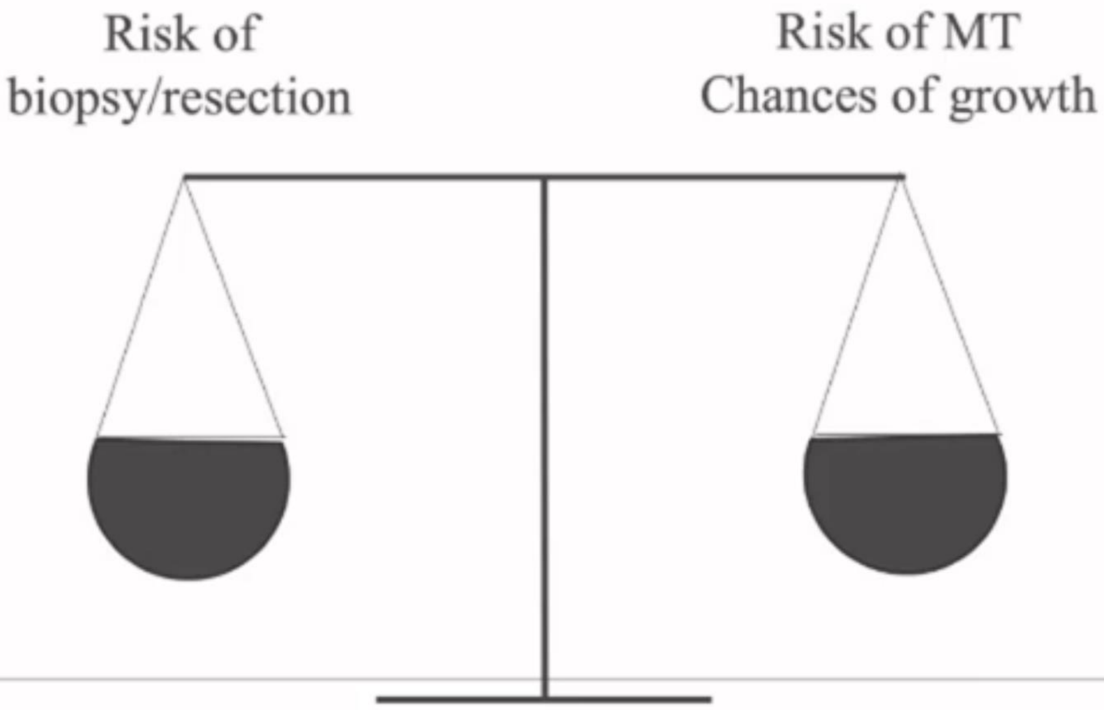
5 WW: 1546
Nevronavigation
3D_Brain_VIEW_T2_HST
06% Angles L-R: 0°, S-I: -90°
/300 (I -> S) Series: 301
dianExplicit
TE: 224.109 TR: 2200
FS: 1.5
07/06/2019, 11:34:08
WL: 1067 WW: 2227
X: 74 px Y: 118 px Value: 63.284 normalized
X: -75.29 mm Y: -43.73 mm Z: 8.38 mm
Nevronavigation
sT1W_3D_TFE GD
Zoom: 817% Angles L-R: 0°, S-I: -90°
Im: 71/150 (I -> S) Series: 501
LittleEndianExplicit
TE: 3.155 TR: 6.4362
FS: 1.5
07/06/2019, 11:51:53

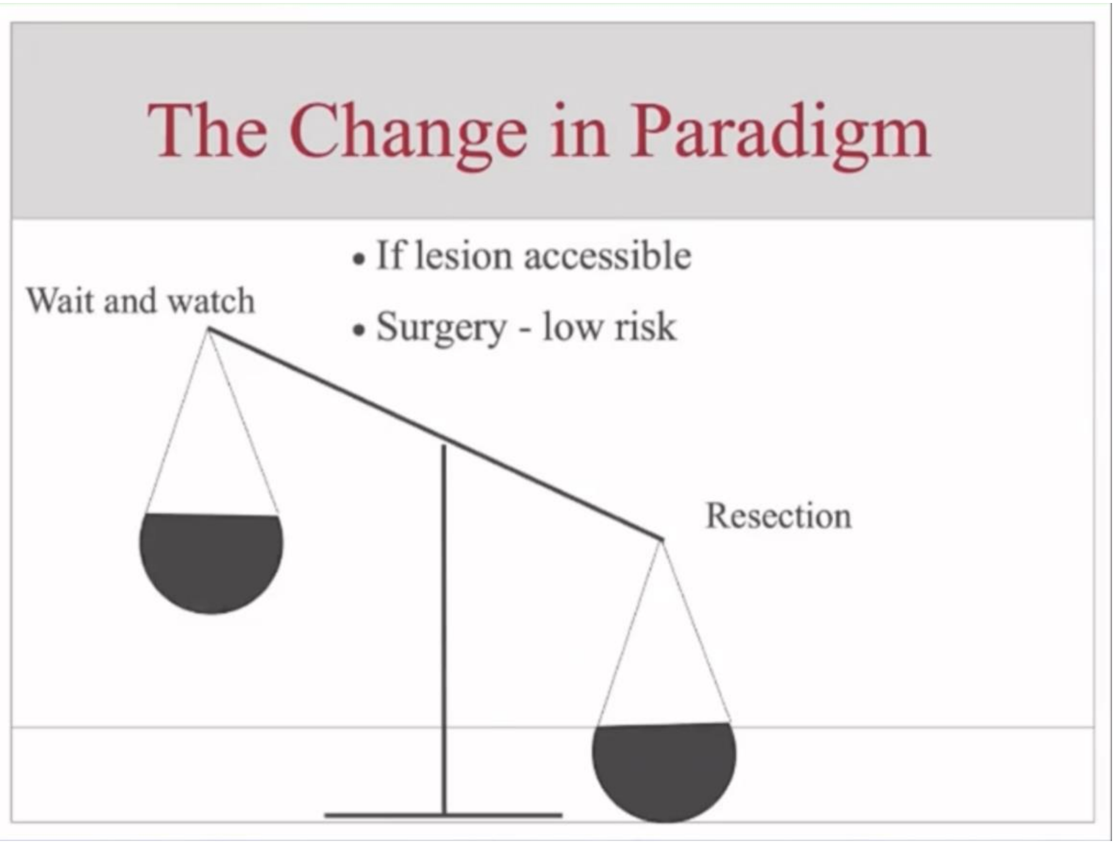
Treatment Options

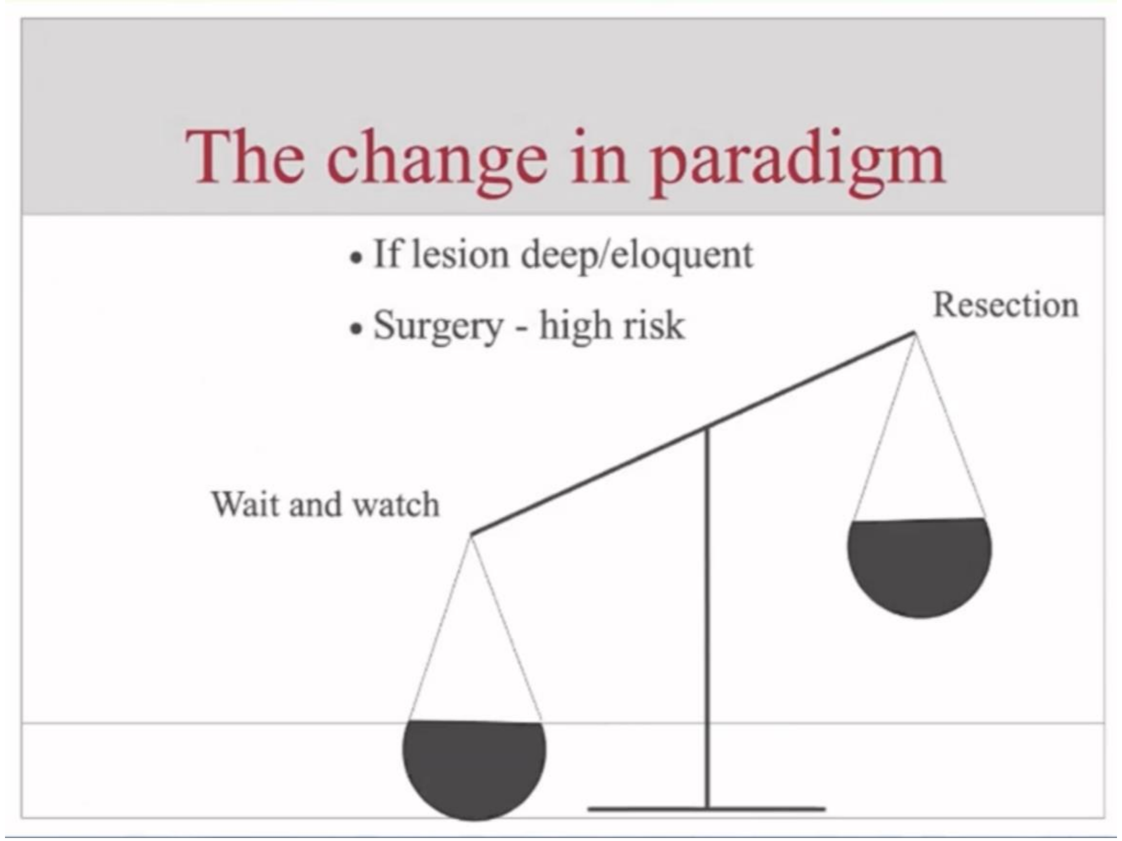
- Wait and scan
- Surgical biopsy
- Surgical resection
- Upfront radio- and/or chemotherapy

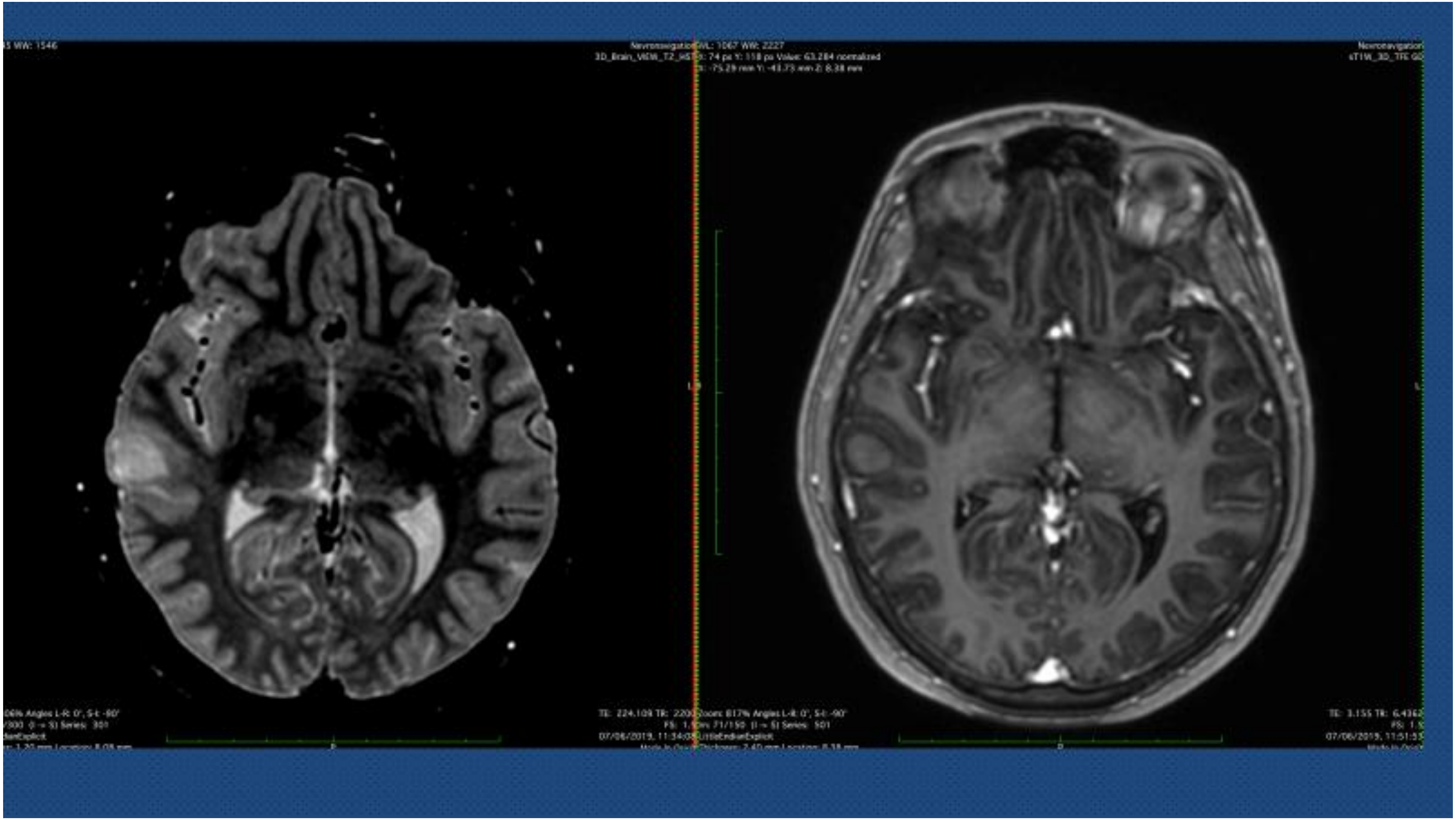


The dilemma in pediatric Incidentalomas




The Change in Paradigm
• If lesion accessible
• Surgery - low risk
Wait and watch
Resection


The change in paradigm
• If lesion deep/eloquent
• Surgery - high risk
Resection
Wait and watch



WW: 1546
WL: 1067 WW: 2227
Y: 118 px Value: 63.284 normalized
Y: -43.73 mm Z: 8.38 mm
Angles L-R: 0°, S-I: -90°
Series: 301
Series: 501
LittleEndianExplicit

Unanswered question

- Can imaging predict which tumor will grow
- Will molecular biology help decide treatment course?
- Does early resection/biopsy change treatment course?
- Does early diagnosis change patient outcome?


MAXIMIZE
POOR
GOOD
EFFICIENCY


Safety
First !


COLLABORATION
SUPPORT
TEAMWORK
COMMUNICATION
TRUST
MOTIVATION
INSPIRATION
SUCCESS