



28th Annual Gabor Racz Advanced Interventional
Pain Conference and Workshop
Budapest, Hungary **August 25-27, 2025**

Intracranial Approaches to Pain Management

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Conflicts of Interest

Type of affiliation/financial interest	Name of commercial company
Receipt of grants/research supports:	
Receipt of honoraria or consultation fees:	BOSTON SCIENTIFIC, MEDTRONIC, ABBOTT, CEREGATE
Participation in a company sponsored speaker's bureau:	
Stock shareholder:	
Spouse/partner:	
Other support (please specify):	



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INTRACRANIAL APPROACHES IN PAIN MANAGEMENT

ABLATIVE PROCEDURES:

- PERCUTANEOUS TECHNIQUES
- GAMMA KNIFE
- RADIOFREQUENCY ABLATION
- FOCUSED ULTRASOUND

CRANIOTOMY

- MICROVASCULAR DECOMPRESSION

NEUROMODULATION

- MOTOR CORTEX STIMULATION
- DEEP BRAIN STIMULATION
- GASSERIAN GANGLION STIMULATION
- GGL. SPHENOPALATINUM STIMULATION





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ABLATIVE PROCEDURES





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1

WITHOUT THE RISK OF CRANIOTOMY

2

EASILY REPEATABLE

3

CHEAPER THAN MOST ADVANCED
PROCEDURES E.G.
NEUROMODULATION





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THERMOCONTROLLED RADIOFREQUENCY ABLATION
(SINCE THE '50)

PULSE RADIOFREQUENCY (SLIJTER 1996)

GLYCEROL RHYZOTOMY (HAKANSON 1981)

BALLON COMPRESSION (MULLAN 1983)

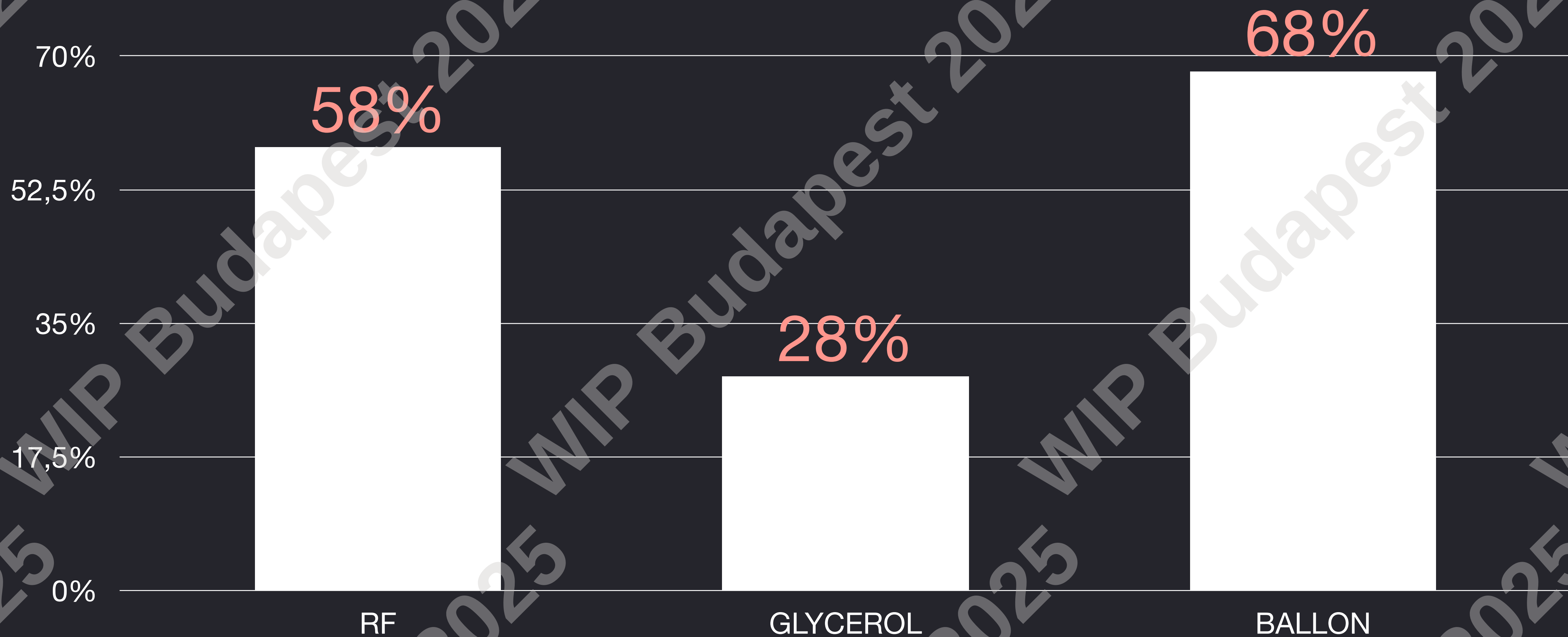
IN THE TREATMENT OF TRIGEMINAL NEURALGIA

PERCUTANEOUS TECHNIQUES



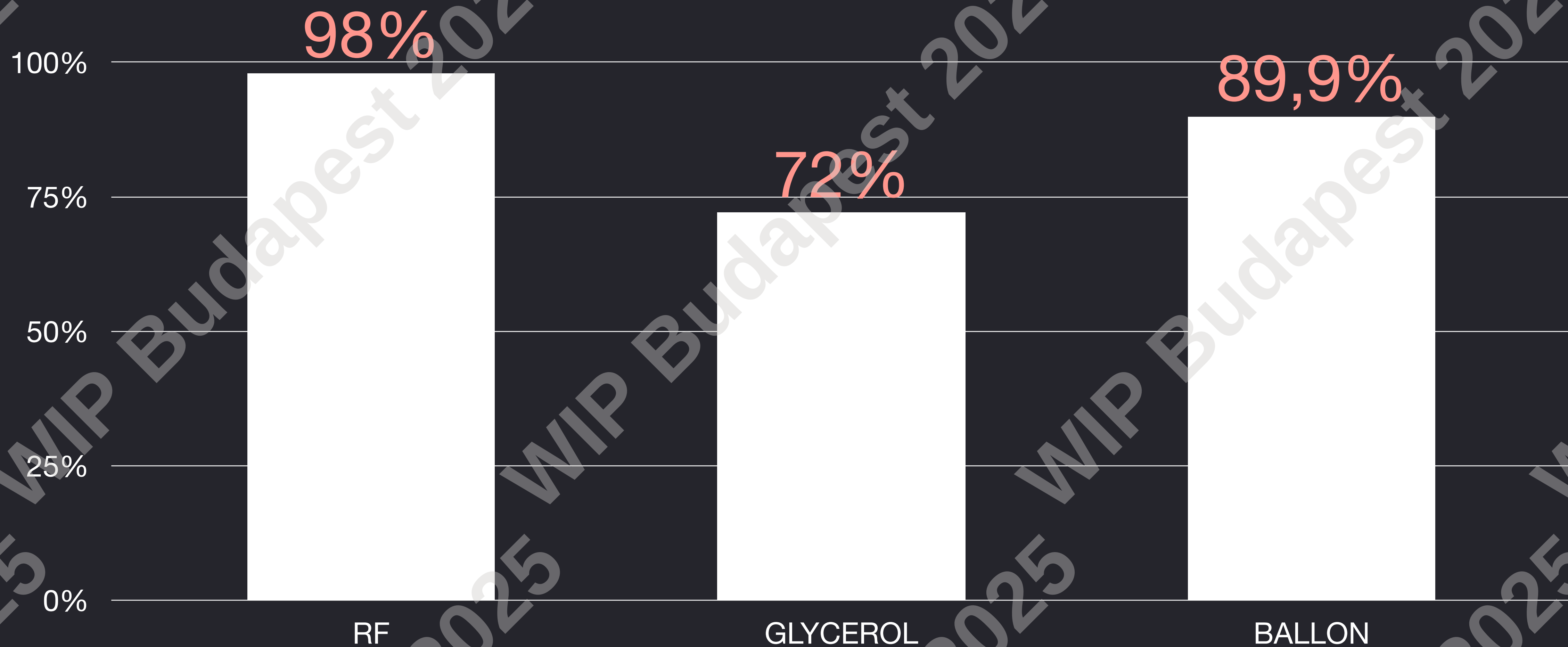


SUCCESS RATE



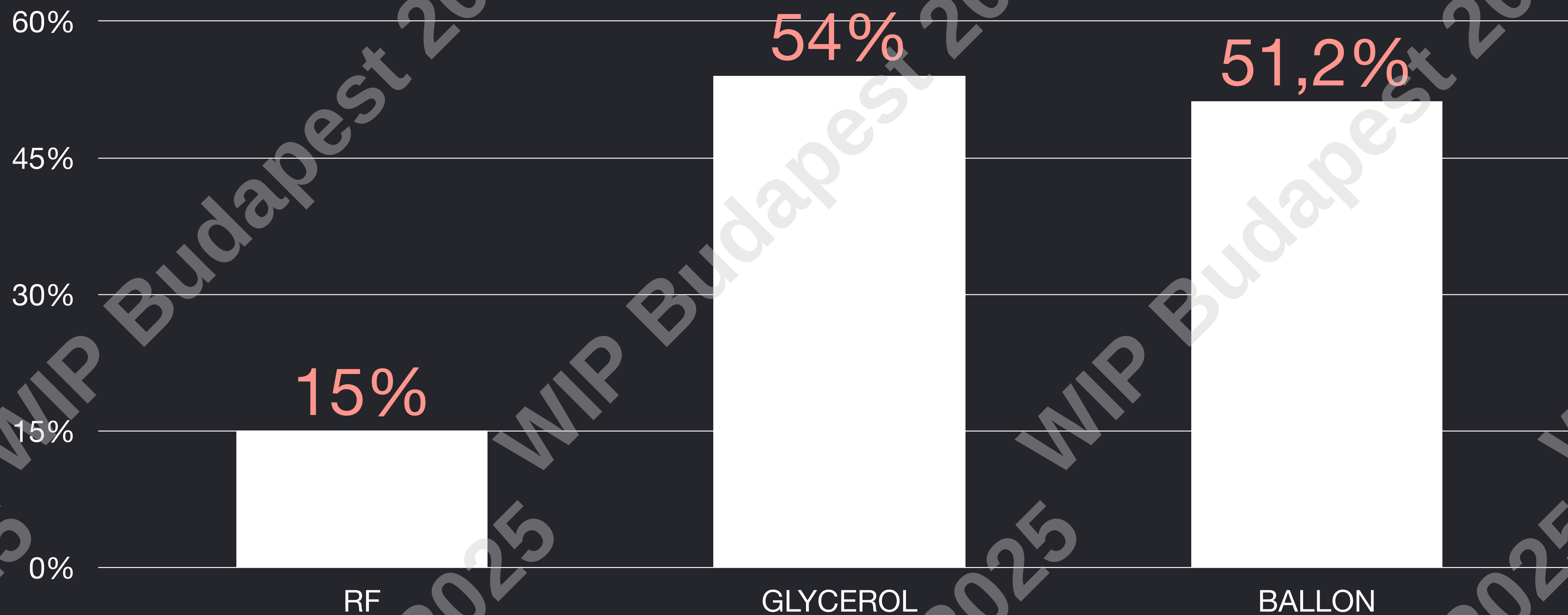


PAIN FREE



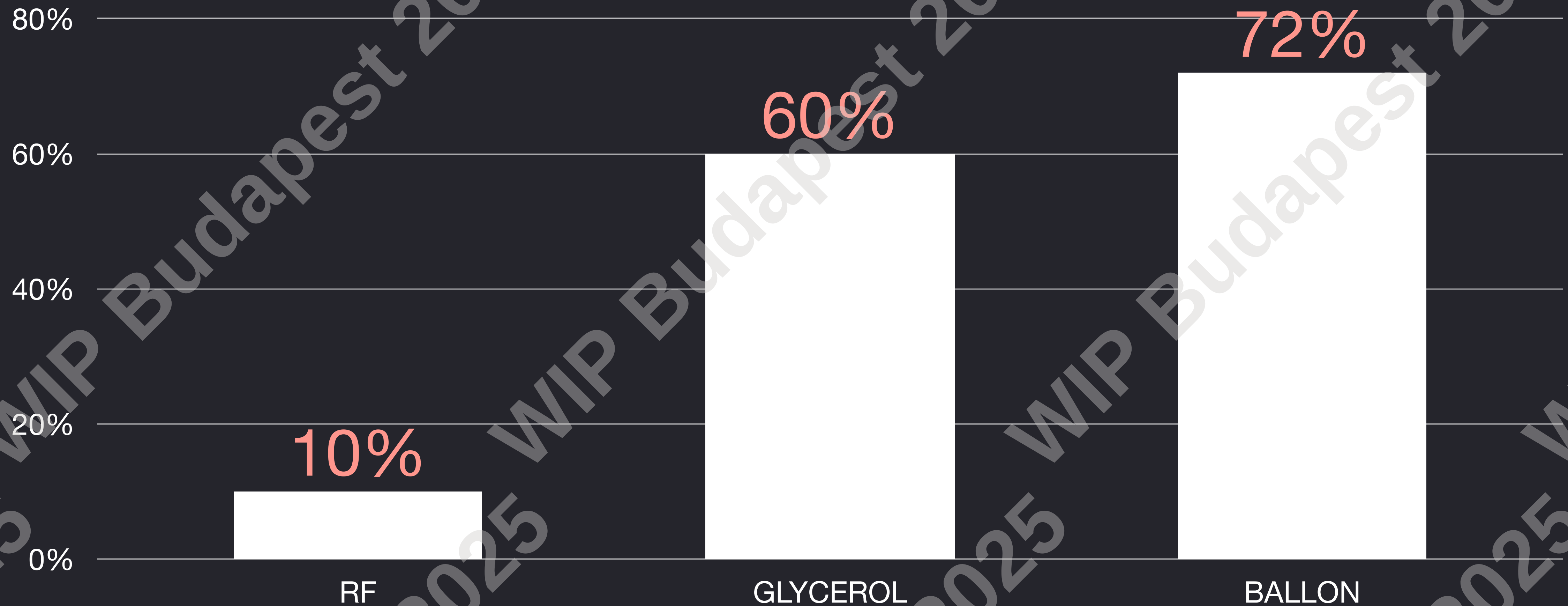


RECURRING PAIN



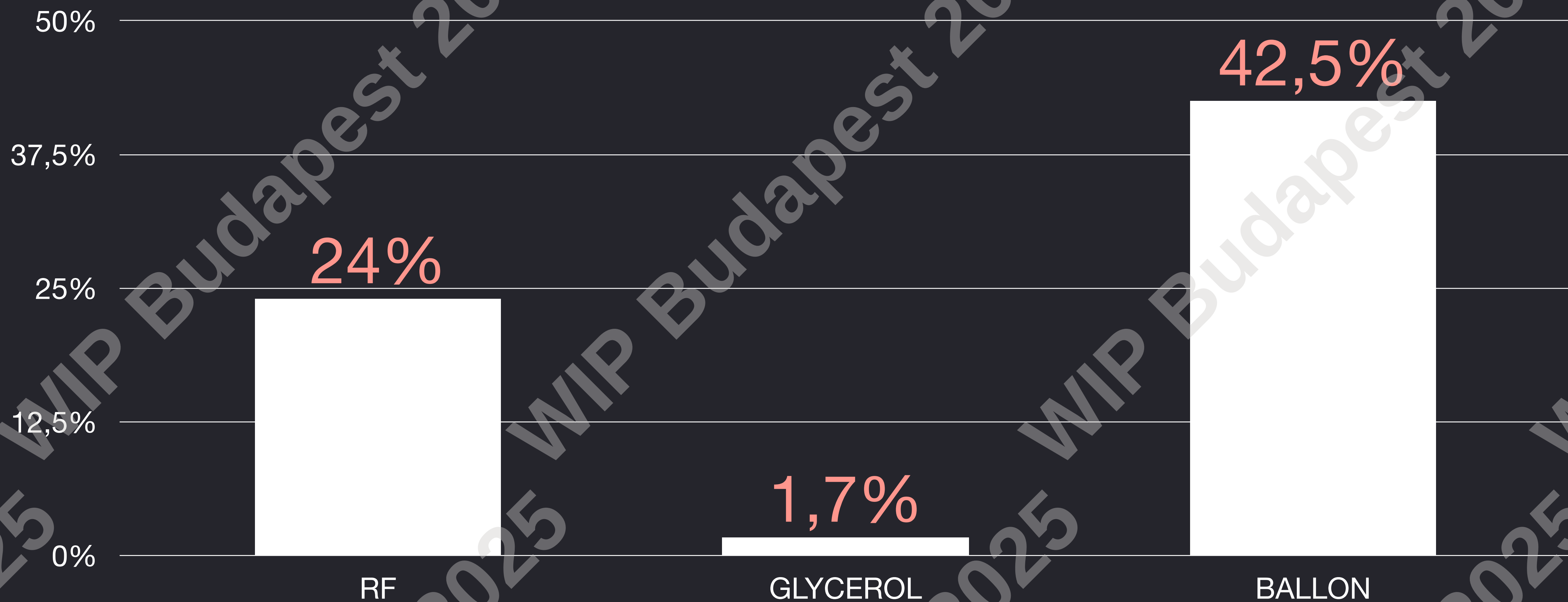


FACIAL NUMBNESS



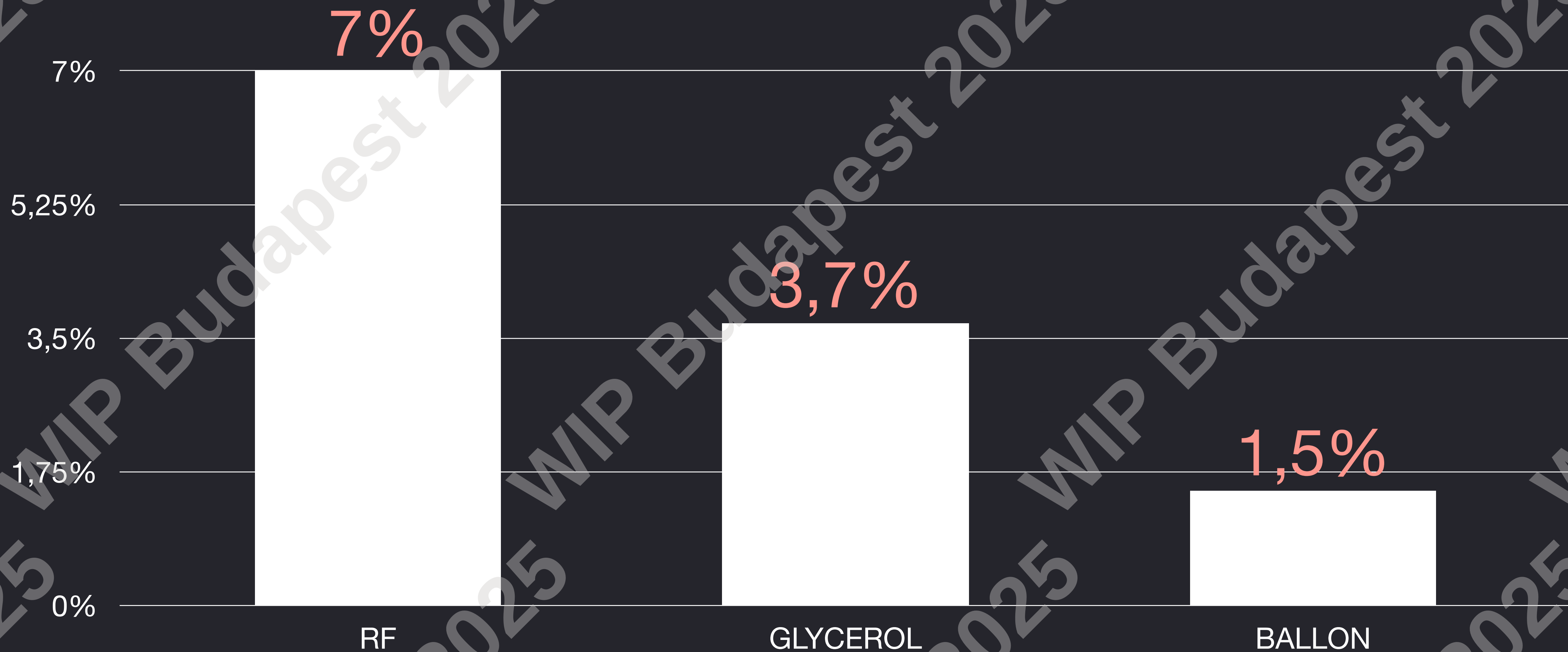


MOTOR DEFICIT



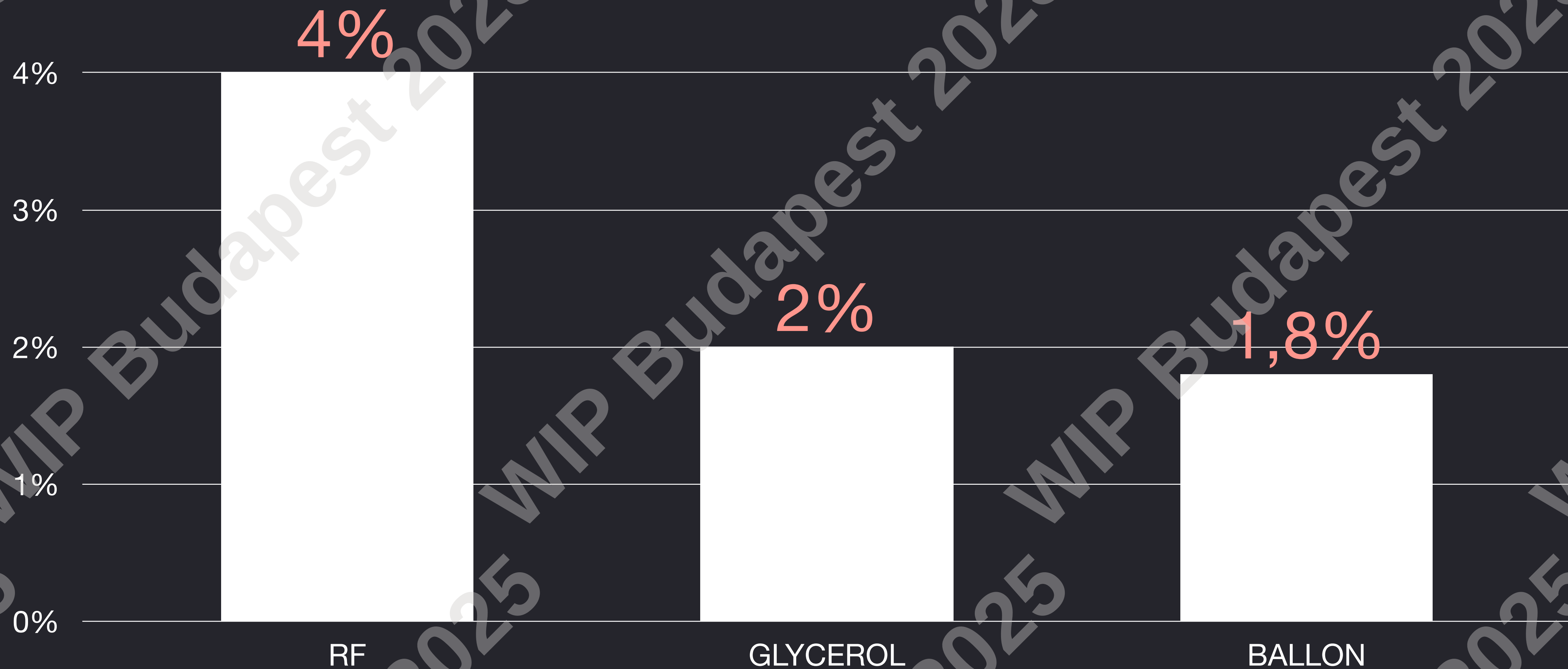


CORNEAL AREFLEXIA





ANAESTHESIA DOLOROSA





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GAMMA **KNIFE**

FIRST PROCEDURE (1951, LEKSELL, GANGLION)

20000 PATIENT WAS TREATED IN THE WORLD

TARGET SINCE 1993 IS NEAR THE BRAINSTEM
PROXIMAL PART OF THE NERVE

1-8 WEEKS AFTER THE TREATMENT 75% OF THE
PATIENTS ARE PAIN FREE

60% IS PAIN FREE IN LONG-TERM, 10% HAS
RECURRING PAIN IN THE FIRST YEAR

COMPLICATIONS: 0-10% PARAESTHESIA





GAMMA **KNIFE**

24 TO 71% OF PATIENTS REPORT
CONTINUED PAIN RELIEF 1 TO 2
YEARS AFTER UNDERGOING THE
PROCEDURE

**33 TO 56% REPORT CONTINUED
PAIN RELIEF AT 4 TO 5 YEARS IN
TRIEMINAL NEURALGIA**





> [Neurol Res.](#) 1995 Feb;17(1):59-65. doi: 10.1080/01616412.1995.11740287.

Technique of stereotactic medial thalamotomy with the Leksell Gamma Knife for treatment of chronic pain

R F Young¹, D S Jacques, R W Rand, B C Copcutt, S S Vermeulen, A E Posewitz

- Nineteen patients, a total of 24 medial thalamic lesions
- chronic intractable pain after extensive prior medical and surgical intervention had failed to provide pain relief
- Lesion locations: intralaminar, mediodorsal, centromedian, and parafascicular nuclei
- 4 mm collimator helmet at radiosurgical doses from 140-180 Gray
- Follow-up MRI scans: anatomically distinct lesions which developed 3-6 weeks after the procedure and were fully formed by 8-12 weeks
- Lesion volumes: 300-400 mm³ for a single isocentre, 600-900 mm³ for two isocentres, and 900-1100 mm³ for three isocentres
- More than 3 months follow-up: four patients **(27%) are pain free** and functioning normally, five other patients **(33%) achieved greater than 50% pain relief** » 9/15 patients (60%) have had worthwhile benefit from medial thalamotomy with the Gamma Knife





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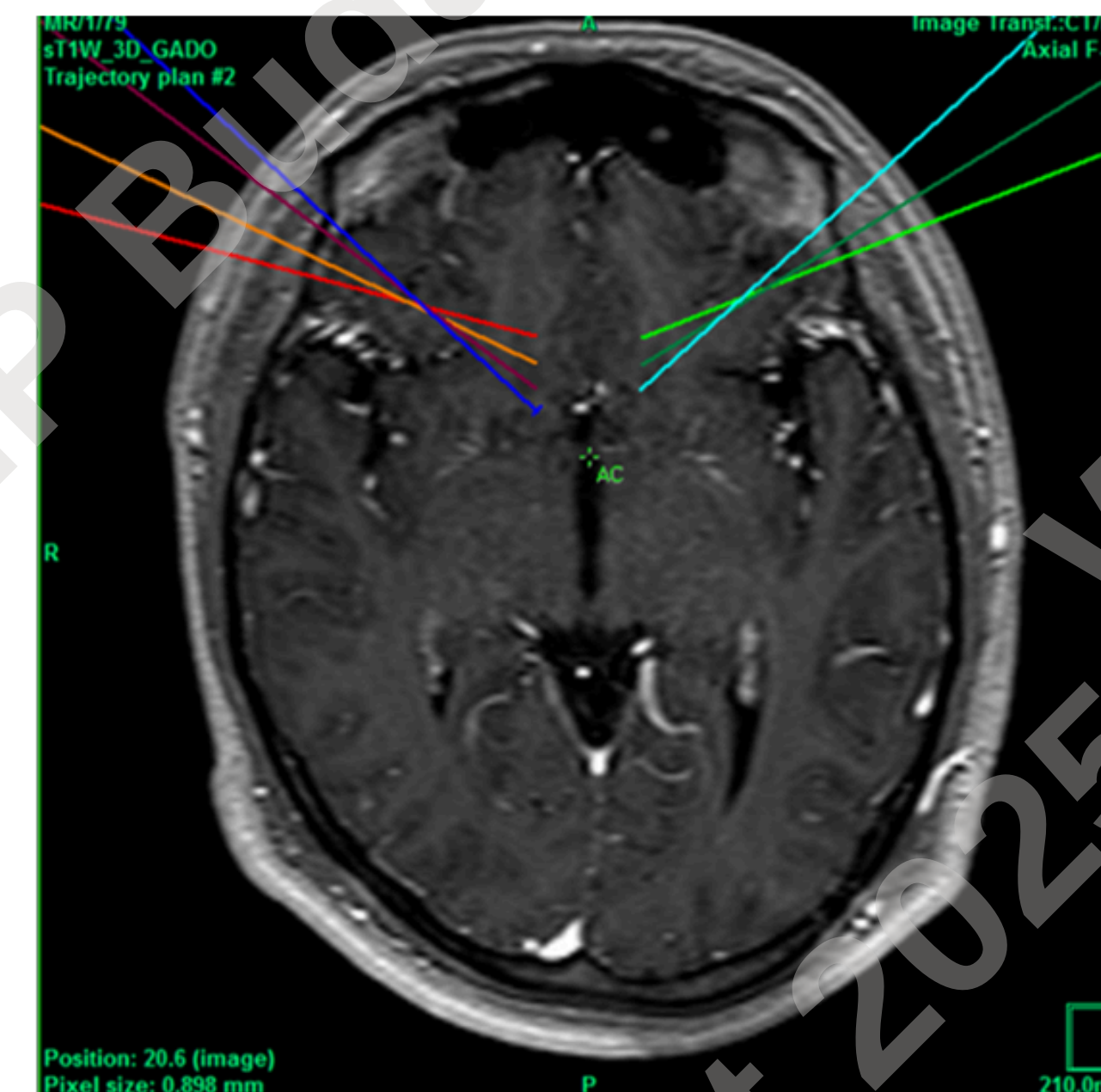
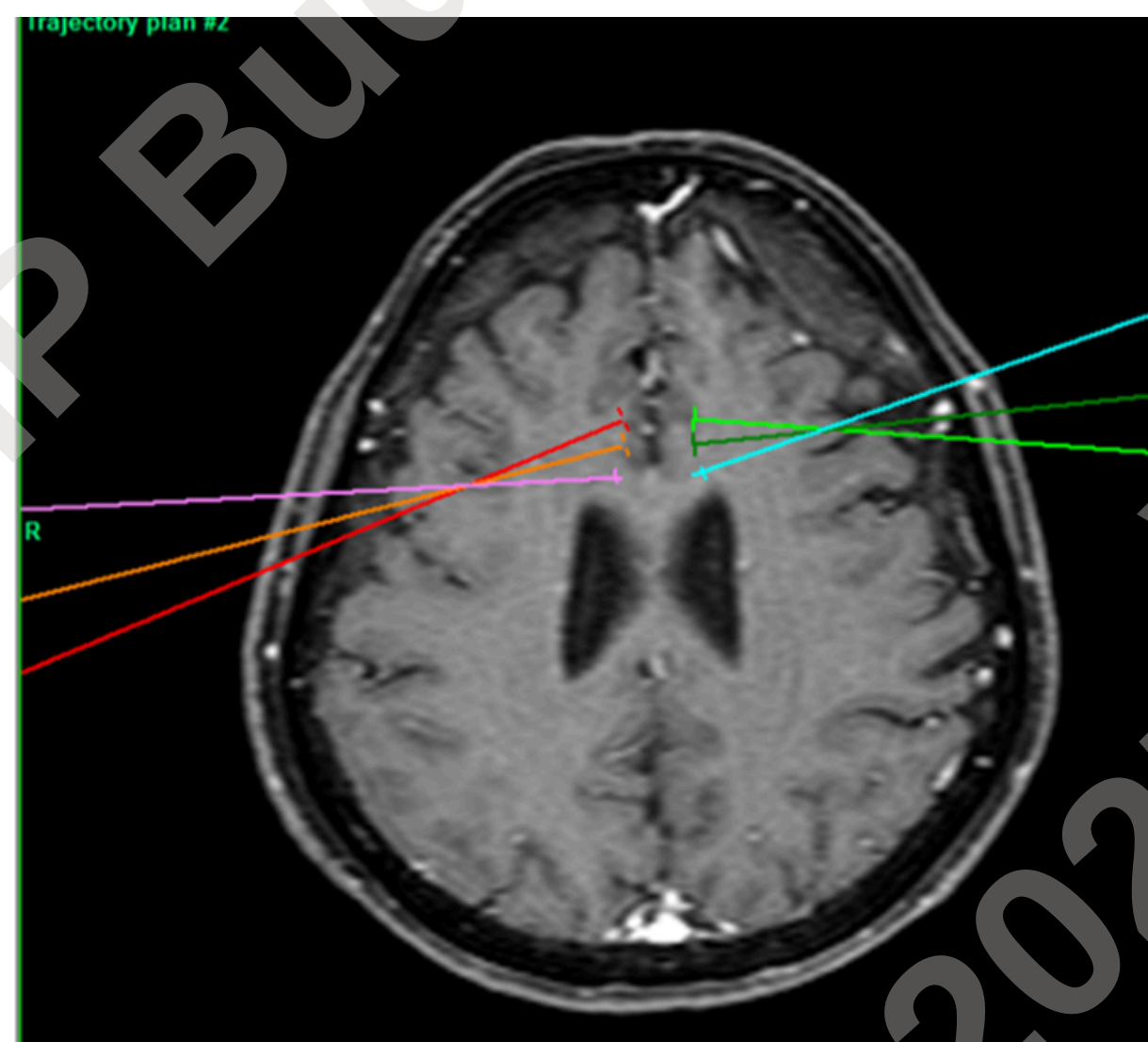
RADIOFREQUENCY ABLATIONS

Case Reports > Healthcare (Basel). 2023 Sep 22;11(19):2607.

doi: 10.3390/healthcare11192607.

Radiofrequency Cingulotomy as a Treatment for Incoercible Pain: Follow-Up for 6 Months

Carlos Castillo Rangel ¹, Gerardo Marin ², Dylan Lucia Diaz Chiguer ²,
Francisco Alberto Villegas López ³, Rodrigo Ramírez-Rodríguez ⁴, Alejandro Gómez Ibarra ²,
Rosalba Aguilar-Velazquez ⁴, Julian Eduardo Soto Abraham ³



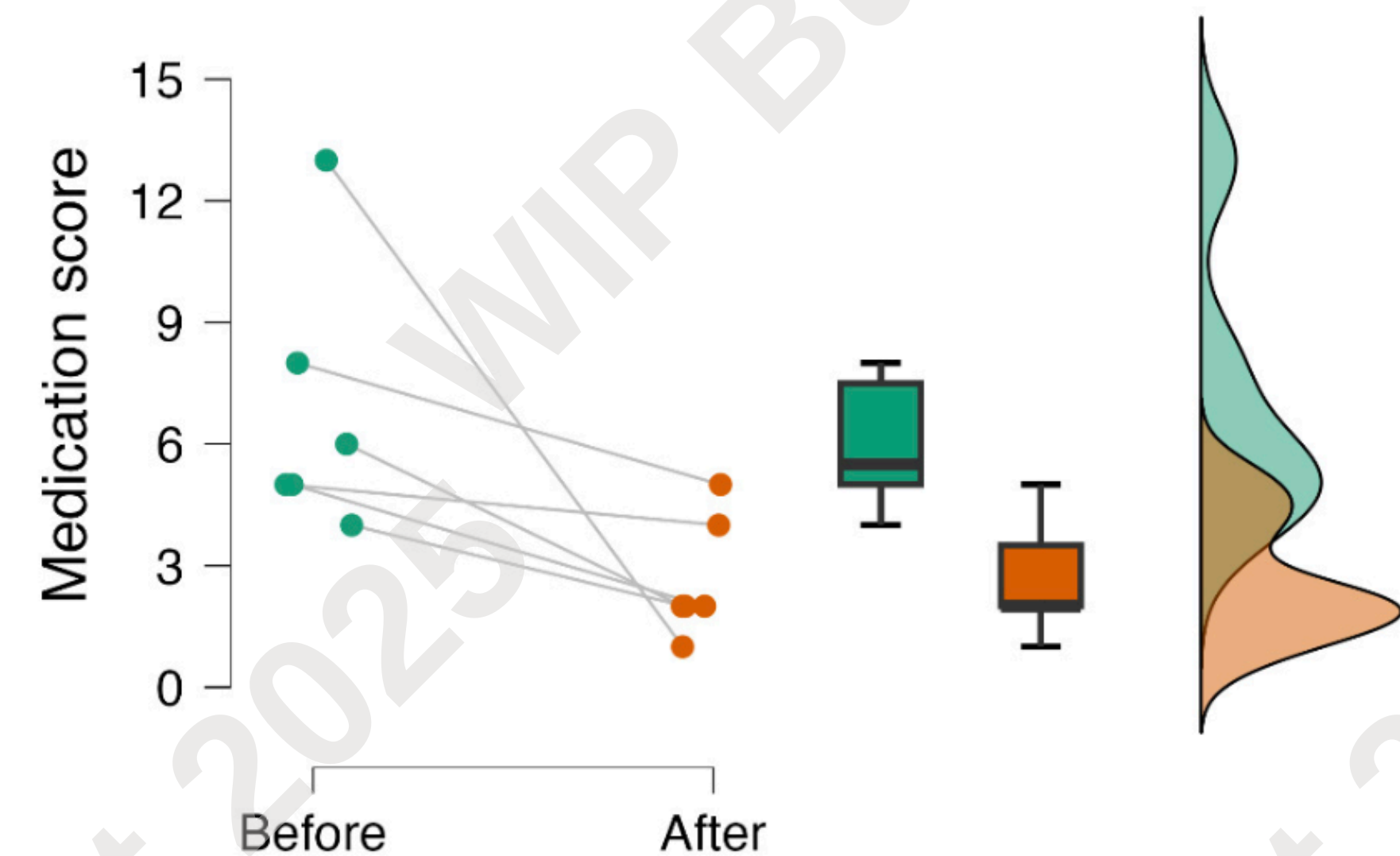
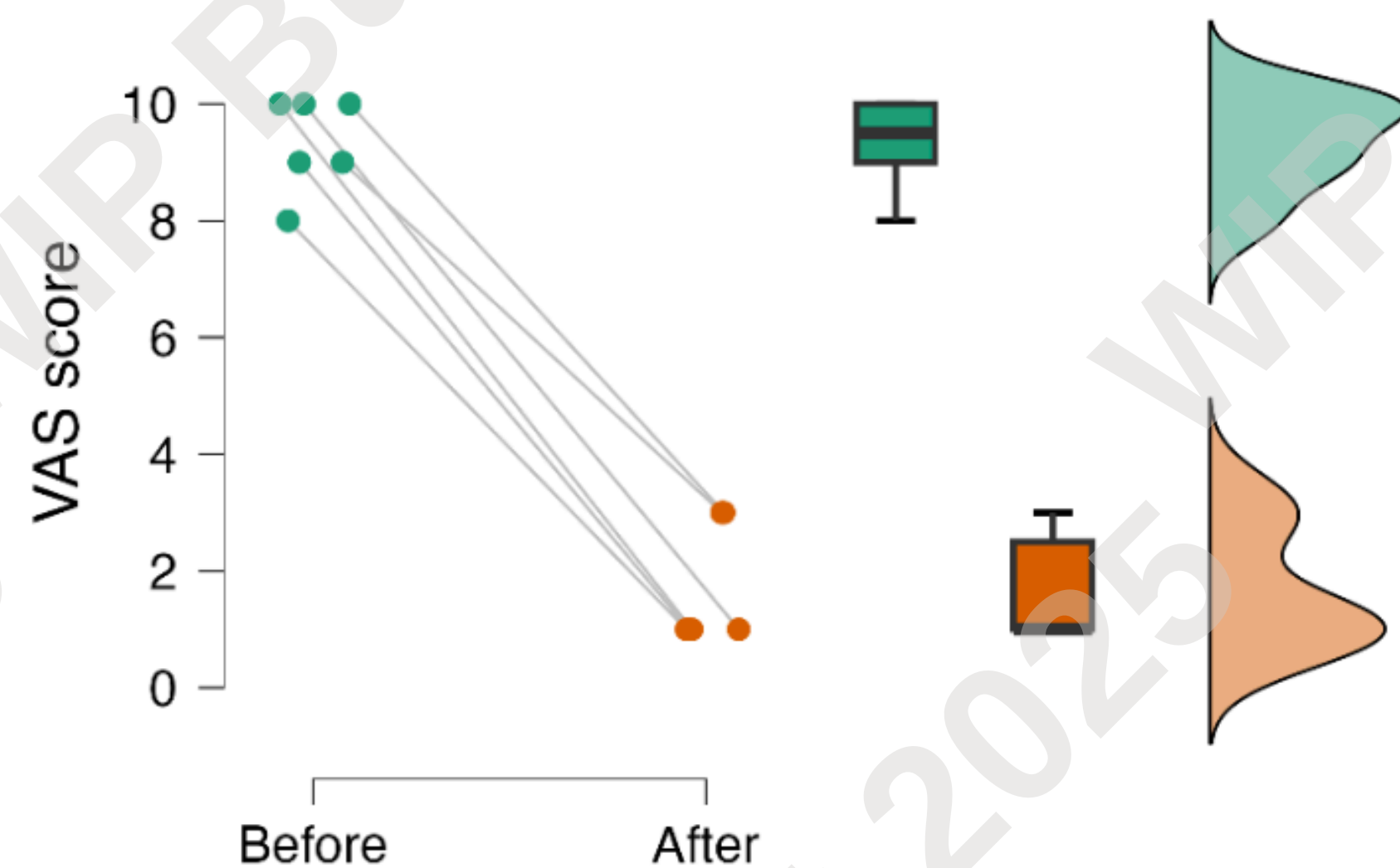


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> [World Neurosurg.](#) 2021 Jul;151:225-234.e6. doi: 10.1016/j.wneu.2021.04.075. Epub 2021 Apr 24.

Stereotactic Radiofrequency Thalamotomy for Cancer Pain: A Systematic Review

Ali Rezaei Haddad¹, James Hayley², Abteen Mostofi³, Matthew Brown⁴, Erlick Pereira³

- Thalamic targets: ventral posterior, central lateral, dorsomedial, centromedian, centromedian/parafascicular, centromedian and anterior pulvinar, pulvinar, limitans, suprageniculate and posterior nuclei
- 97% of patients experienced initial pain relief and 79% experienced significant lasting relief
- Adverse events: typically transient
- Radiofrequency thalamotomy for cancer pain is **well tolerated** and can produce **significant relief from intractable cancer pain**
- No superiority of thalamic target could be determined





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MIGHT EVEN BE AMBULATORY

MRI GUIDED AND CONTROLLED PROCEDURE

ALMOST INSTANT EFFECT

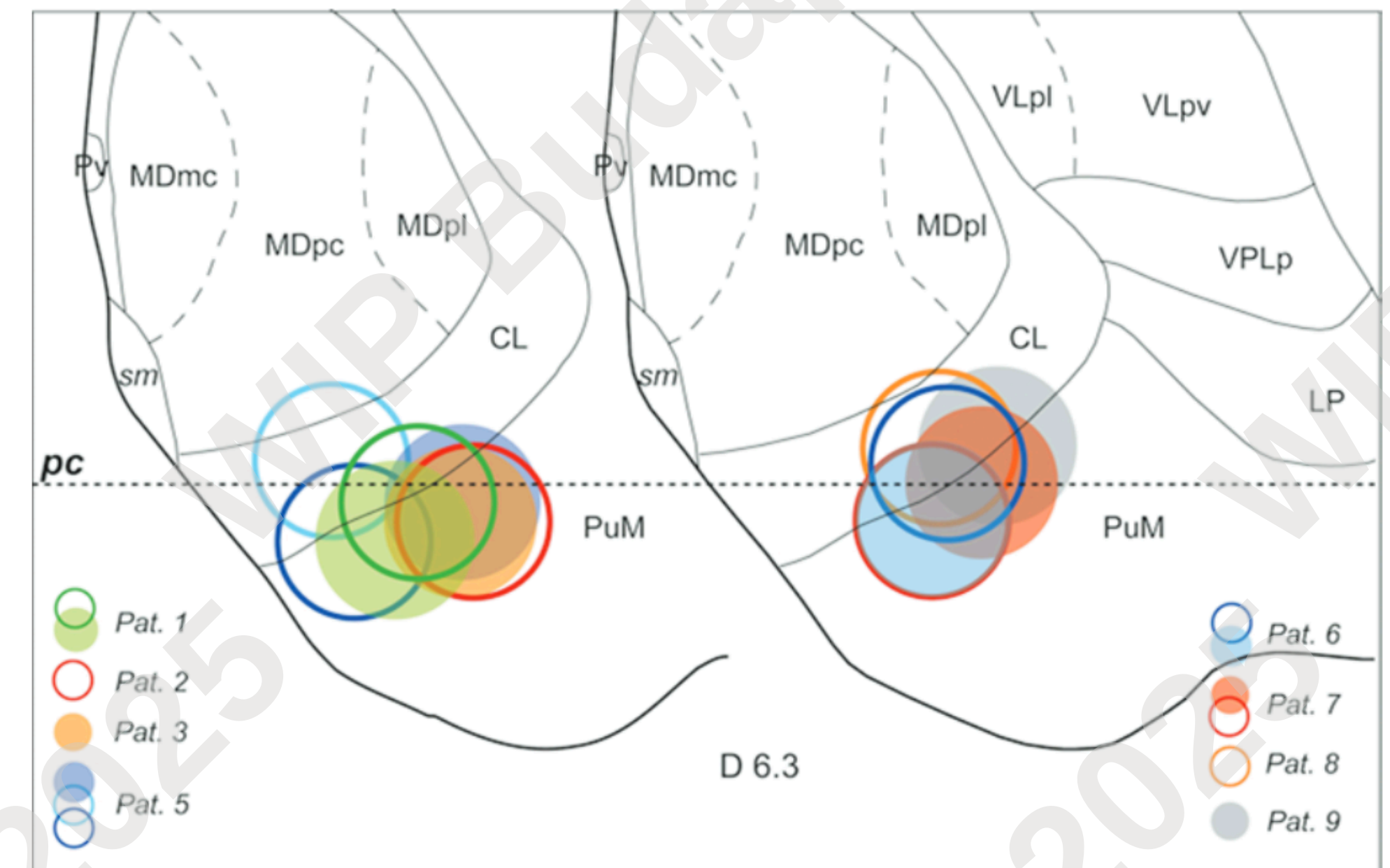
FOCUSED ULTRASOUND

> [Neurosurg Focus](#). 2012 Jan;32(1):E1. doi: 10.3171/2011.10.FOCUS11248.

Transcranial magnetic resonance imaging-guided focused ultrasound: noninvasive central lateral thalamotomy for chronic neuropathic pain

Daniel Jeanmonod¹, Beat Werner, Anne Morel, Lars Michels, Eyal Zadicario, Gilat Schiff, Ernst Martin

- 11 patients, chronic therapy-resistant neuropathic pain, tcMRgFUS CLT
- precisely localized thermal ablations of 3-4 mm in diameter in the posterior part of the central lateral thalamic nucleus
- peak temperatures between 51 ° C and 64 ° C
- Treated neuropathic pain syndromes: peripheral (5 patients) or central (6 patients) origins and covered all body parts (face, arm, leg, trunk, and hemibody)
- **Mean pain relief of 49% at the 3-month follow-up (9 patients), 57% at the 1-year follow-up (8 patients).**

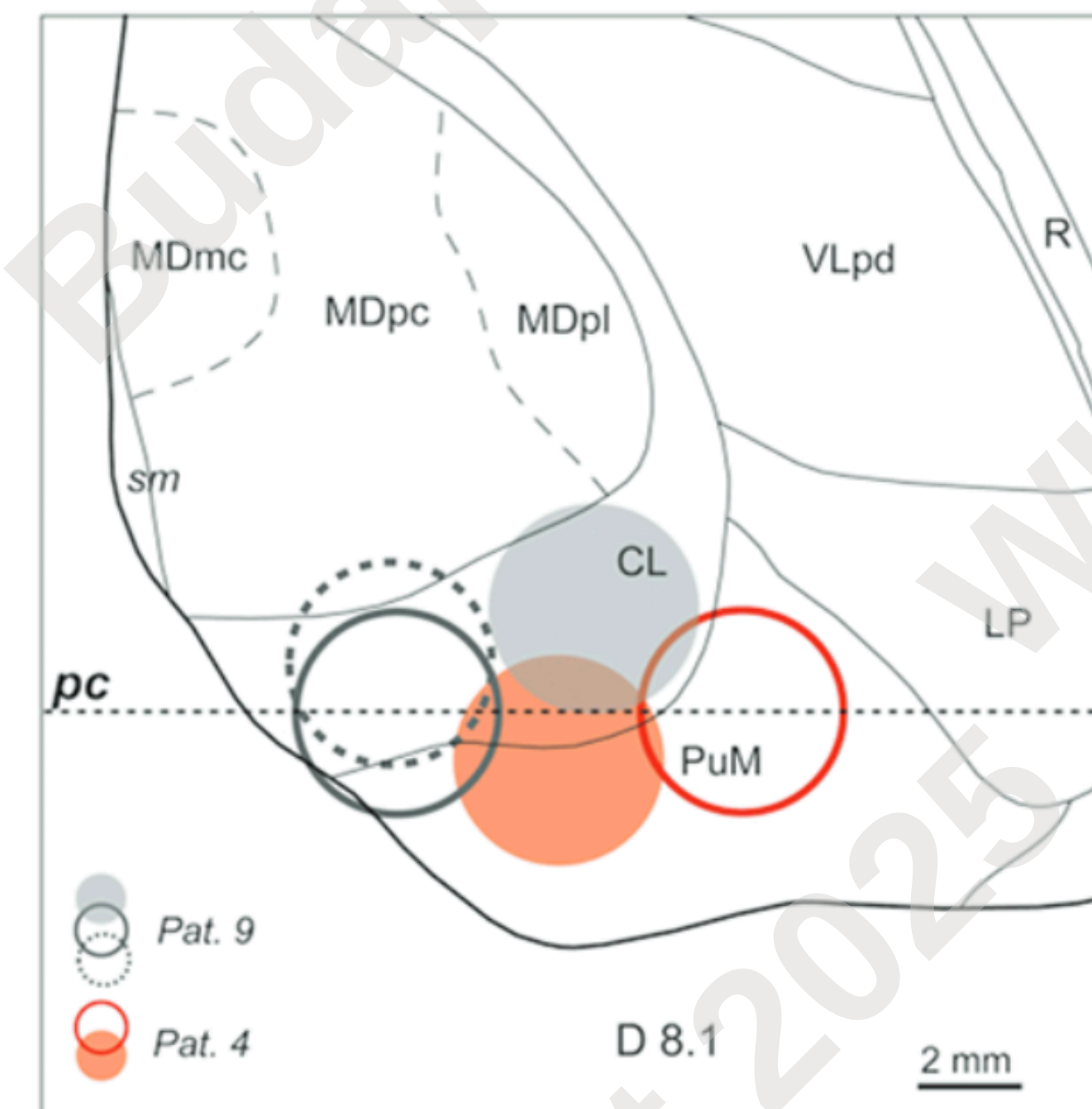
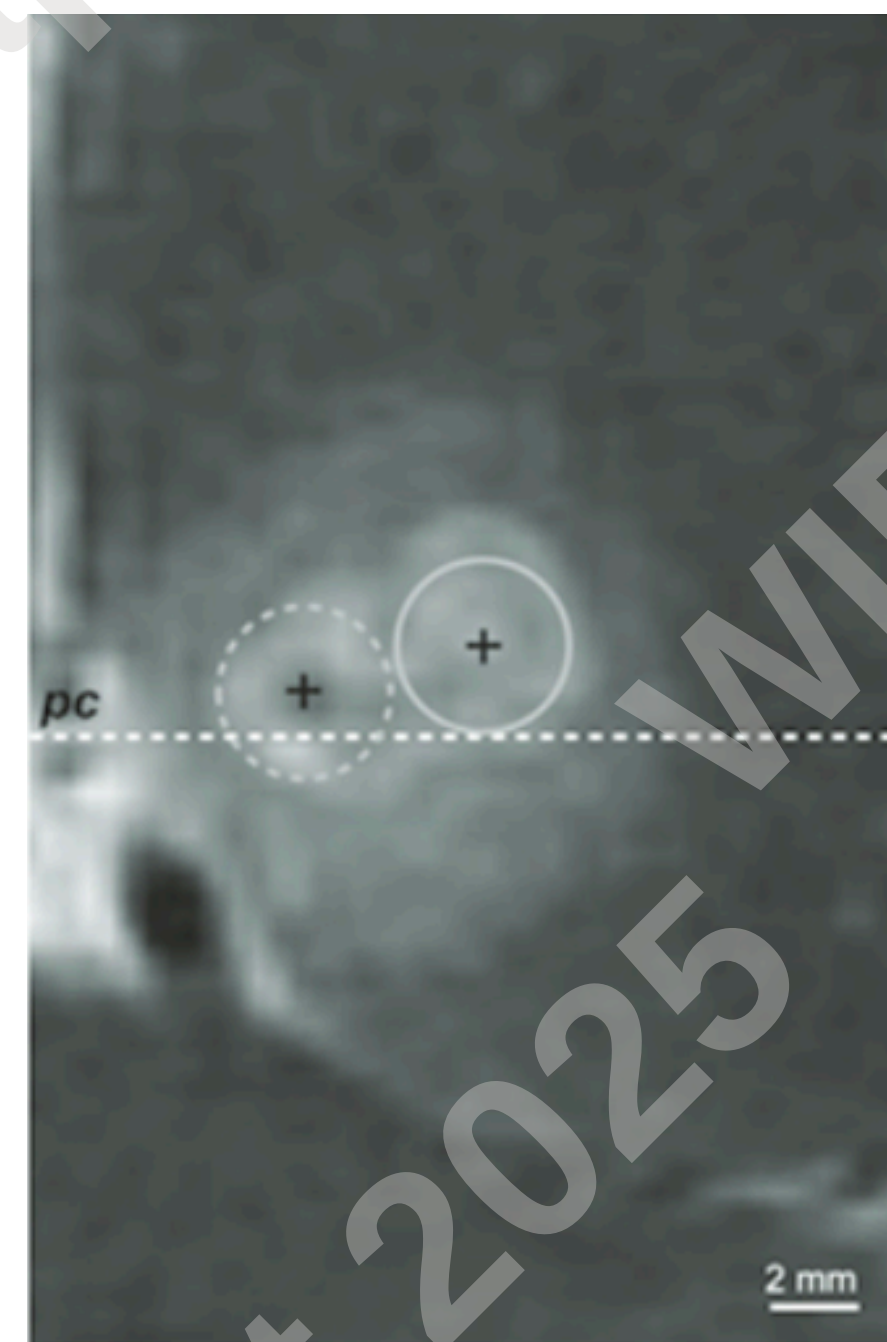


> [Neurosurg Focus](#). 2012 Jan;32(1):E1. doi: 10.3171/2011.10.FOCUS11248.

Transcranial magnetic resonance imaging-guided focused ultrasound: noninvasive central lateral thalamotomy for chronic neuropathic pain

Daniel Jeanmonod¹, Beat Werner, Anne Morel, Lars Michels, Eyal Zadicario, Gilat Schiff,
Ernst Martin

- Six patients: immediate and persisting somatosensory improvements
- Quantitative electroencephalography (EEG): significant reduction in EEG spectral overactivities
- Targeting precision within a millimeter for all 3 coordinates
- 1 complication: a bleed in the target with ischemia in the motor thalamus





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Idegsebészeti és Neurointervenciók Klinika

med. habil. Dr. Erőss Loránd PhD,
klinikaigazgató



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CRANIOTOMY



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MICROVASCULAR DECOMPRESSION

CLASSIC TRIGEMINAL NEURALGIA

NEUROVASCULAR ORIGIN

75,5% SCA

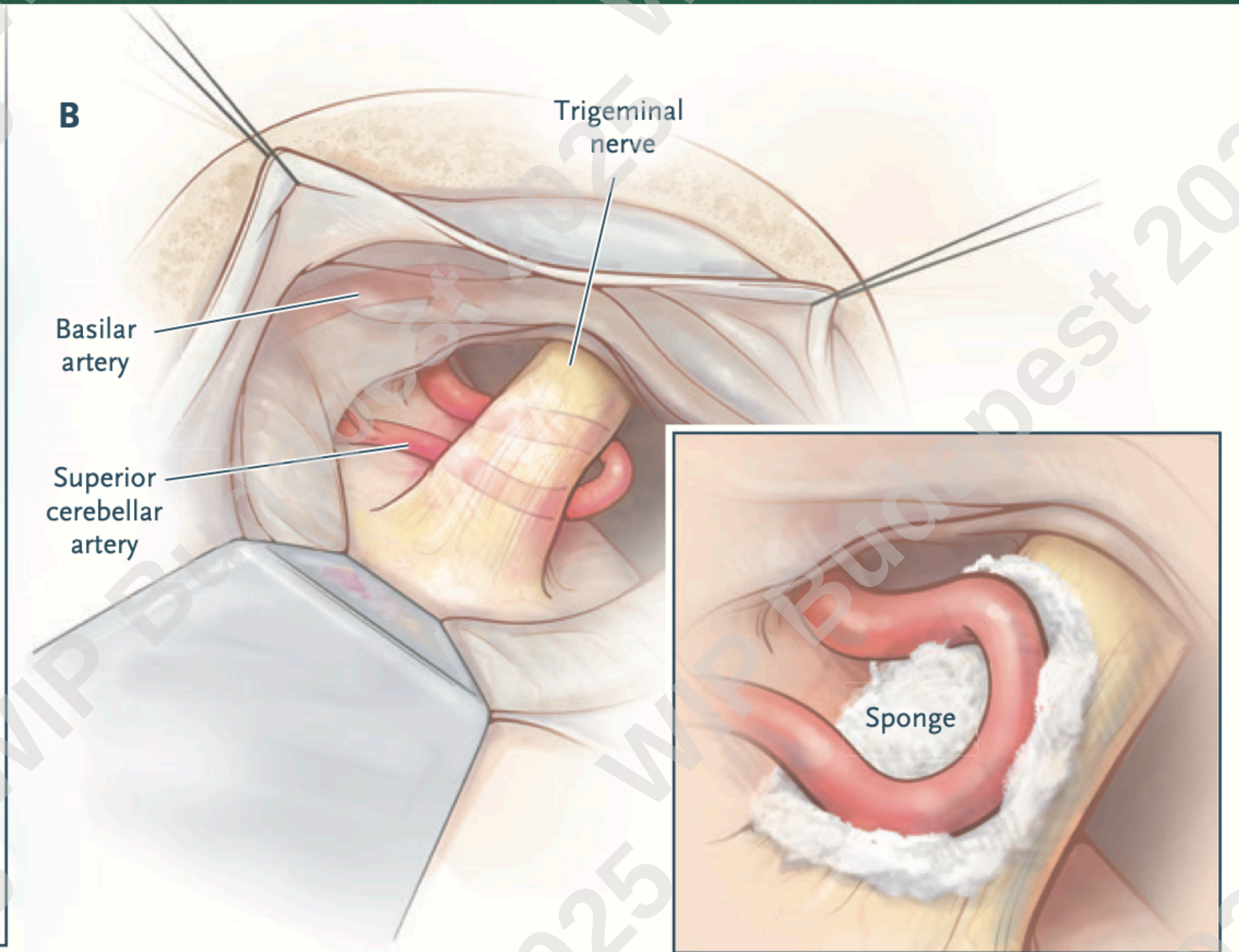
LOWER CHANCE OF AN ONSET OF A
SENSORY DEFICIT THAN ABLATIVE
PROCEDURES

Cruccu G, Di Stefano G, Truini A. Trigeminal
Neuralgia. N Engl J Med. 2020 Aug
20;383(8):754-762. doi: 10.1056/NEJMra1914484.





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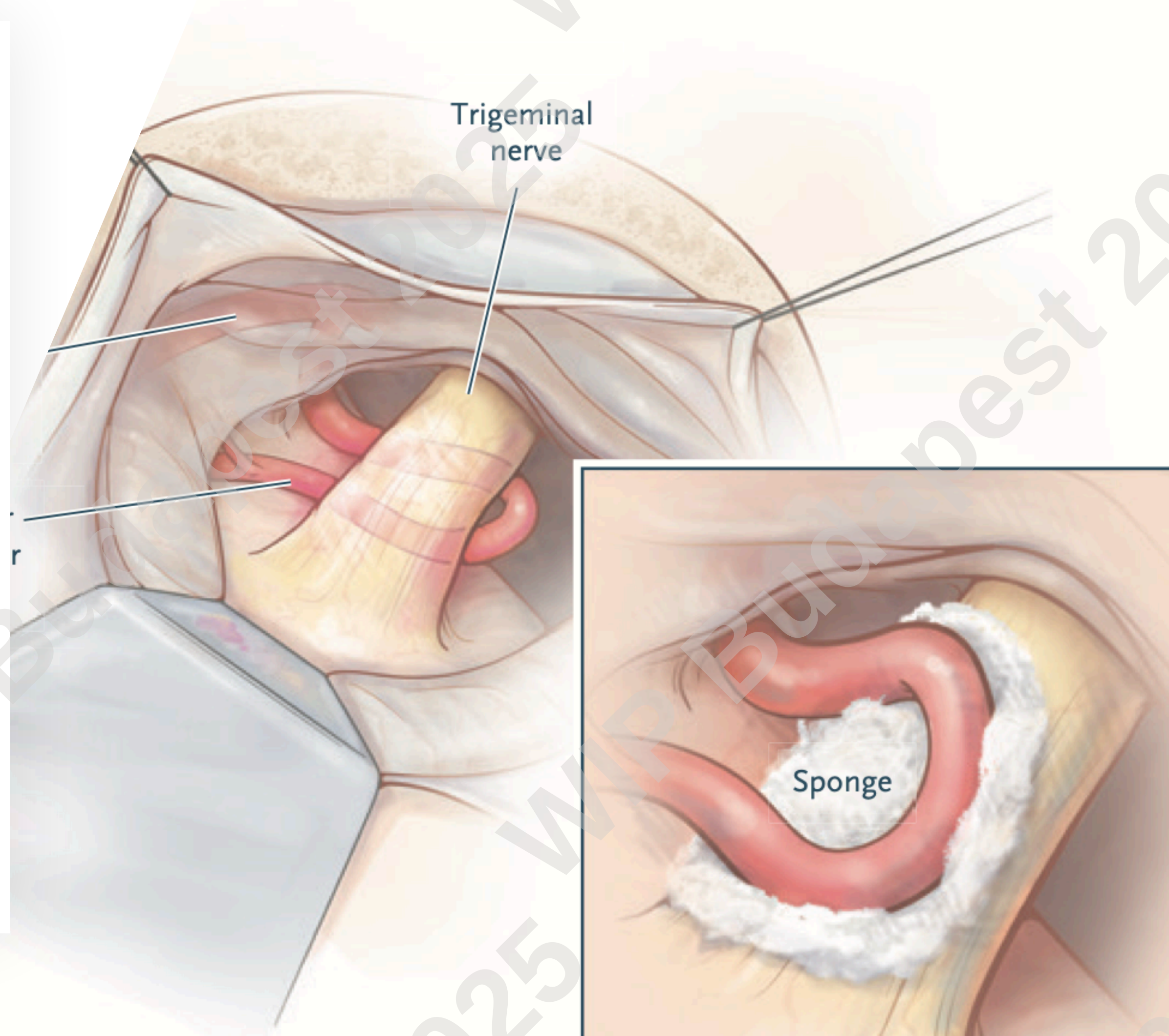


MICROVASCULAR DECOMPRESSION

1 TO 2 YEARS 68-88% OF PATIENTS
HAVE PAIN RELIEF

4 TO 5 YEARS
61-80% HAVE PAIN RELIEF

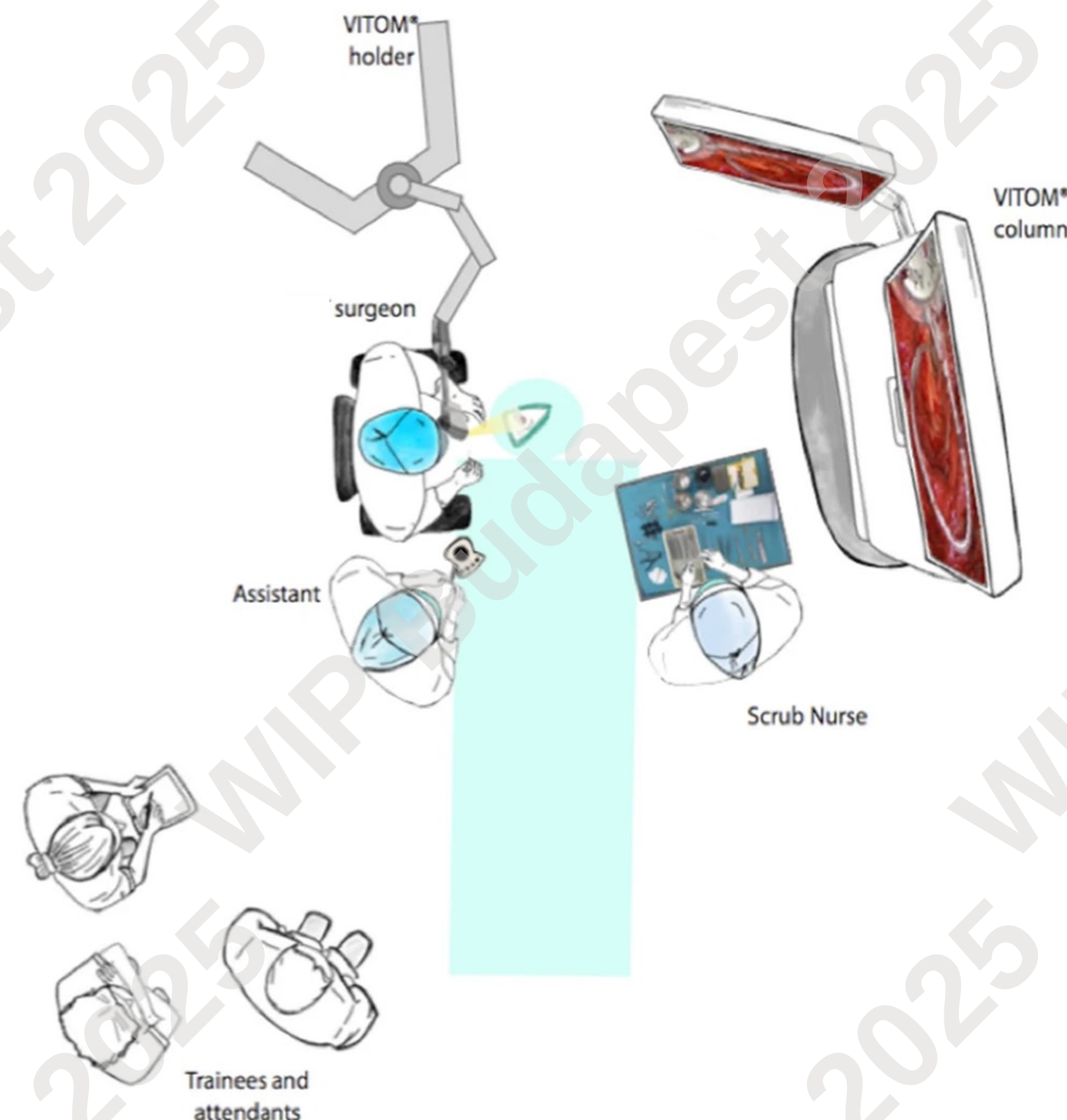
Cruccu G, Di Stefano G, Truini A. Trigeminal
Neuralgia. N Engl J Med. 2020 Aug
20;383(8):754-762. doi: 10.1056/NEJMra1914484.



EXOSCOPE

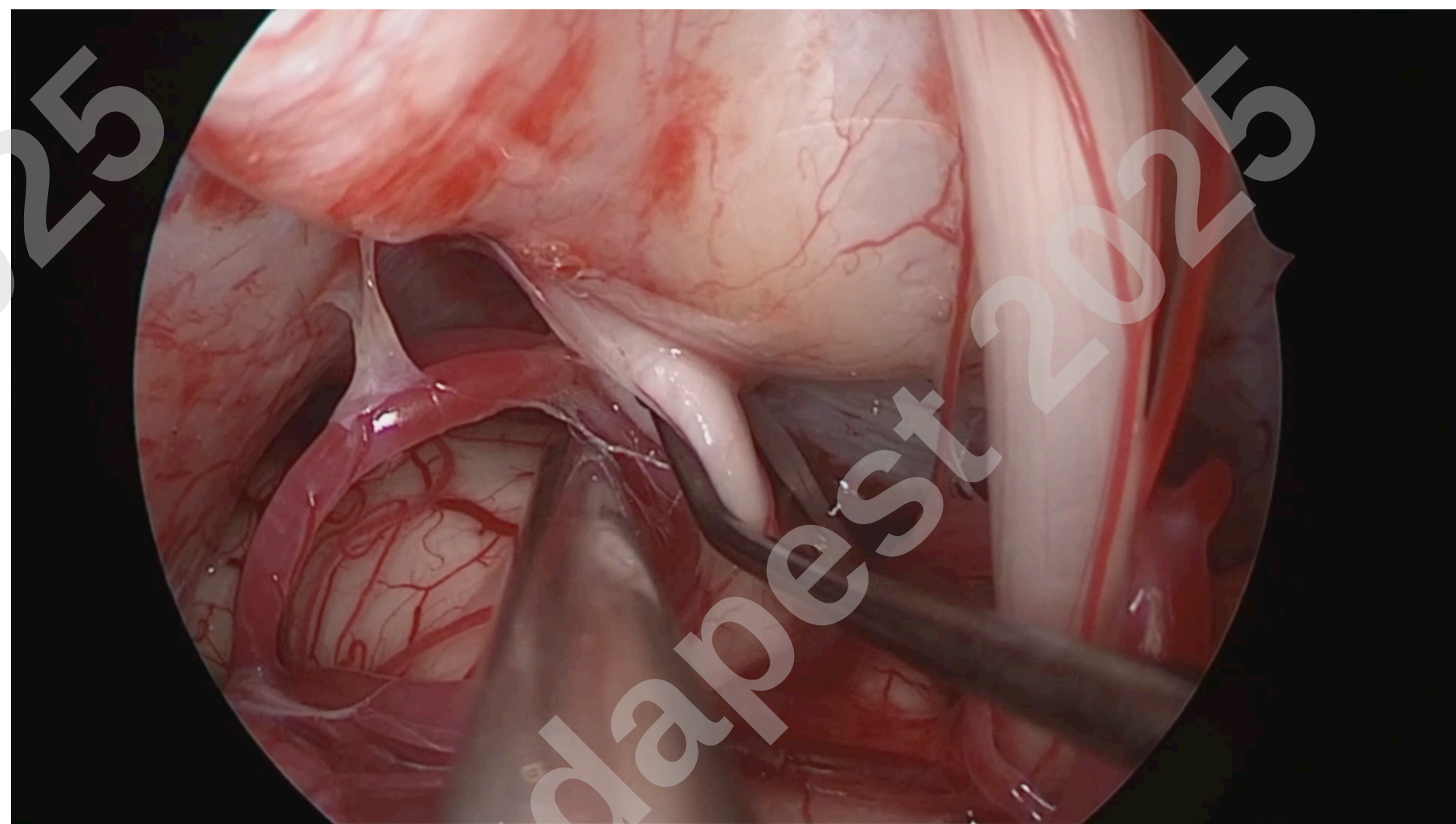
(Montemurro et al. 2022)

- Digital 3D imaging system
- 3D glasses and monitor » Provides high magnification to visualize critical vascular or neural structures
- Use cases: brain tumor surgery, skull base surgery, aneurysms, vascular pathologies, cervical and lumbar spine surgery
- 5-aminolevulinic-acid (5-ALA) and indocyanine video-angiography





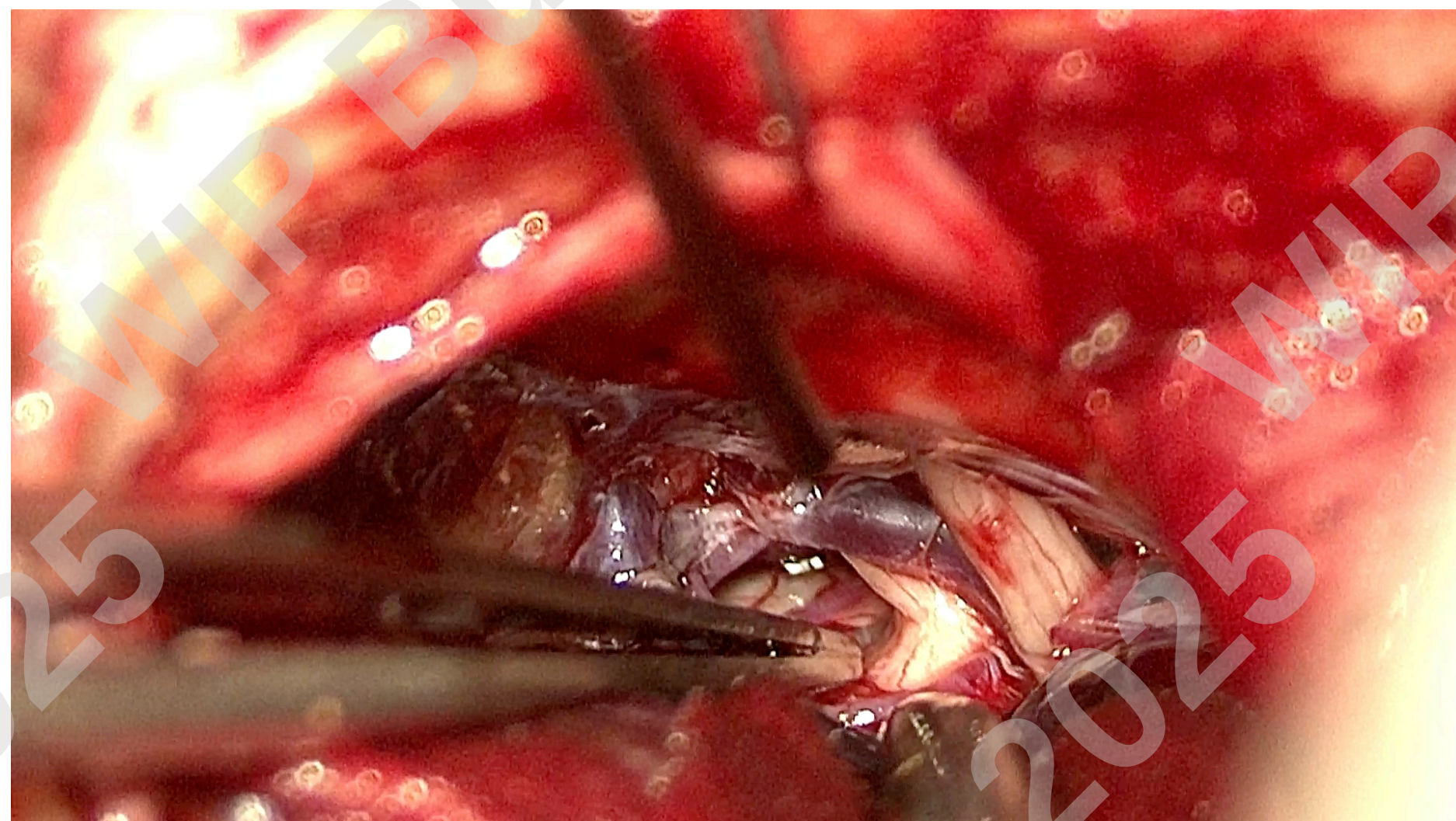
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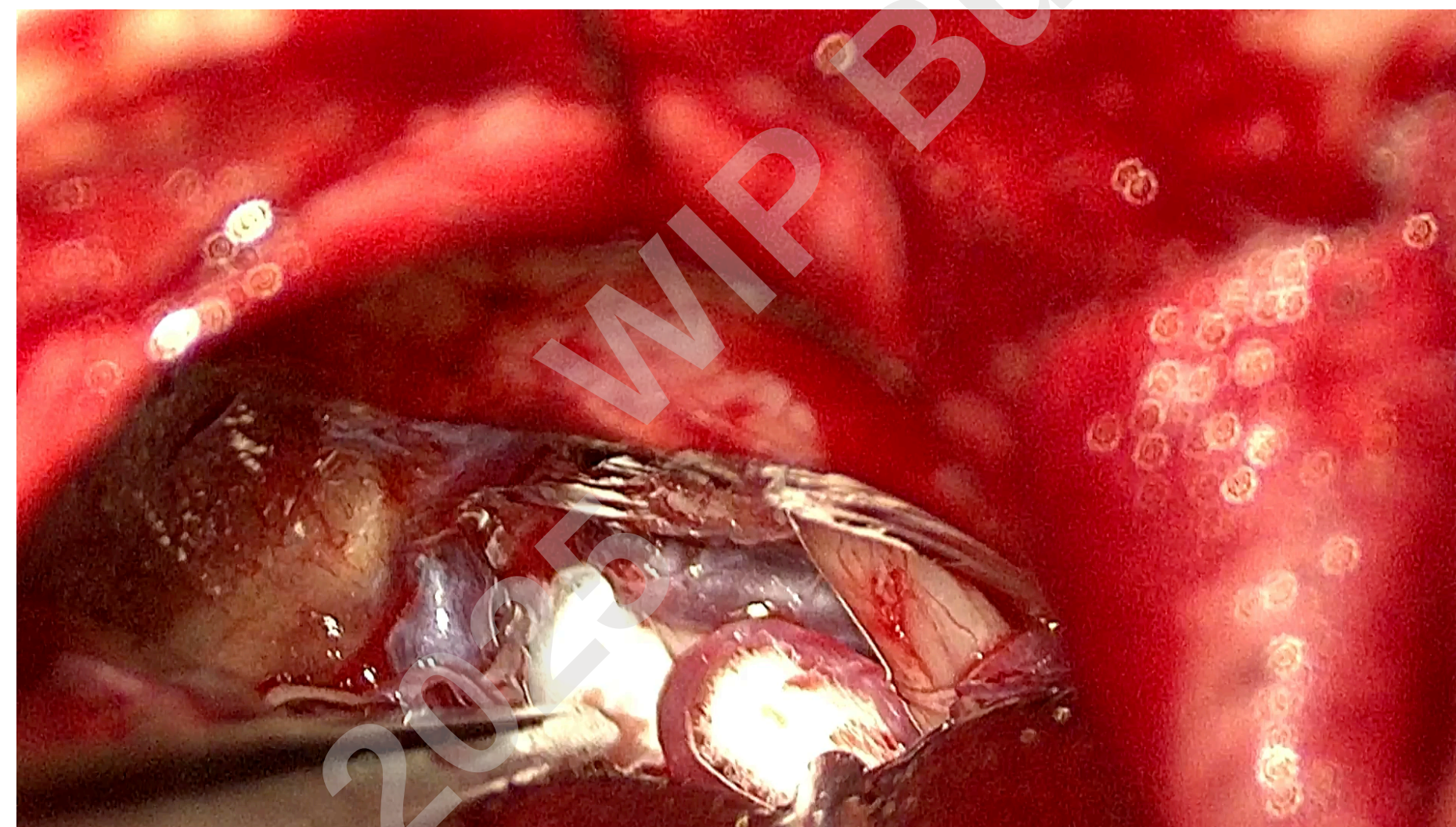
Endoscope



Microscope



Exoscope



Exoscope



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Microscope



Exoscope



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IN THE TREATMENT OF PAIN SYNDROMES

NEUROMODULATION



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MOTOR CORTEX STIMULATION

TSUBOKAWA 1991 CENTRAL DEAFERENTATION
PAIN

N'GUYEN 1997, DEVELOPED THE TECHNIQUE

800 PUBLISHED CASE SINCE 1991

NO DOUBLE BLIND CONTROLLED STUDY

„A MULTICENTRIC, PROSPECTIVE, RANDOMIZED,
DOUBLE BLIND STUDY IS REQUIRED”

(12 EUROPIAN CENTER, 104 PATIENT, 2,5 YEARS)
FAILED



Review

> [Neurol India](#). 2020 Nov-Dec;68(Supplement):S235-S240.

doi: 10.4103/0028-3886.302471.

Deep Brain Stimulation and Motor Cortex Stimulation for Chronic Pain

Patrick Senatus¹, Sarah Zurek¹, Milind Deogaonkar²

Affiliations + expand

PMID: 33318357 DOI: [10.4103/0028-3886.302471](#)

- *Motor cortex stimulation could provide pain relief in*
 - Any neuropathic or deafferentation pain
 - anesthesia dolorosa
 - post-treatment deafferentation face pain
 - post-stroke pain





RESULTS

MOTOR CORTEX STIMULATION

CENTRAL PAIN 80%

TRIGEMINAL NEUROPATHIC PAIN 75,7%

BRACHIAL PLEXUS AVULSION 34%

PHANTOM LIMB PAIN 53%

N'GUYEN 2005

fMRI + navigation

navigation

anatomy alone

VAS reduction

69,2% (2005)

30,7%

12,5% (1991)



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DEEP BRAIN STIMULATION



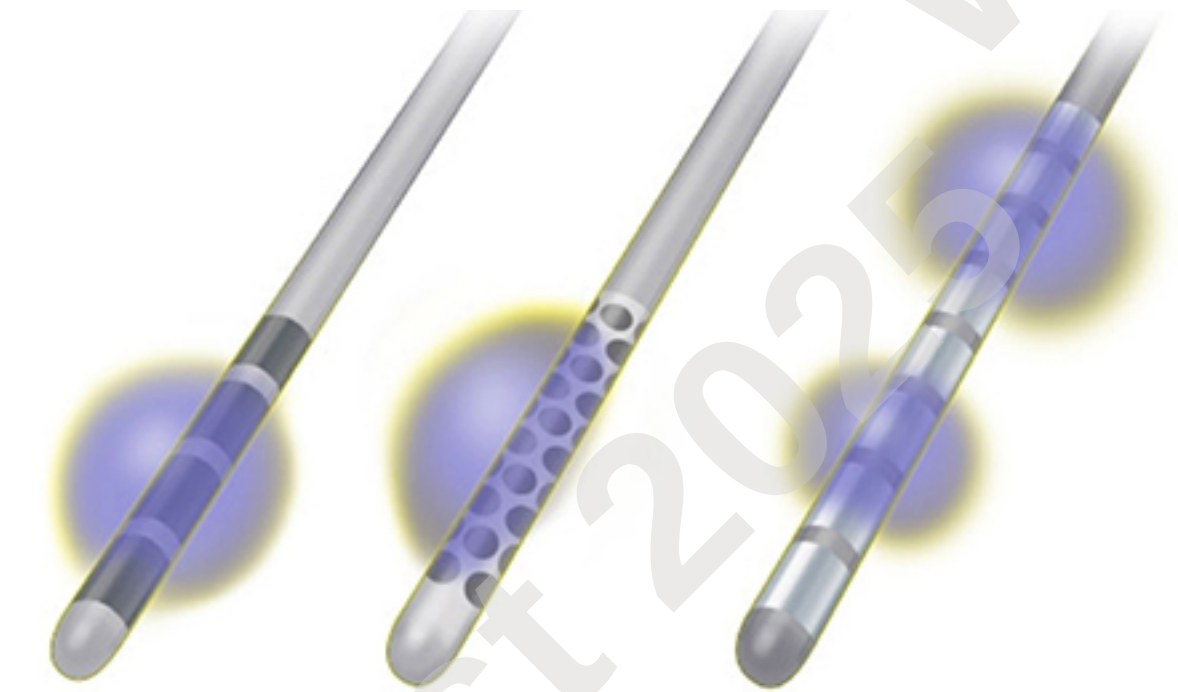
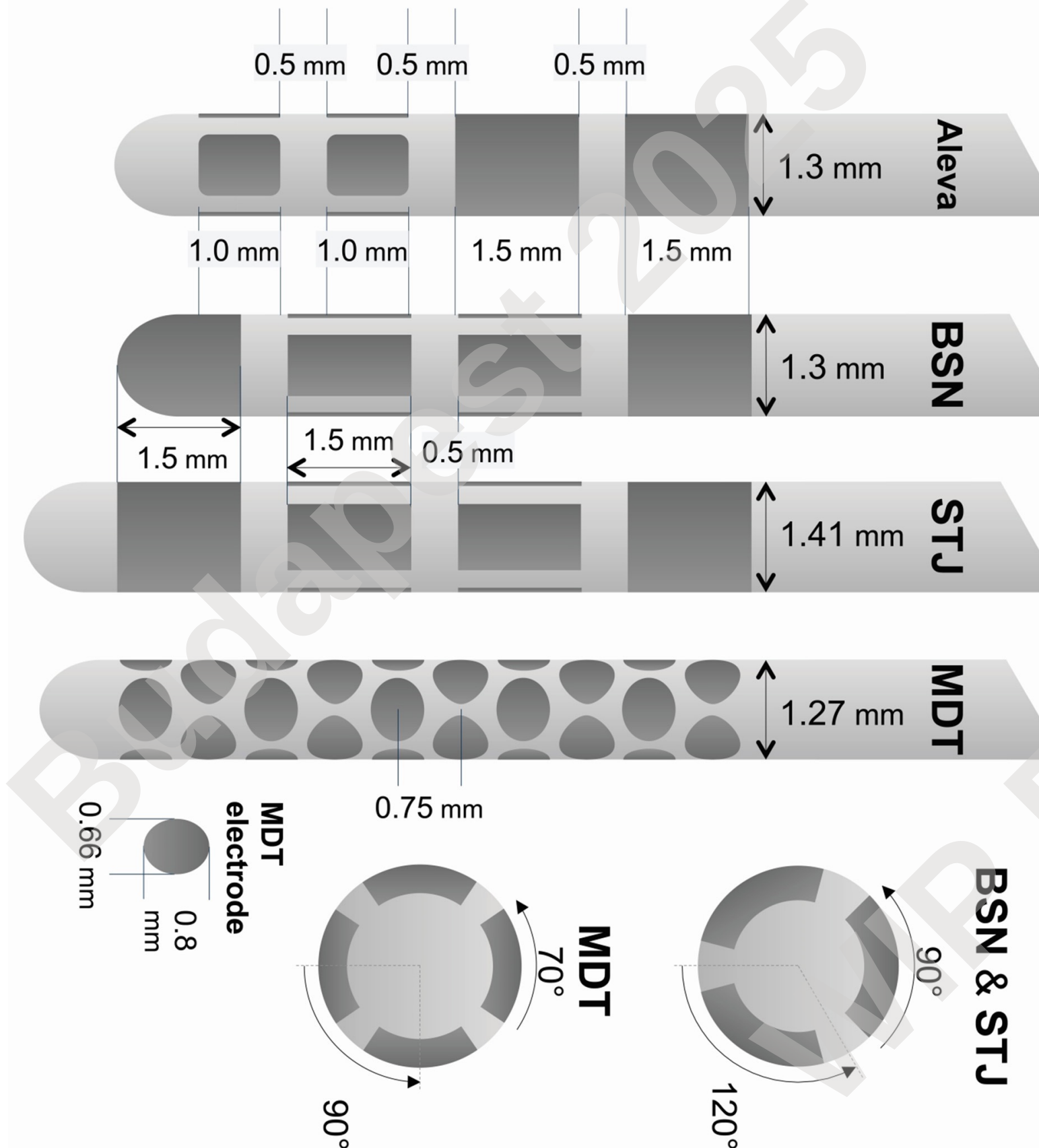
DBS IN CHRONIC PAIN



	Case	Initial success	Long-term success	Ratio
Phantom limb pain	9	7	4	44%
Post-stroke pain	45	24	14	31%
FBSS	59	54	46	78%
Peripheral nerve injury	44	36	31	70%
Post-herpetic neuralgia	11	6	4	36%
Intercostal neuralgia	4	3	1	25%
Brachial plexus avulsion	12	9	6	50%
Facial pain	32	21	12	38%
Central medullary pain	47	28	20	43%



TECHNOLOGICAL ADVANCEMENTS IN DBS



- Current steering with directional electrodes (Pollo et al Brain 2014)
- Dual stimulation in different target structures in the brain (Sims-Williams et al. 2013 Streotact Funct Neurosurgery)



Review > [Neurol India](#). 2020 Nov-Dec;68(Supplement):S235-S240.

doi: 10.4103/0028-3886.302471.

Deep Brain Stimulation and Motor Cortex Stimulation for Chronic Pain

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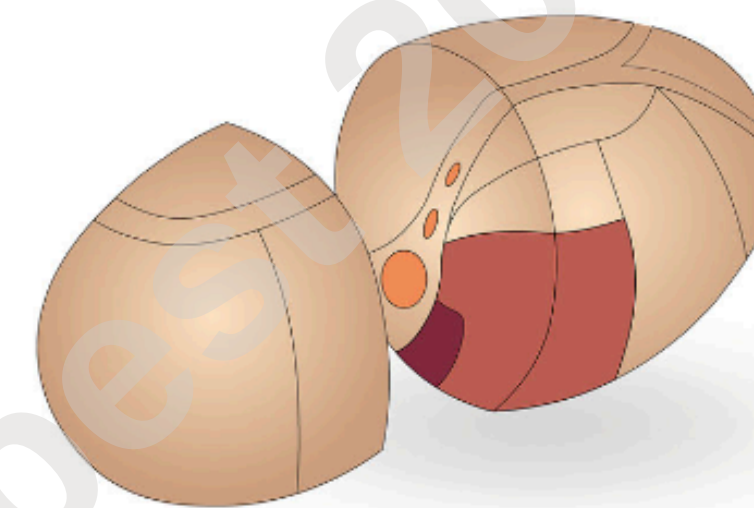
Affiliations + expand

PMID: 33318357 DOI: [10.4103/0028-3886.302471](#)

- Deep brain stimulation targets:

- **Sensory thalamus**, nucleus ventralis caudalis (VC) or ventral posterolateral (VPL) and ventral posteromedial (VPM) - **NEUROPATHIC PAIN SYNDROMES**
- **Centro-lateral (CL) and Centro-medial parafascularis (CM-Pf) complex** - **ALTERATION TO PAIN AWARENESS AND AFFECT**
- **PVG/PAG area** - **NOCICEPTIVE PAIN**
- **Nucleus accumbence (NAcc), Ventral capsule-Ventral striatum (VC-VS)** - **LARGE AFFECTIVE BURDEN ASSOCIATED WITH PAIN**
- **Posterior hypothalamus** - **INTRACTABLE CLUSTER HEADACHES, NEUROPATHIC FACE PAIN, SHORT-LASTING TRIGEMINAL AUTONOMIC CEPHALALGIA (SUNCT)**

Thalamic nuclei



- Nucleus Ventromedialis (VPM)
- Nucleus Ventrolateralis (VPL)
- Centrum-Median and Parafascicular Nucleus (CmPf)

Review > Pain Ther. 2022 Jun;11(2):459-476. doi: 10.1007/s40122-022-00381-1.

Epub 2022 Apr 26.

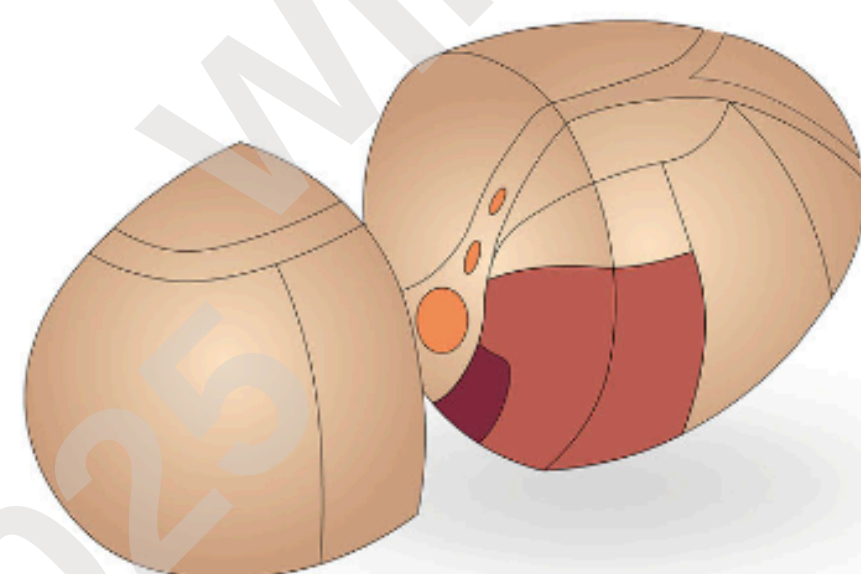
Deep Brain Stimulation, Stereotactic Radiosurgery and High-Intensity Focused Ultrasound Targeting the Limbic Pain Matrix: A Comprehensive Review

Martin Nüssel ^{# 1}, Yining Zhao ^{# 1}, Constantin Knorr ², Martin Regensburger ³,
Andreas Stadlbauer ⁴, Michael Buchfelder ¹, Alessandro Del Vecchio ⁵, Thomas Kinfe ⁶

Affiliations + expand

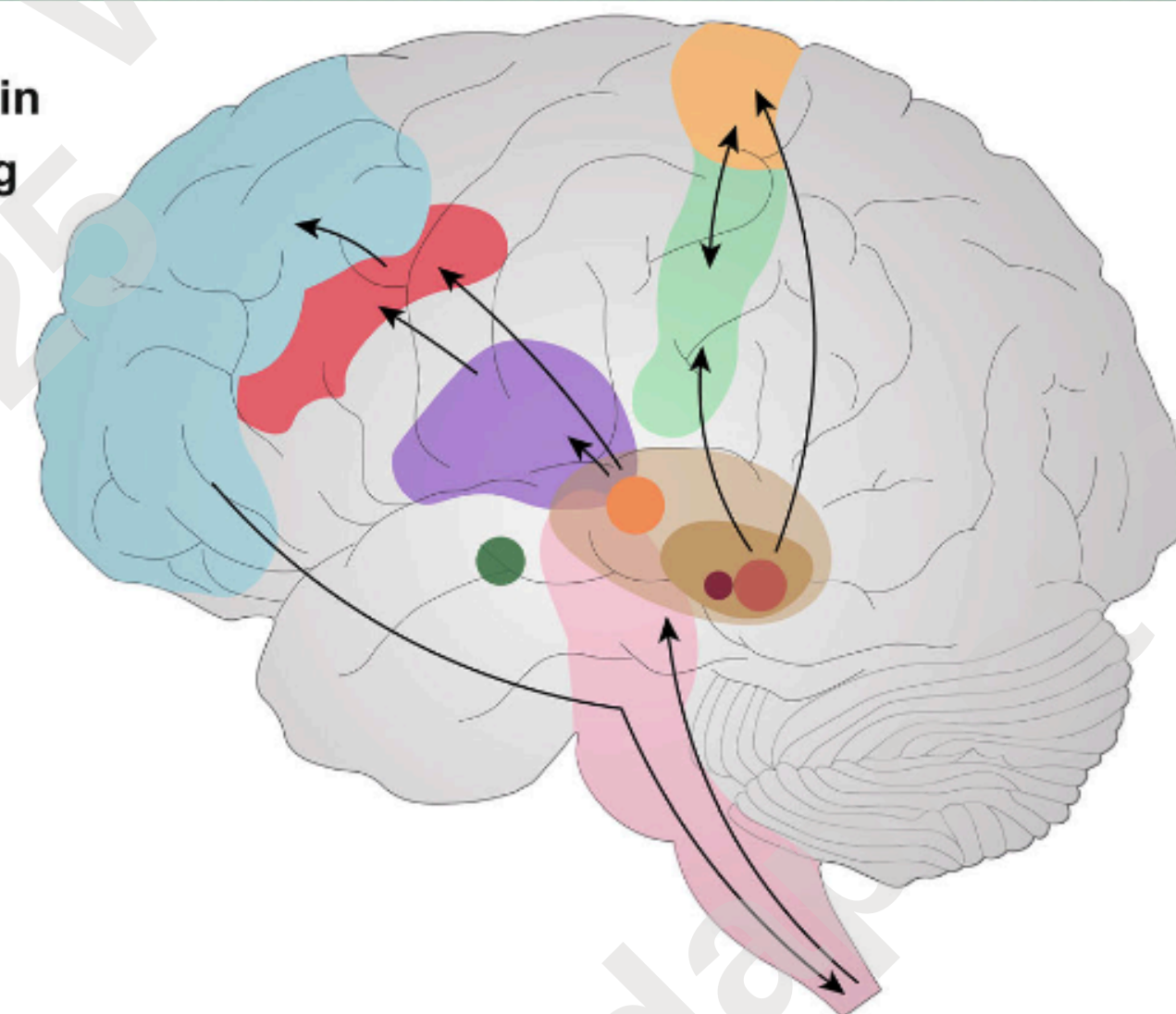
PMID: 35471626 PMCID: [PMC9098763](#) DOI: [10.1007/s40122-022-00381-1](#)

Thalamic nuclei



- Nucleus Ventromedialis (VPM)
- Nucleus Ventrolateralis (VPL)
- Centrum-Median and Parafascicular Nucleus (CmPf)

Affective pain processing



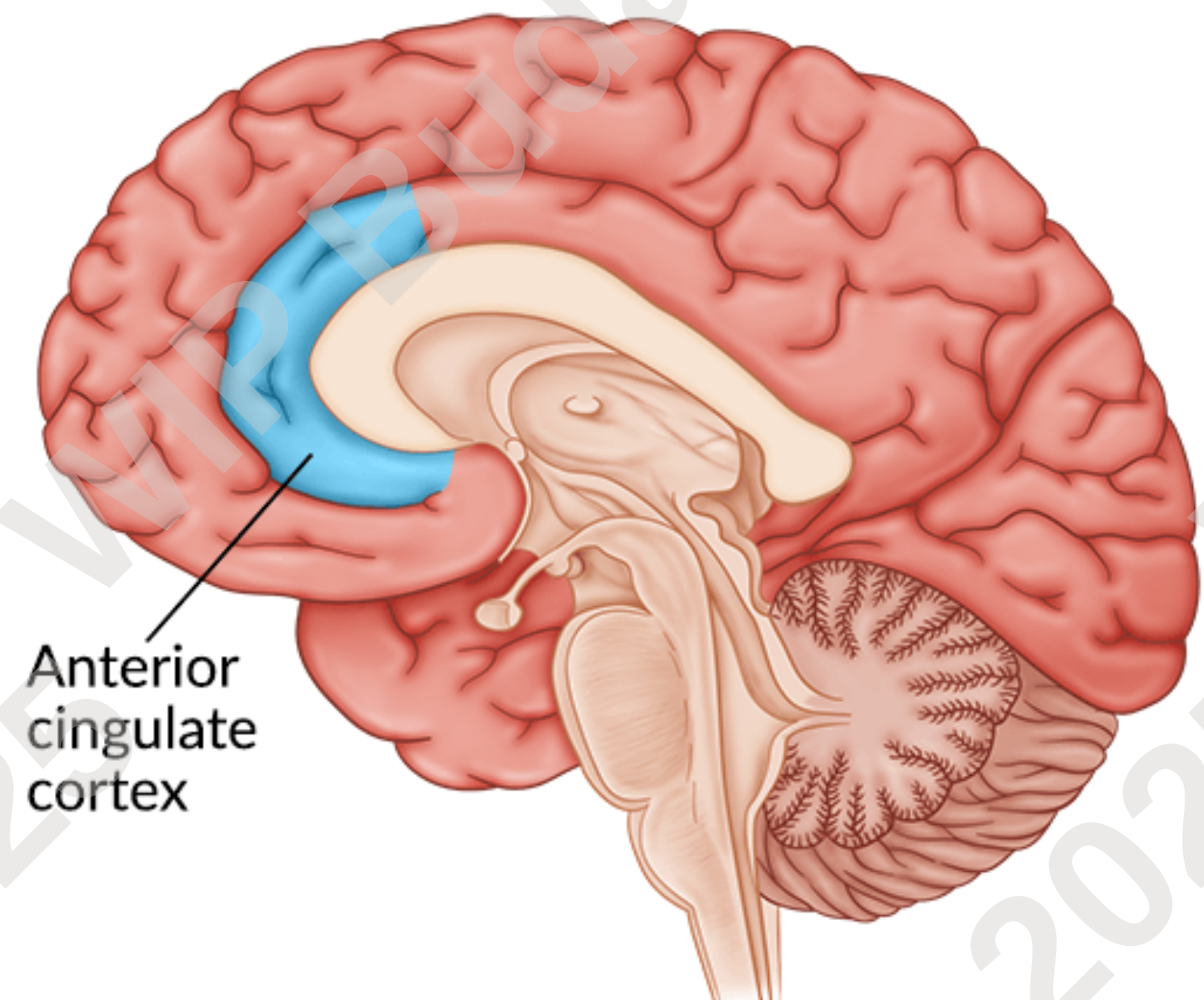
Types of intervention	VPM	VPL	CmPf	CLT	VS/ALIC	ACC	PFC	S1	S2	Brainstem	Insula	References
DBS	●	●	●		●	●						Abdallat et al. 2021 Ten Brinke et al. 2020 Levi et al. 2019 Lempka et al. 2017 Boccard et al. 2017
SRS	●	●										Lovo et al. 2022 / 2019 Franzini et al. 2020 Urgosik et al. 2018 Young et al. 1994 / 1995 Steiner et al. 1980
MRgFUS		●		●								Gallay et al. 2020 Jeanmonod et al. 2012 Martin et al. 2009

> [World Neurosurg.](#) 2017 Oct;106:625-637. doi: 10.1016/j.wneu.2017.06.173. Epub 2017 Jul 11.

Long-Term Results of Deep Brain Stimulation of the Anterior Cingulate Cortex for Neuropathic Pain

Sandra G J Boccard¹, Simon J Prangnell², Laurie Pycroft³, Binith Cheeran³, Liz Moir³,
Erlick A C Pereira⁴, James J Fitzgerald³, Alexander L Green³, Tipu Z Aziz³

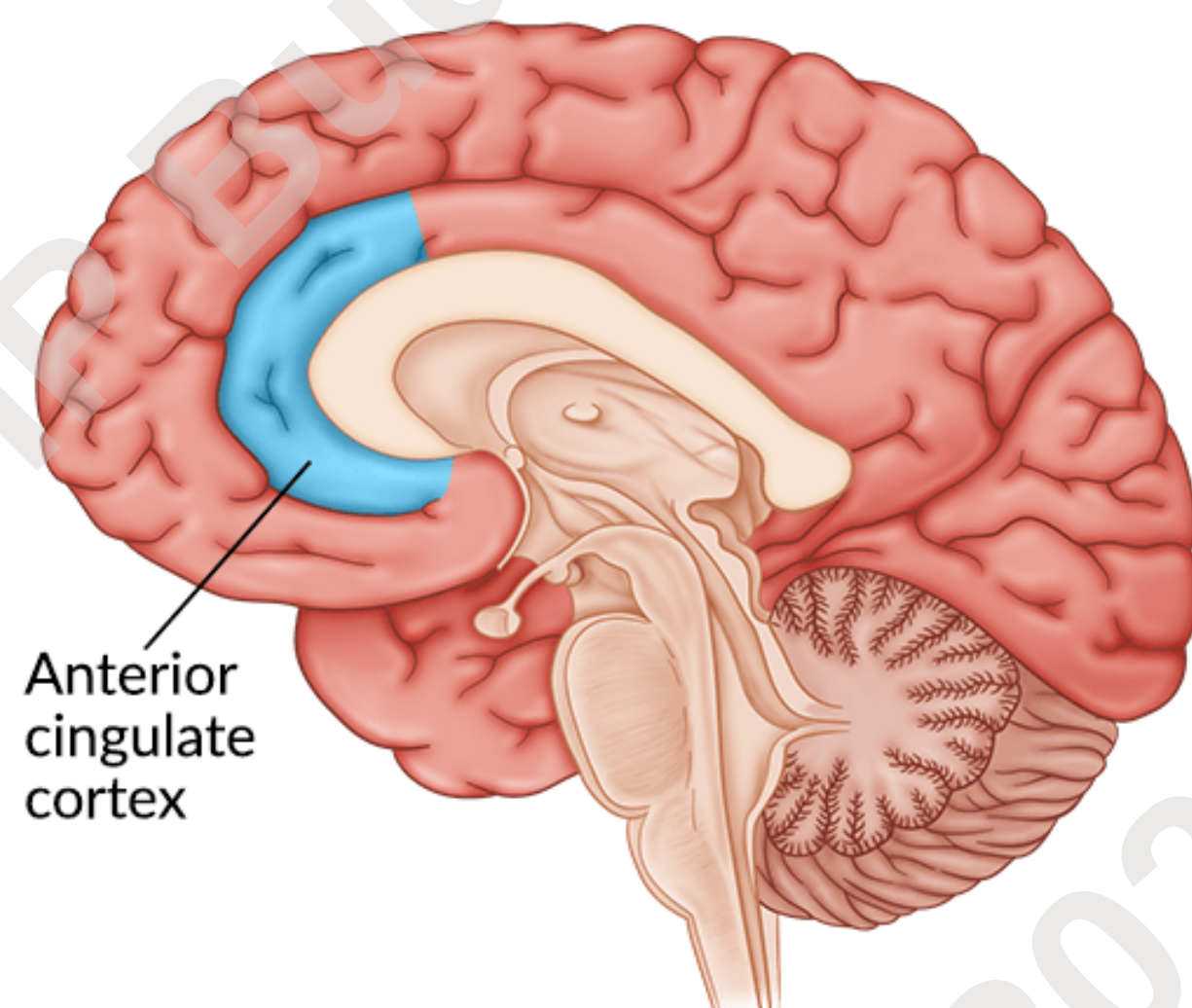
- 24 patients, neuropathic pain, bilateral ACC DBS
- Numerical Rating Scale (NRS), Short-Form 36 quality of life (SF-36), McGill Pain Questionnaire (MPQ), EuroQol 5-domain quality of life (EQ-5D) questionnaire
- Twenty-two patients after a trial week were fully internalized, 12 had a mean follow-up of 38.9 months.



> [World Neurosurg.](#) 2017 Oct;106:625-637. doi: 10.1016/j.wneu.2017.06.173. Epub 2017 Jul 11.

Long-Term Results of Deep Brain Stimulation of the Anterior Cingulate Cortex for Neuropathic Pain

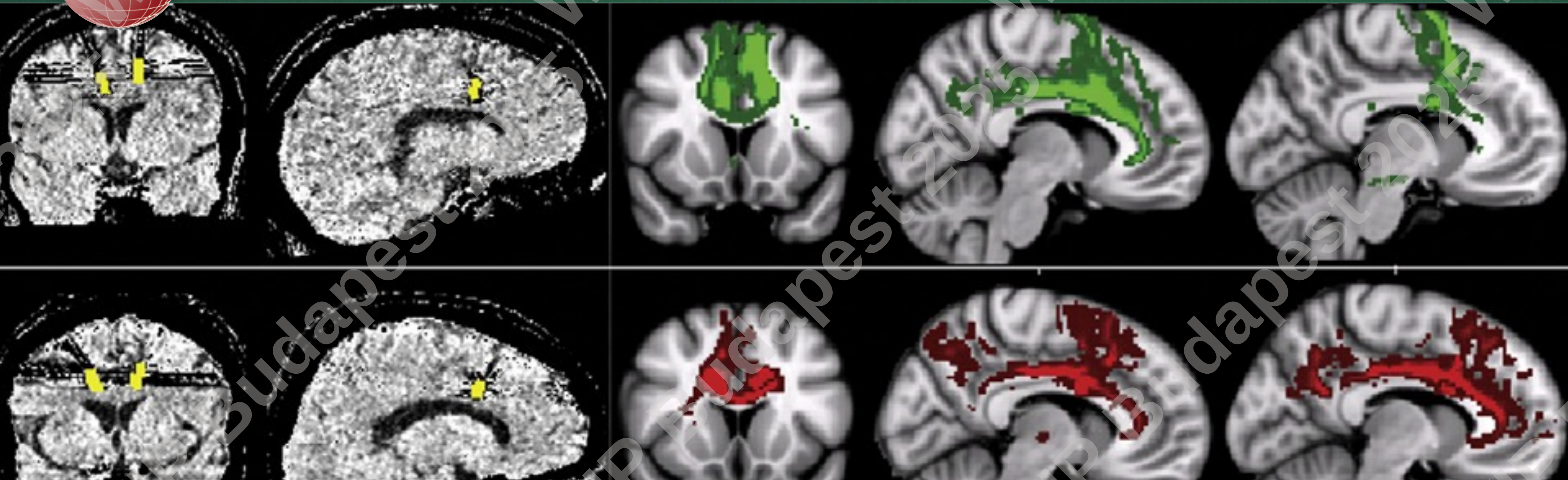
Sandra G J Boccard¹, Simon J Prangnell², Laurie Pycroft³, Binith Cheeran³, Liz Moir³,
Erlick A C Pereira⁴, James J Fitzgerald³, Alexander L Green³, Tipu Z Aziz³



- Six months after surgery
- mean NRS score decreased from 8.0 to 4.27 ($P = 0.004$)
- significant improvement in the MPQ (mean, -36%; $P = 0.021$)
- EQ-5D score significantly decreased (mean, -21%; $P = 0.036$)
- physical functioning domain of SF-36 significantly improved (mean, +54.2%; $P = 0.01$)
- After 1 year, NRS score decreased by 43% ($P < 0.01$), EQ-5D was significantly reduced (mean, -30.8; $P = 0.05$), significant improvements for different domains of the SF-36



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TECHNOLOGICAL ADVANCEMENTS IN DBS

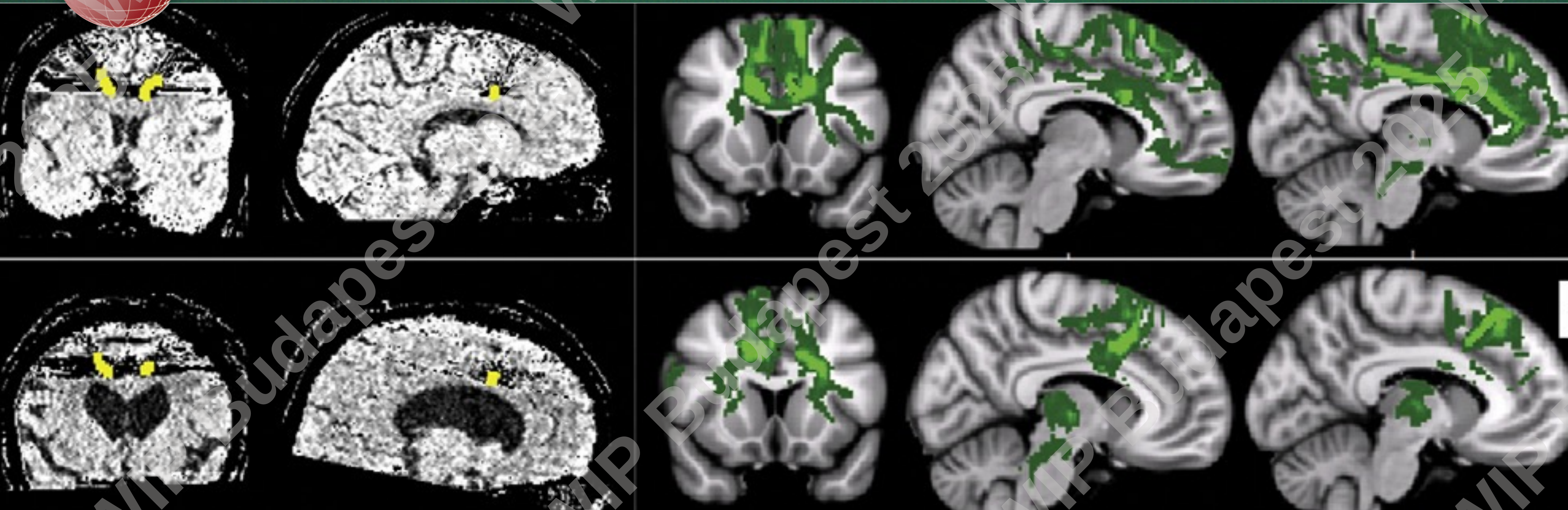
- Probabilistic tractography

- Stimulating portion of the **ANTERIOR CINGULATE CORTEX** that has strong connectivity to the **PRECUNEUS** results in **WORSE OUTCOME**

Boccard et al. World neurosurgery, 2016



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TECHNOLOGICAL ADVANCEMENTS IN DBS

- Stimulating portion of the **ANTERIOR CINGULATE CORTEX** that has strong connectivity to the **BRAINSTEM** and the **THALAMUS** results in **GOOD PAIN RELIEF**

Boccard et al. World neurosurgery, 2016



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GASSERIAN GANGLION

STIMULATION

SHELDEN 1967, MEYERSON 1980: SUBTEMPORAL,
EPIDURAL, PERCUTANEOUS CERVICAL, TRANS-
FORAMEN MAGNUM IMPLANTATION

CANNOT BE USED IN CLASSIC TRIGEMINAL
NEURALGIA

TRIGEMINAL NEUROPATHIC PAIN

TEST PERIOD OF 7-20 DAYS IS ADVISED





PUBLISHED RESULTS

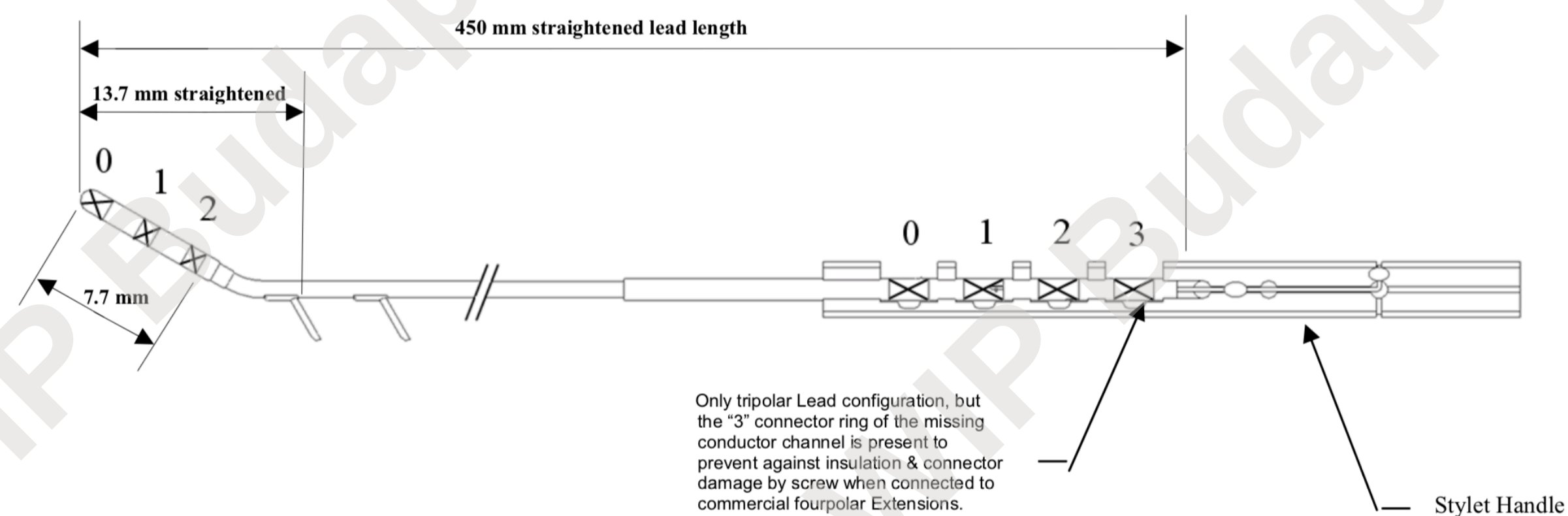
GASSERIAN GANGLION STIMULATION

	YEAR	NUMBER OF PATIENTS	EFFICACY (50%)
Meyerson	1980	5	100%
Meglio	1984	5	100%
Steude.	1984	10	30%
Meyerson	1986	14	79%
Broggi	1987	8	38%
Young	1995	16	56%
Taub	1997	19	23%
Mehrkens	2007	321	52%



GASSERIAN GANGLION STIMULATION

Custom made lead



Lead length	45 cm
diameter	1.0 mm
Stiff lead length	10 mm
Stiff lead diameter	1.27 mm
Stimulation contact length (tip)	1.7 mm
Stimulation contact length	1.0 mm
Interspace	2.0 mm
Resistance	12 Ohm



PATIENT POPULATION

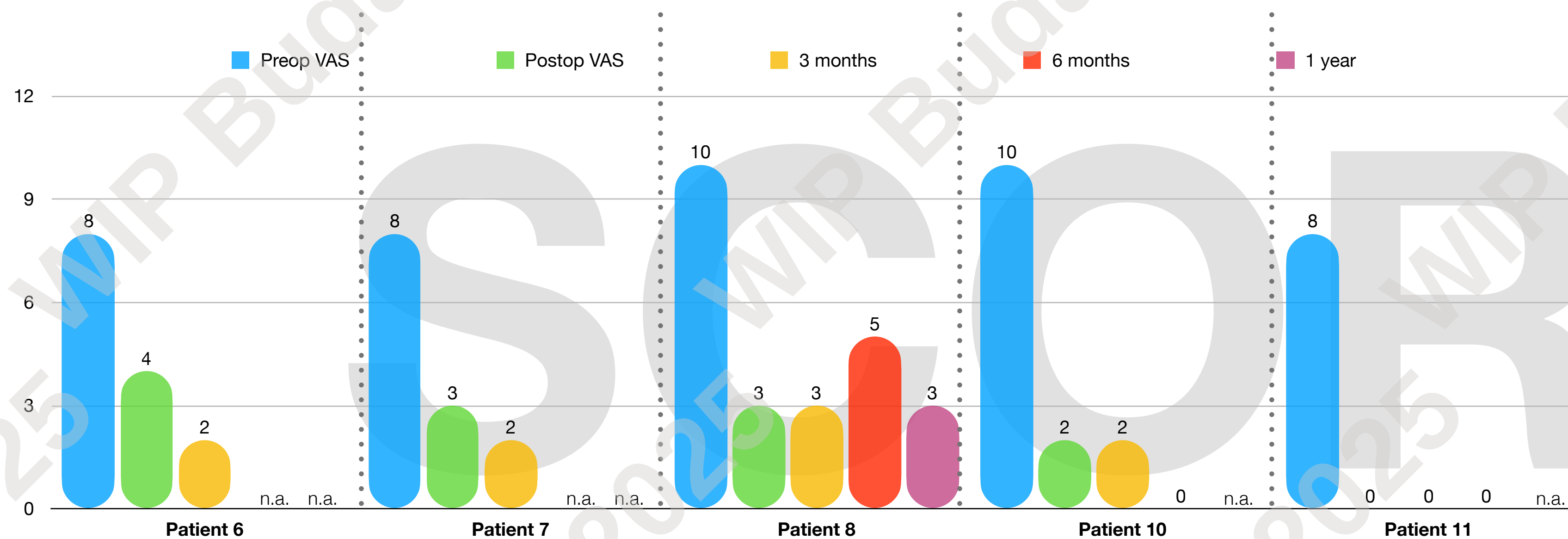
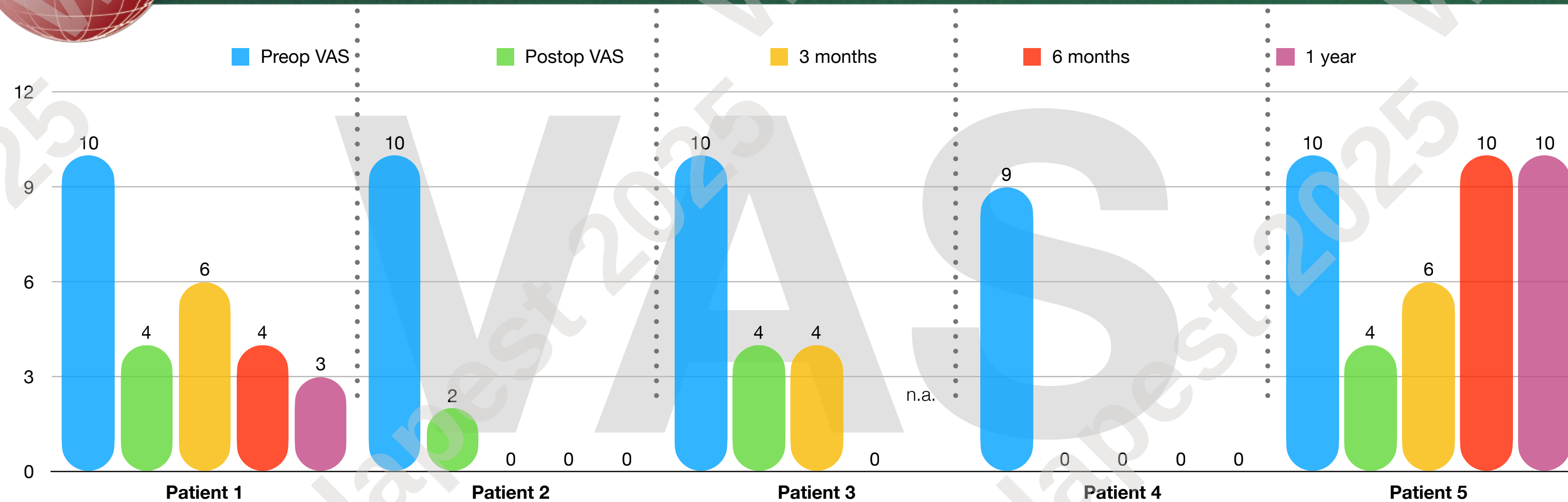
MEAN AGE: 53 YEARS

		Dermatome	Cause	Date of birth	Onset	Years passed since onset	Age
Patient 1	female	V/1-2-3	postherpetic	1953	2016	2	65
Patient 2	male	V/2	unknown	1955	1988	30	62
Patient 3	female	V/2	unknown	1969	2016	3	49
Patient 4	female	V/2	orbital, maxillary fracture	1988	2009	9	30
Patient 5	male	V/1-2	postherpetic	1958	2015	3	60
Patient 6	male	V/2	burning accident	1978	1988	31	40
Patient 7	female	V/1-2-3	car accident	1973	2011	8	45
Patient 8	female	V/2-3	parotydectomy	1949	2016	2	66
Patient 9	male	V/2-3	intraoral cyst resection	1957	2000	1	61
Patient 10	female	V/1-2-3	iatrogenic (Jannetta)	1983	2017	1	35
Patient 11	female	V/1-2-3	iatrogenic (gamma knife)	1937	2008	10	81



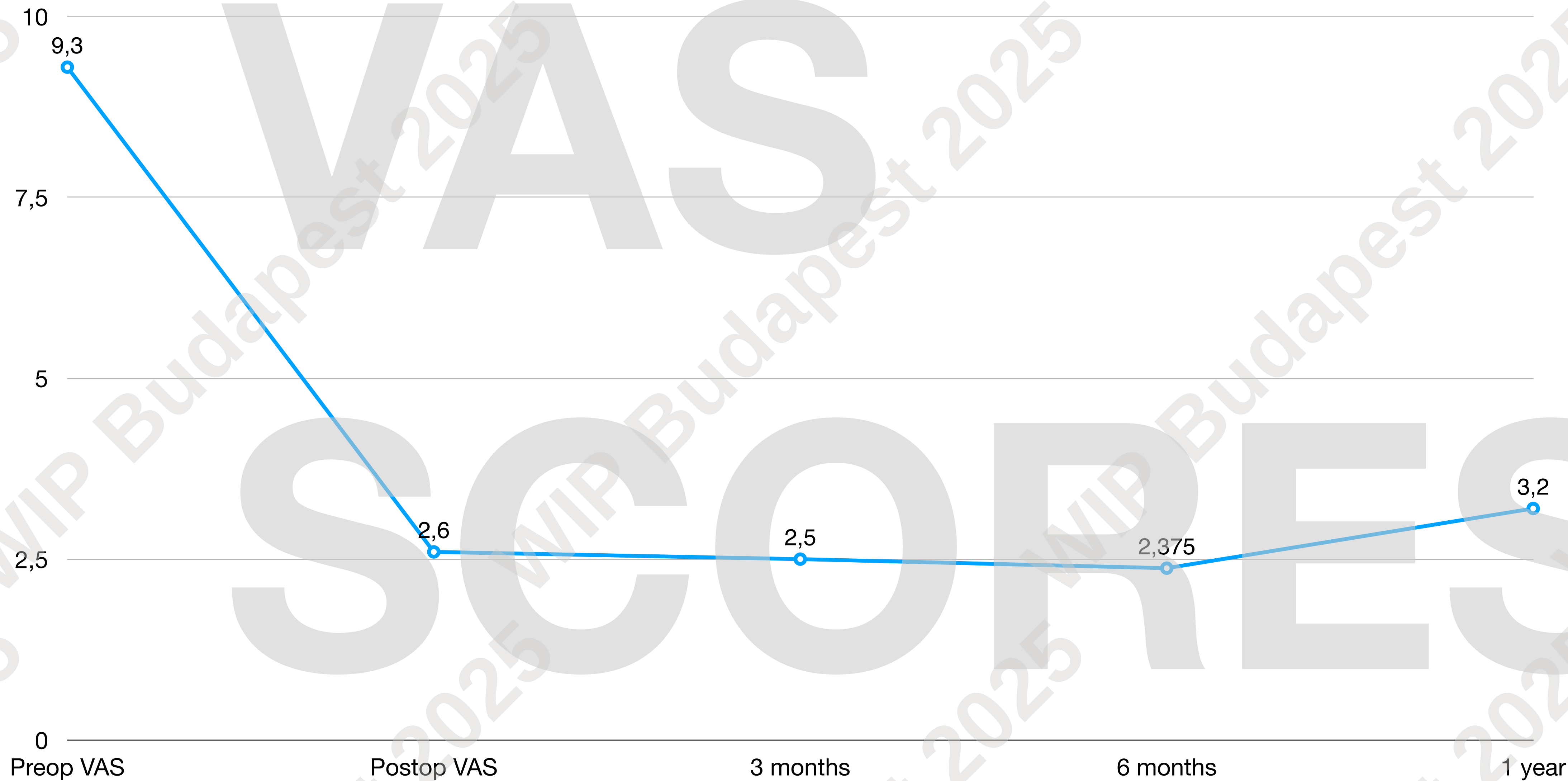
28th Annual Gabor Racz Advanced Interventional Pain Conference and Workshop

Budapest, Hungary August 25-27, 2025



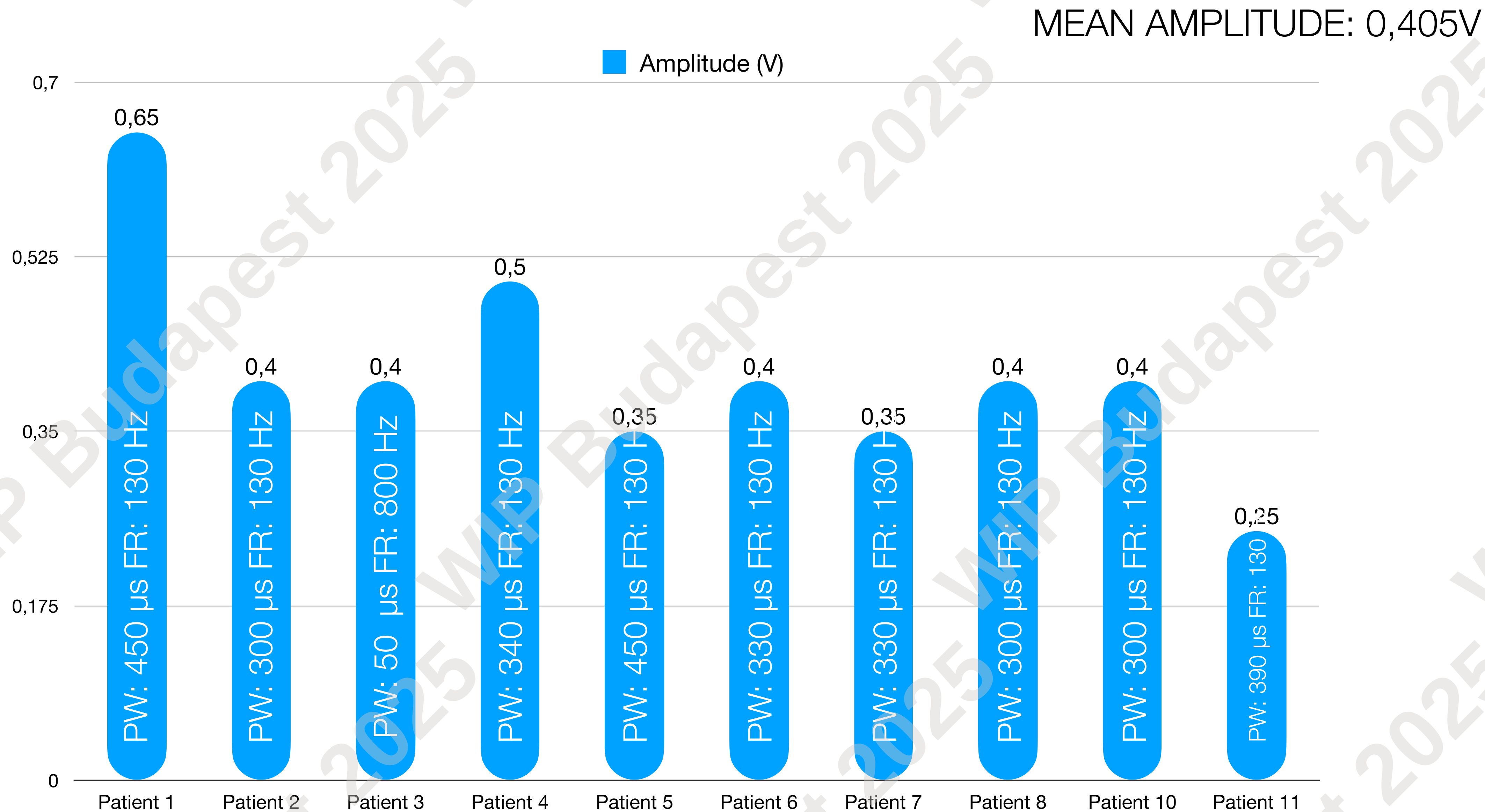


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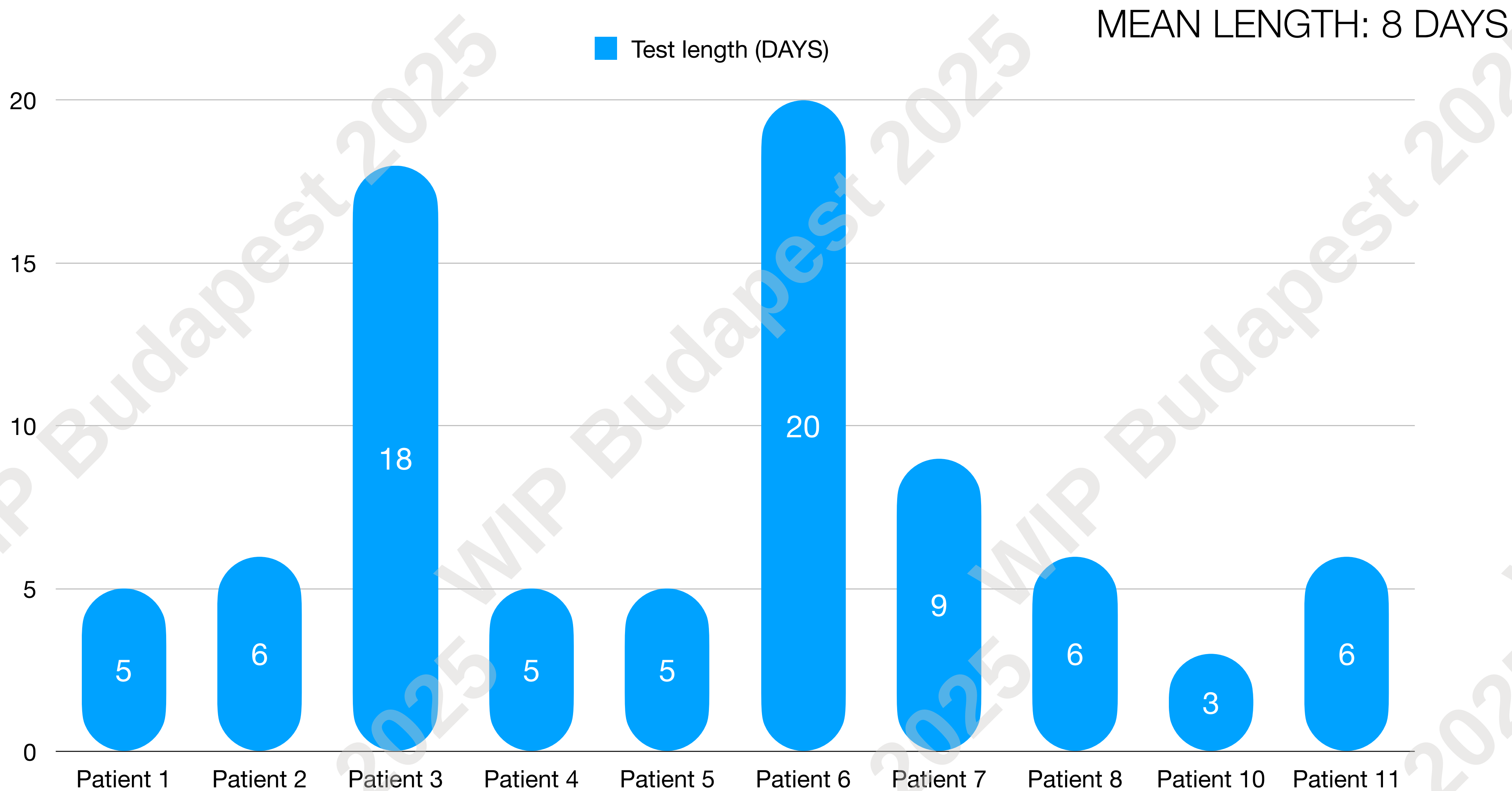


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INTRACRANIAL APPROACHES IN PAIN MANAGEMENT

ABLATIVE PROCEDURES:

- PERCUTANEOUS TECHNIQUES FOR TRIGEMINAL NEURALGIA
- GAMMA KNIFE
- RADIOFREQUENCY ABLATION
- FOCUSED ULTRASOUND

CRANIOTOMY

- MICROVASCULAR DECOMPRESSION

NEUROMODULATION

- MOTOR CORTEX STIMULATION
- DEEP BRAIN STIMULATION
- GASSERIAN GANGLION STIMULATION
- GGL. SPHENOPALATINUM STIMULATION





Thank you for your attention

ESSFN Congress 24.-27.September 2025 - Budapest