

Neurostimulation for Chronic Headache Syndromes

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DALLAS NEUROSURGICAL AND SPINE ASSOCIATES



HEADACHES OF IMPORTANCE TO NEUROSURGEONS

- INTRACRANIAL PRESSURE – SPACE OCCUPYING LESIONS
- SUBARACHNOID HEMORRHAGE
- POST TRAUMATIC
- POST SURGICAL
- PSEUDOTUMOR CEREBRI
- INTRACRANIAL HYPOTENSION
- CEREBRAL VENOUS OBSTRUCTION
- POST LUMBAR PUNCTURE
- TEMPORAL ARTERITIS
- MENINGITIS
- TRIGEMINAL NEURALGIA

HEADACHES WE CARE LESS ABOUT!

- Vascular headaches
 - Migraine with aura
 - Chronic migraine/chronic daily headaches
- Sinus headaches
- Tension headaches
- Cluster headaches
- Glaucoma
- Occipital neuralgia and other secondary headaches

Headache Classification and Diagnosis

Primary Headaches

- Migraine
- Tension-type
- Cluster headache

Secondary Headaches

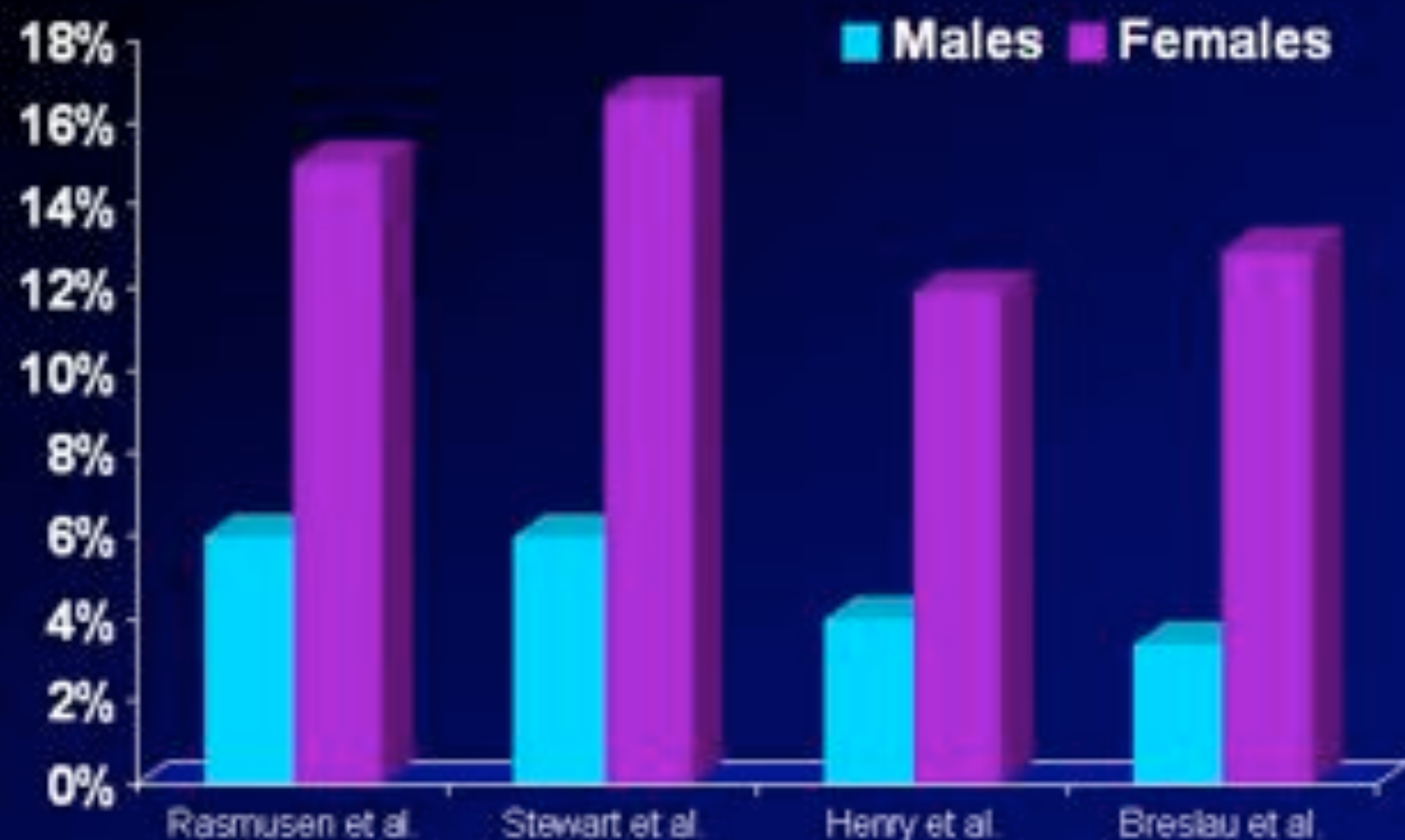
- Tumor
- Meningitis
- Giant cell arteritis



Prevalence of Migraine Globally

France	5-12%
Denmark	10%
Germany	11%
Italy	12%
Taiwan	9.1%
UK	7%
USA	9-12%

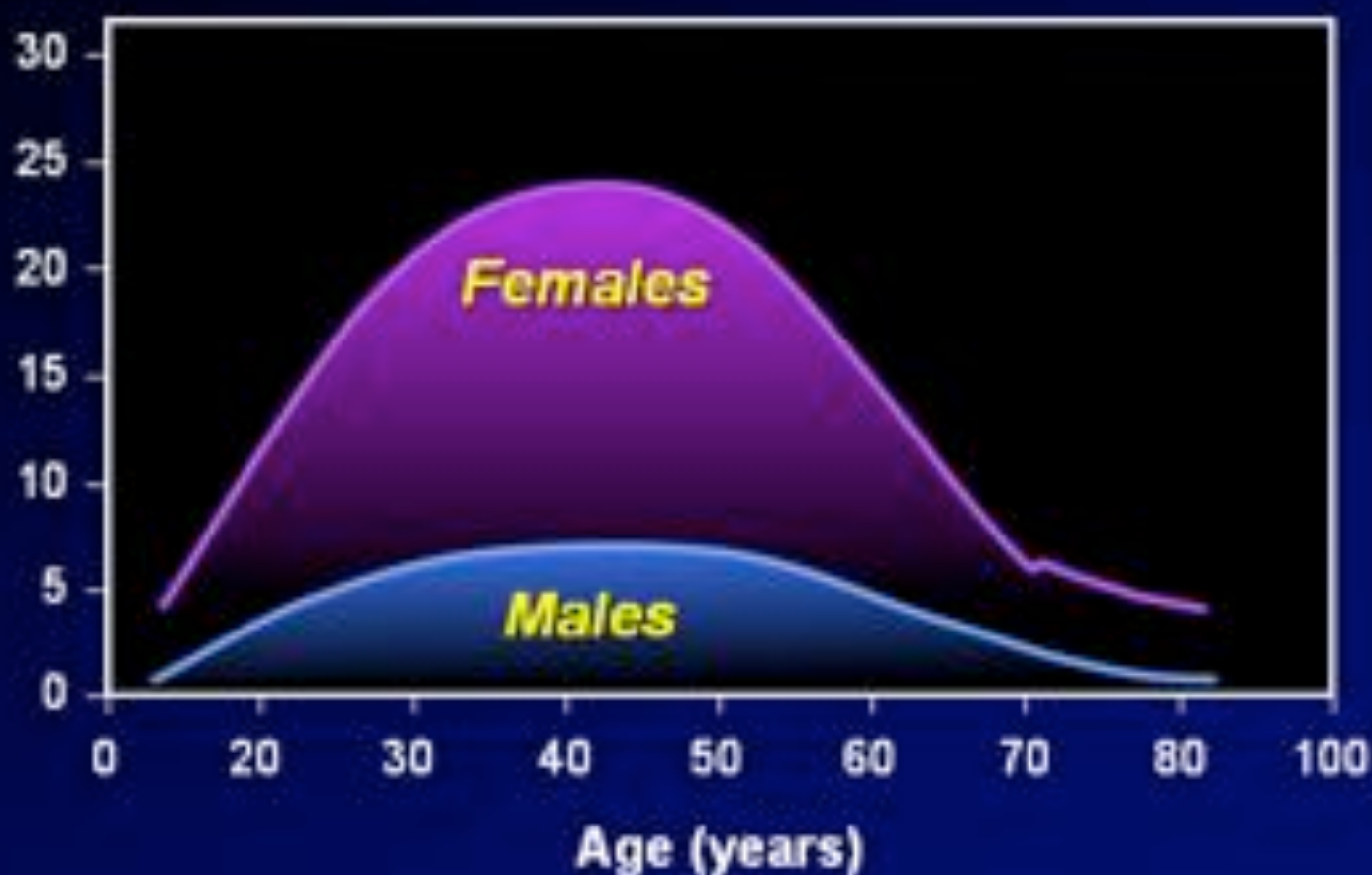
Prevalence of Migraine: Gender Differences



Adapted from Lipton RB, et al. *Headache*. 1994

Migraine Prevalence by Age and Gender

Migraine Prevalence %



Occipital Nerve Importance

- Surgical procedures common over the posterior head and neck
- Surgical landmarks for avoiding cutaneous nerve injury in this region poorly understood in general
- C2,3 sensory nerves (occipital) important source of headache pain
- Chronic post surgical headaches difficult to diagnose and treat
- C2 crosstalk with descending tract of V

Occipital Neuralgia Pitfalls in Diagnosis

- Think TN sx for ON pain description:
 - unilateral
 - lancinating, shocking
 - hypesthetic
 - responds to nerve block
- ON important trigger in Migraine:
 - with or without aura
 - photo/phonophobia
 - nausea/emesis
- Chronically become indistinguishable with daily headache

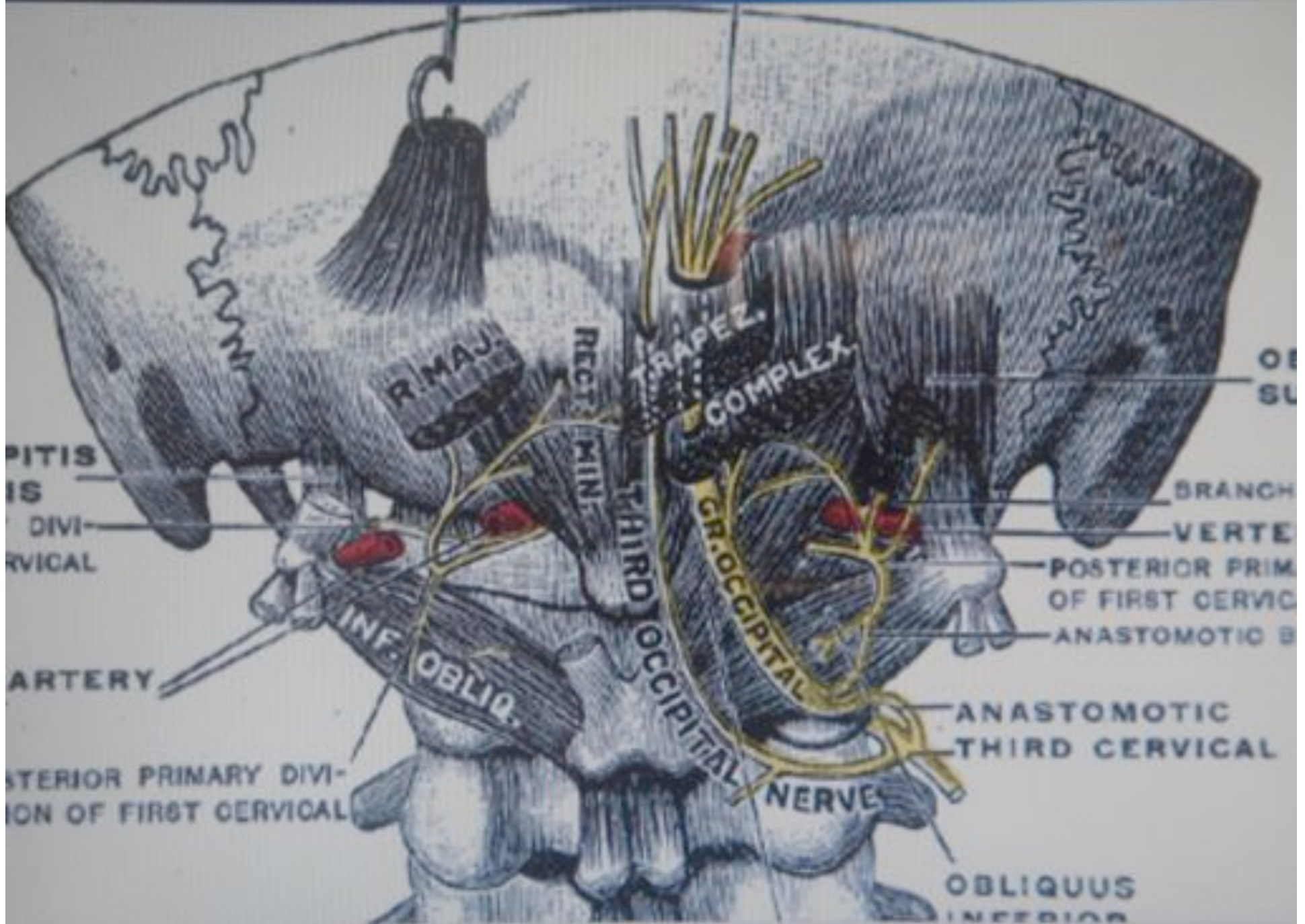
Occipital Headaches

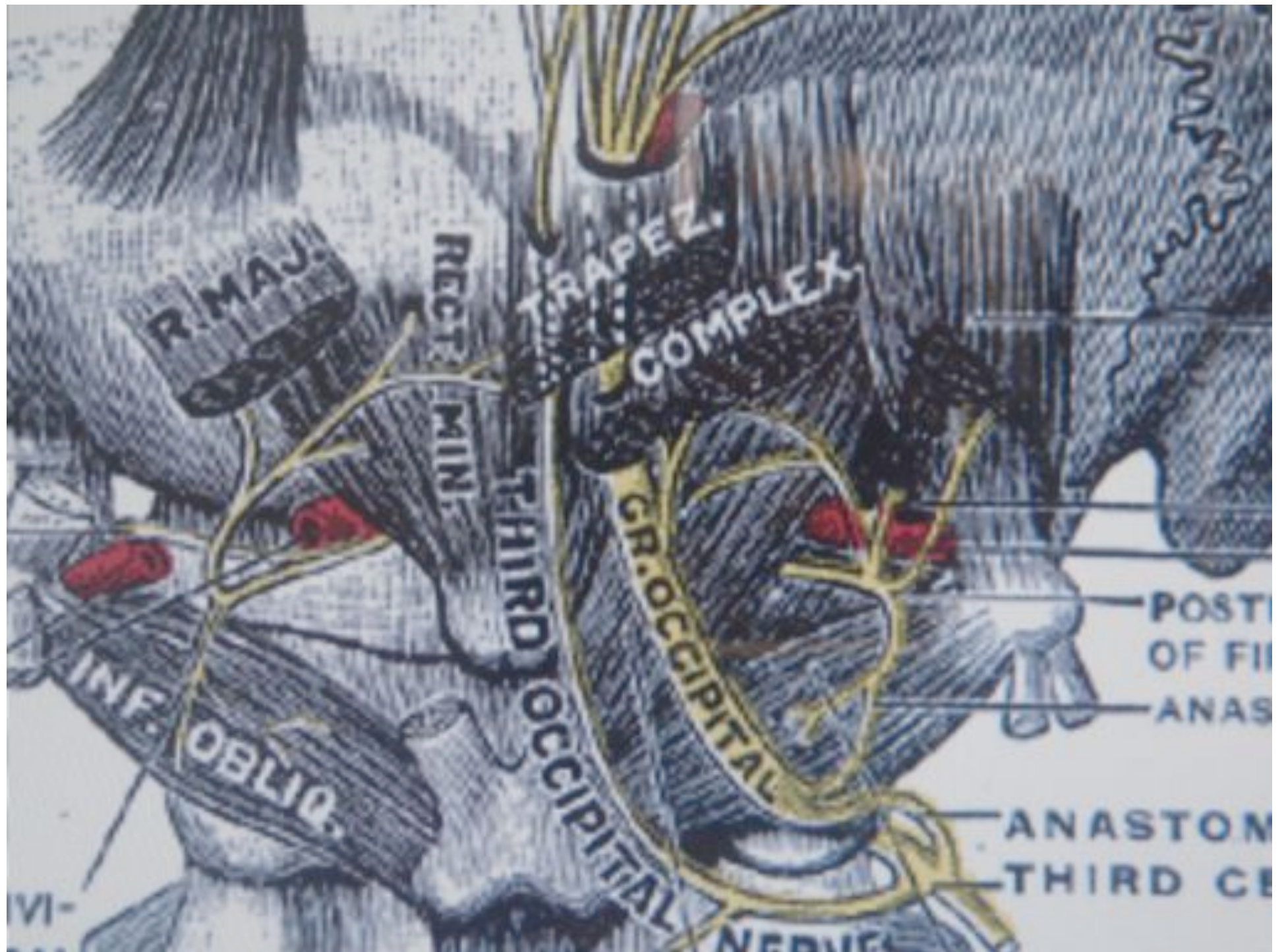
Diagnosis

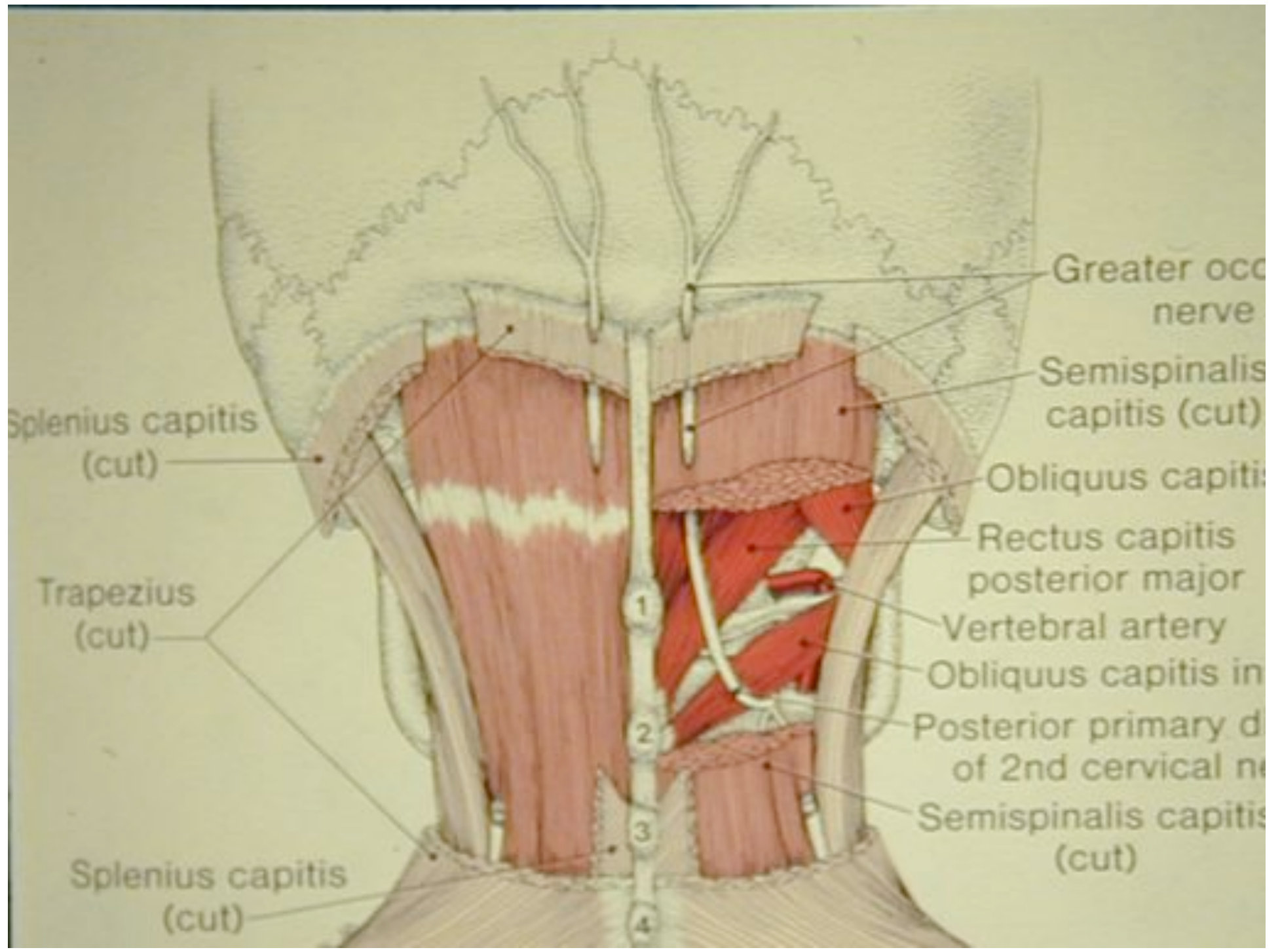
- Occipital Neuralgia
- Cervicogenic Pain
- C2-3 Mediated Headache
- Tension Headache
- Migraine
 - Classic
 - Transformed migraine

Occipital Nerve Anatomy

- Greater occipital nerve – originates as posterior primary medial branch of C2
- Traverses submuscularly through trapezius and supraspinatus m superiorly.
- Becomes subcutaneous in proximity to the greater occipital protuberance
- Lesser (lateral) and third (medial) nerves in similar distribution along an intermastoid line
- Location at skull base approx one thumb breadth (2cm) from midline







Splenius capitis
(cut)

Trapezius
(cut)

Splenius capitis
(cut)

Greater occipital
nerve

Semispinalis
capitis (cut)

Obliquus capitis

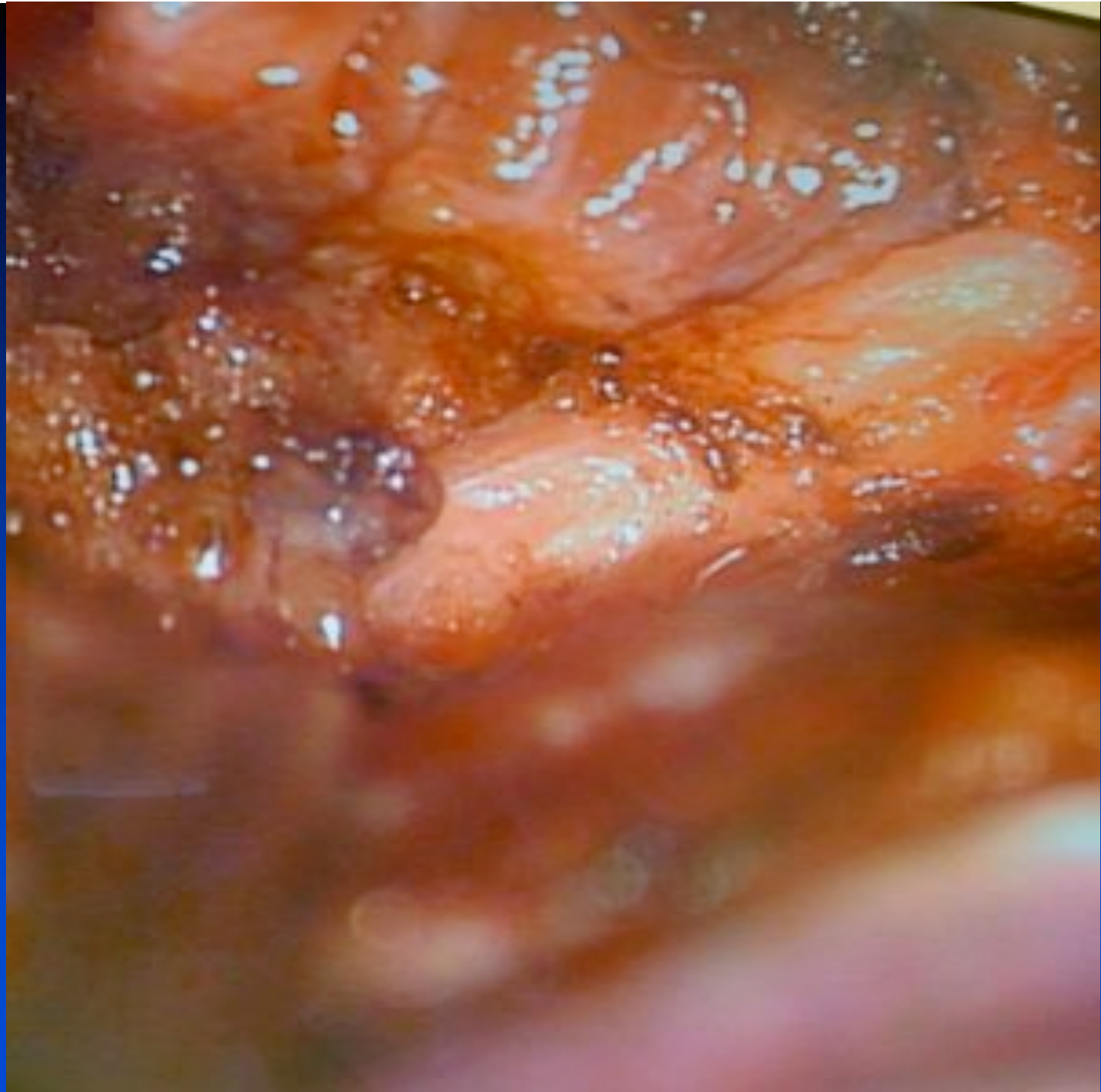
Rectus capitis
posterior major

Vertebral artery

Obliquus capitis in

Posterior primary d
of 2nd cervical n

Semispinalis capitis
(cut)

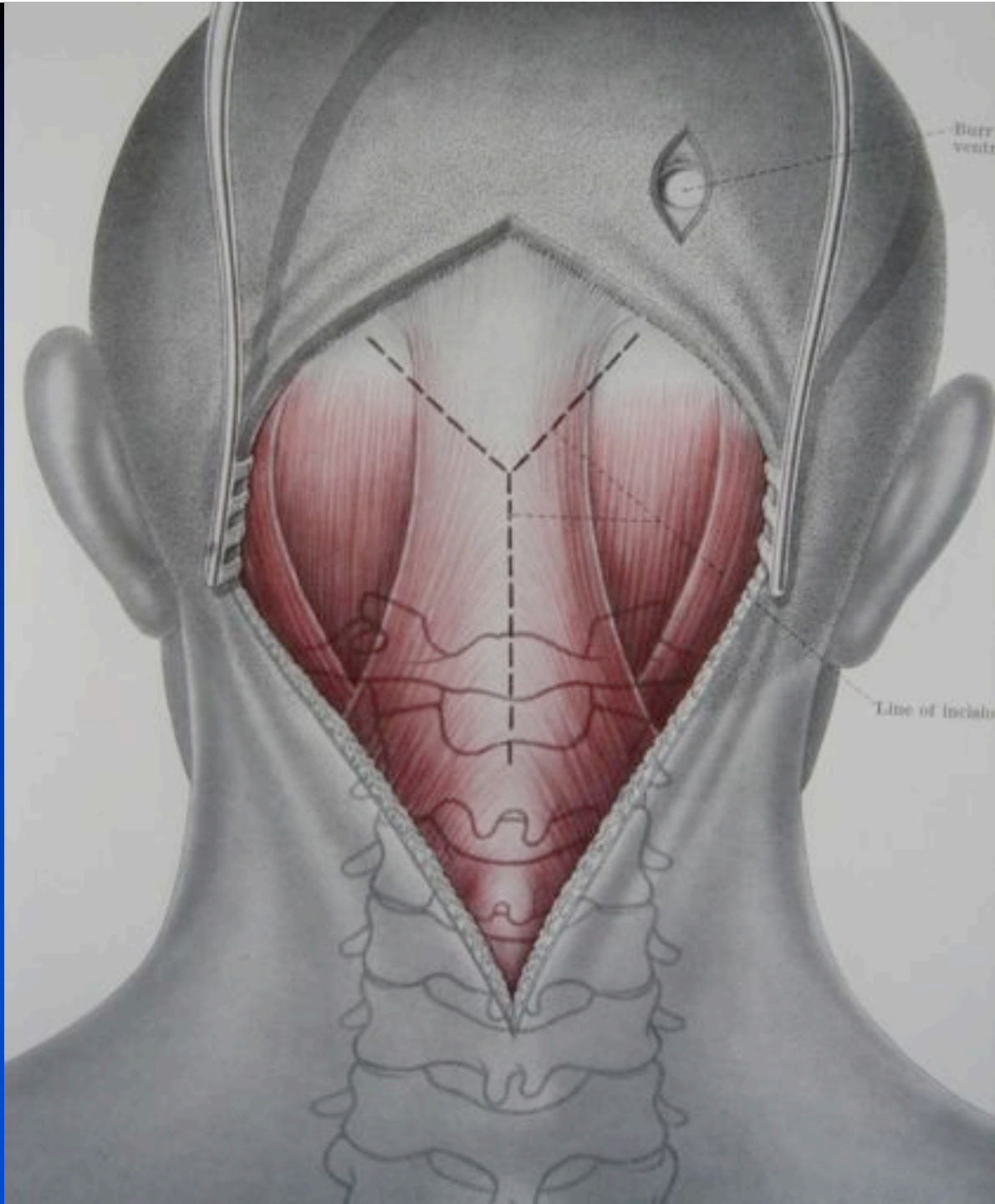


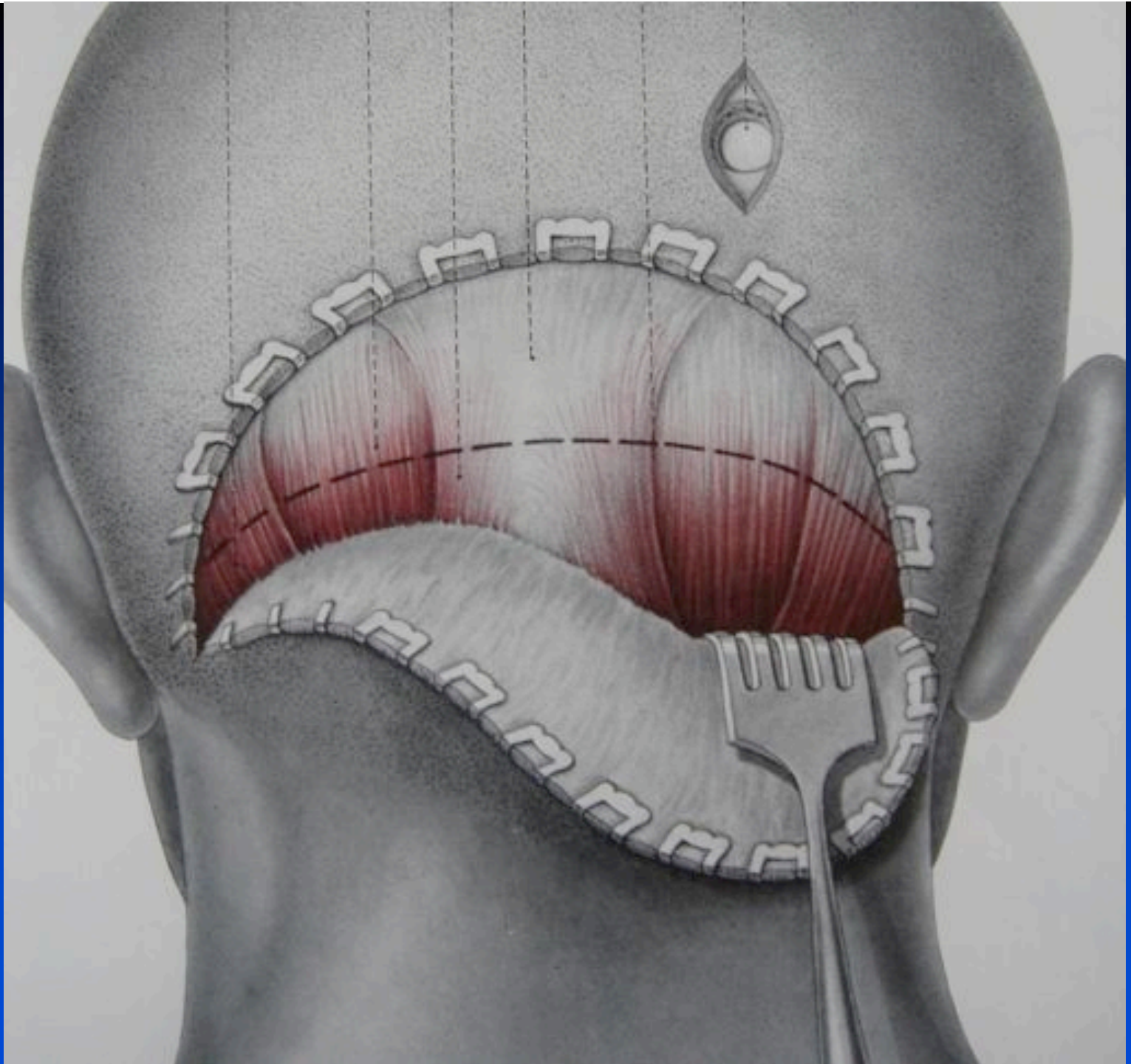
Mechanisms of Injury

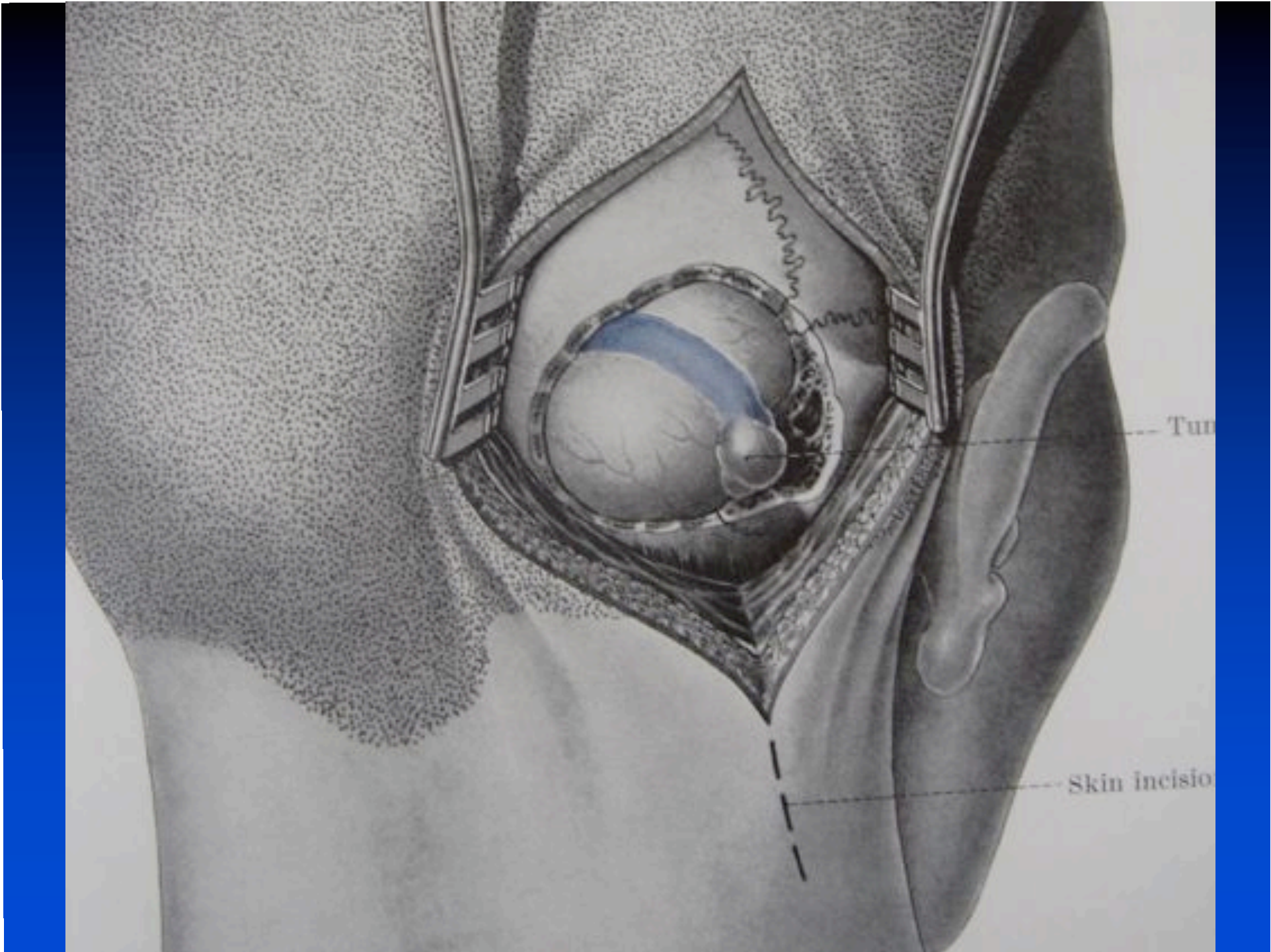
- Transection
- Stretch
- Entrapment
- Ischemic
- Compression
- Blunt Force

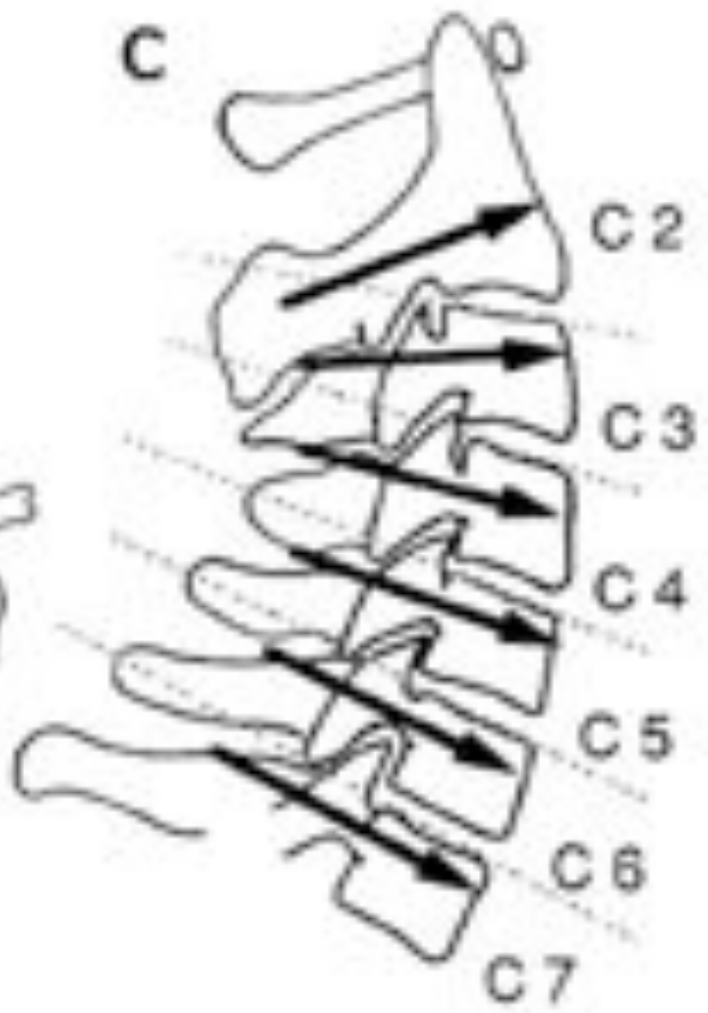
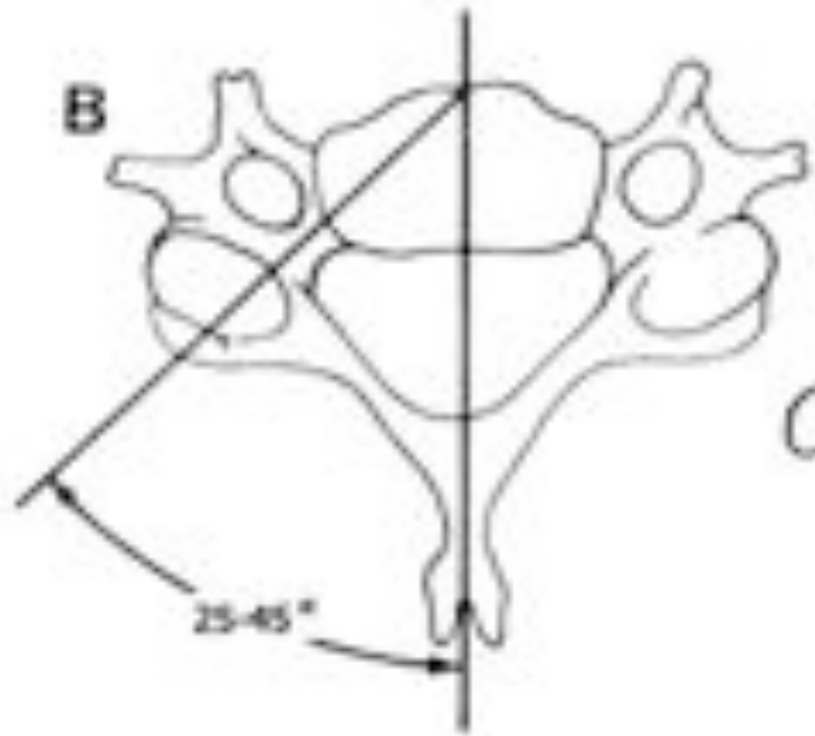
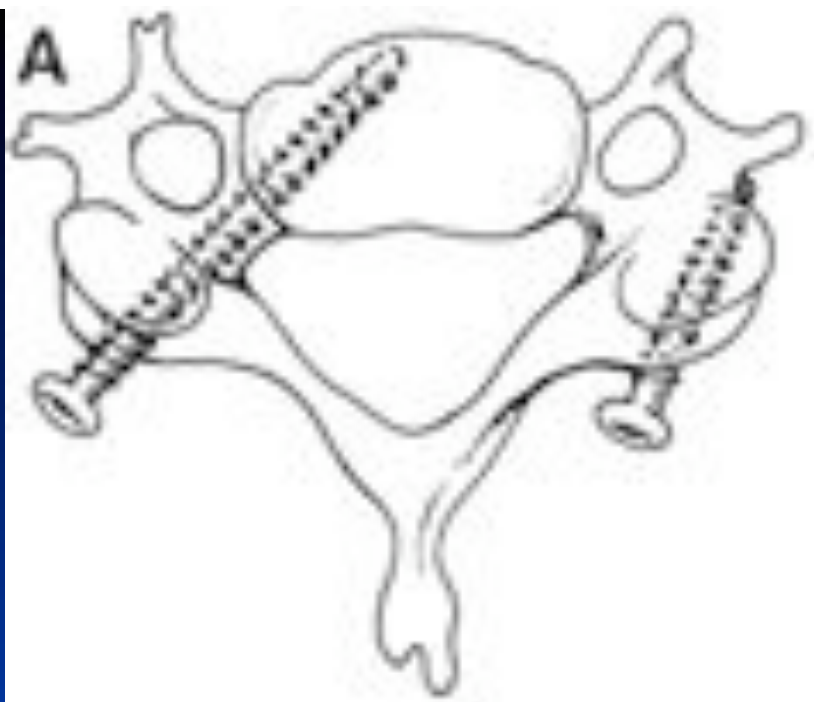
Surgically Suseptible Conditions

- Chiari malformation
- PF craniotomy
- CP angle Crani
- Upper Cervical Surgery
- Post traumatic
gsw, stab wounds, blunt
trauma









Treatment Options - Medical

- Medications
 - Tryptans
 - Antiseizure meds
 - Antidepressants
 - Narcotics
- Occipital nerve or C2 blocks
- Cervical immobilization (collar)
- Manipulative physical therapy
- TENS
- Ultrasound/heat
- Cryoanalgesia

Treatment Options - Surgical

- Occipital Nerve Neurolysis/Neurectomy
- C2 Ganglionectomy
- C2 Decompression
- C1,2 Fusion
- C2 Intradural Rhizotomy
- Radiofrequency GON Rhizotomy
- C1-2 Retro SCS/High Cervical SCS
- Subcutaneous PNS

Subcutaneous Neurostimulation

- OBSERVATIONS:
 1. The subcutaneous tissues conduct electrical pulses
 2. Electrical conduction appears to occur along dermatomal and myotomal patterns
 3. Stimulation is perceived as paresthesias and modulates pain perception

Occipital Lead Position

- Transverse C1
- Diagonal Suboccipital
- Vertical Paramedian
- Combination

C1 Localization



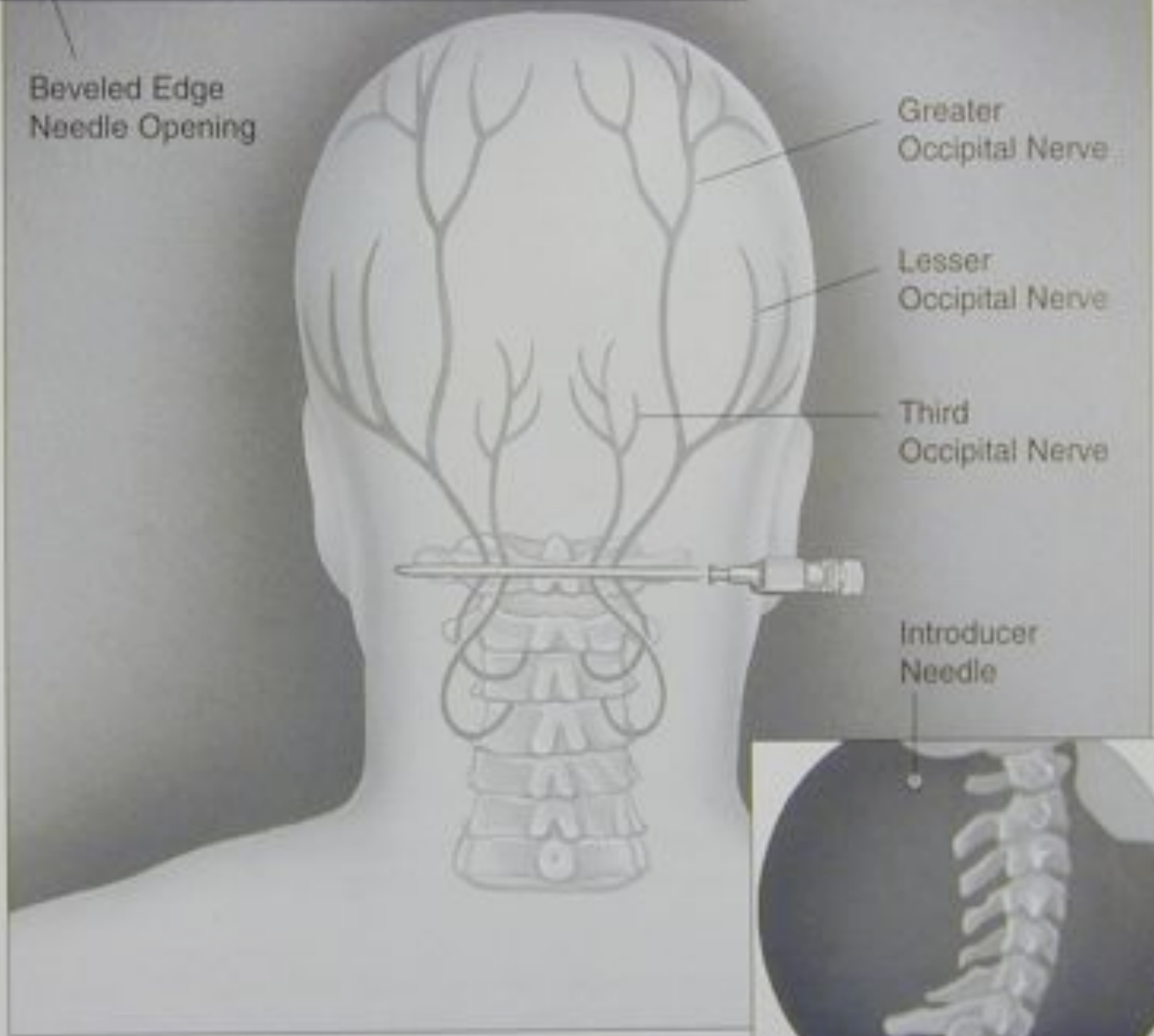
Beveled Edge
Needle Opening

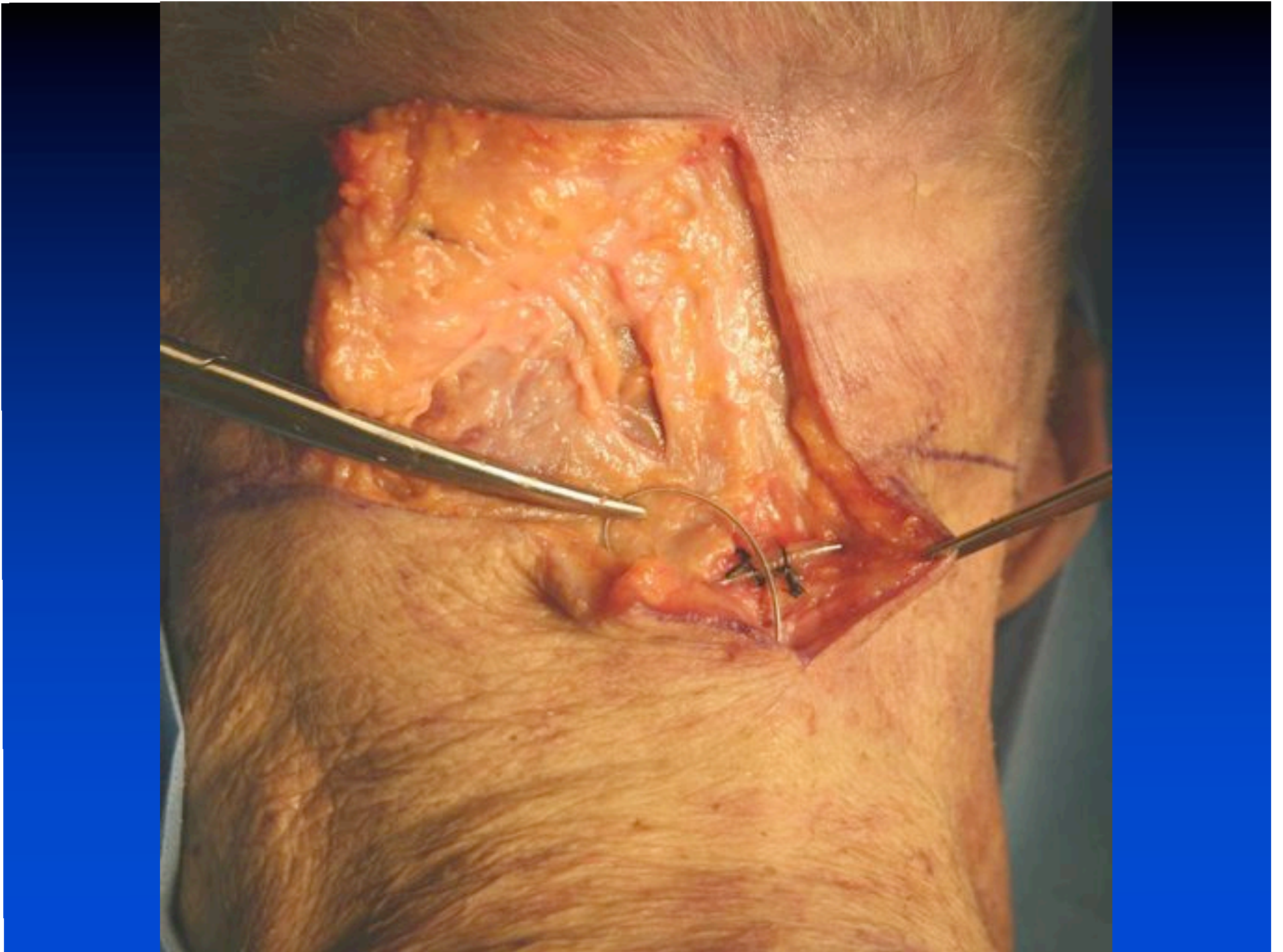
Greater
Occipital Nerve

Lesser
Occipital Nerve

Third
Occipital Nerve

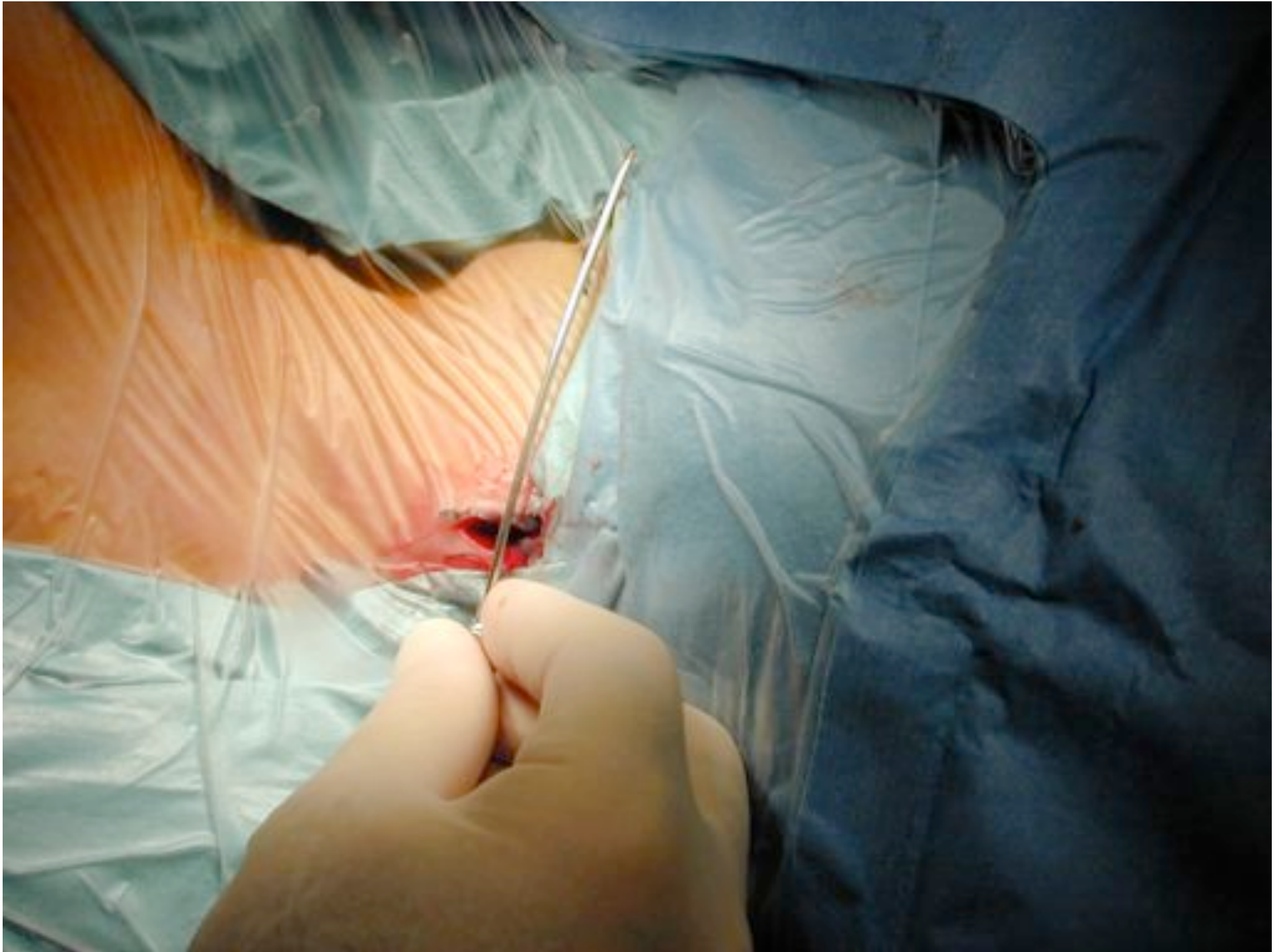
Introducer
Needle



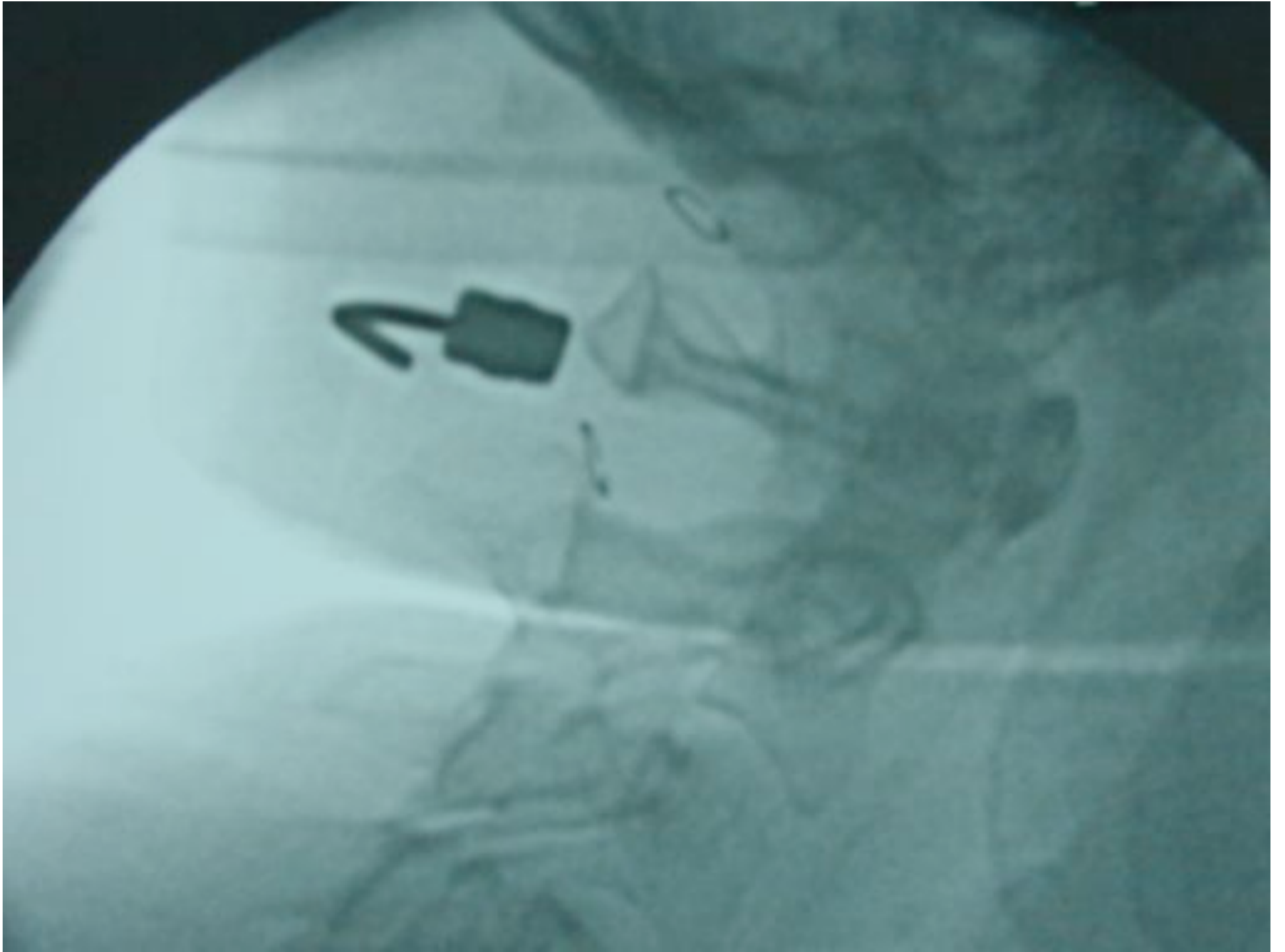






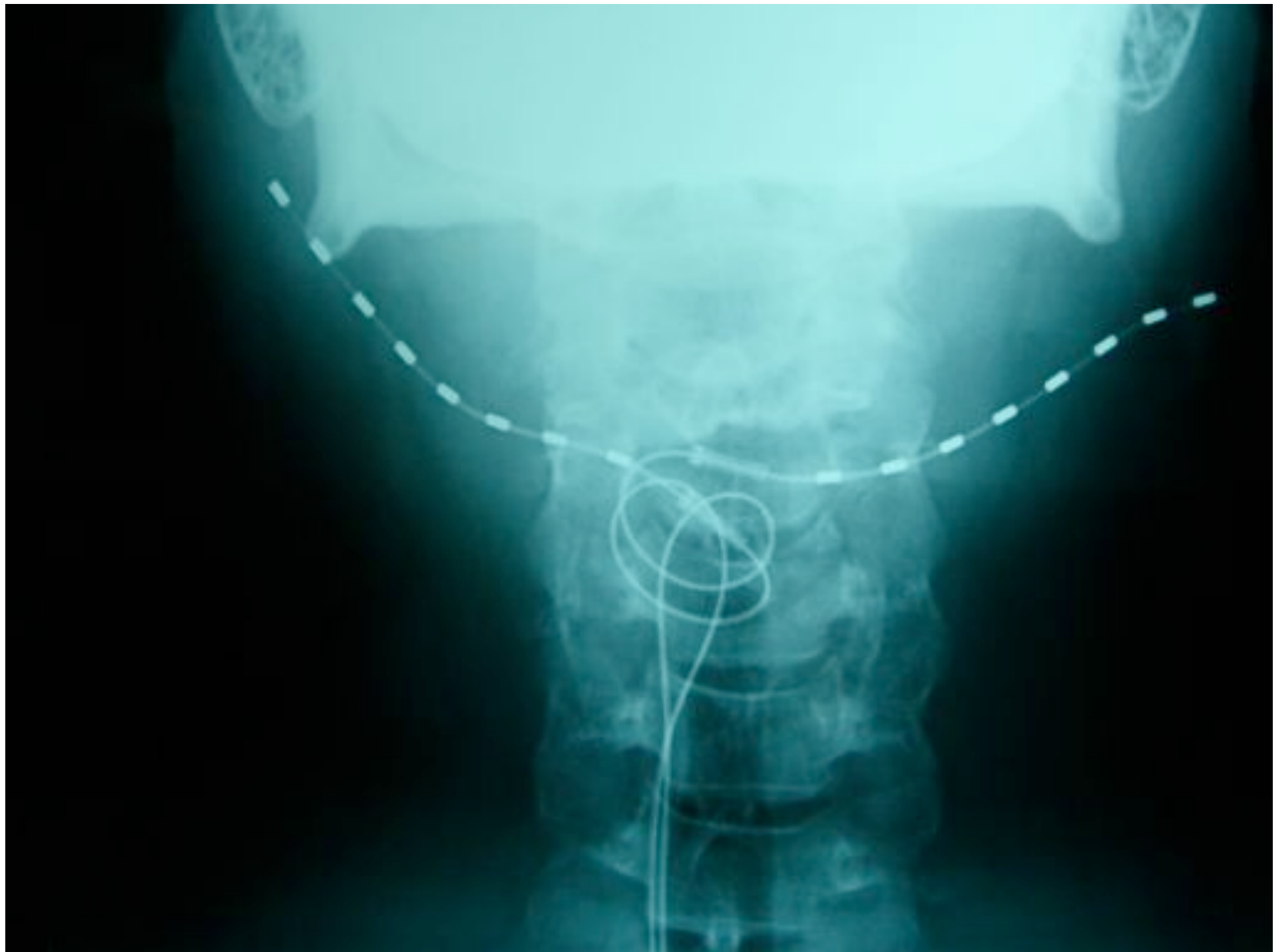






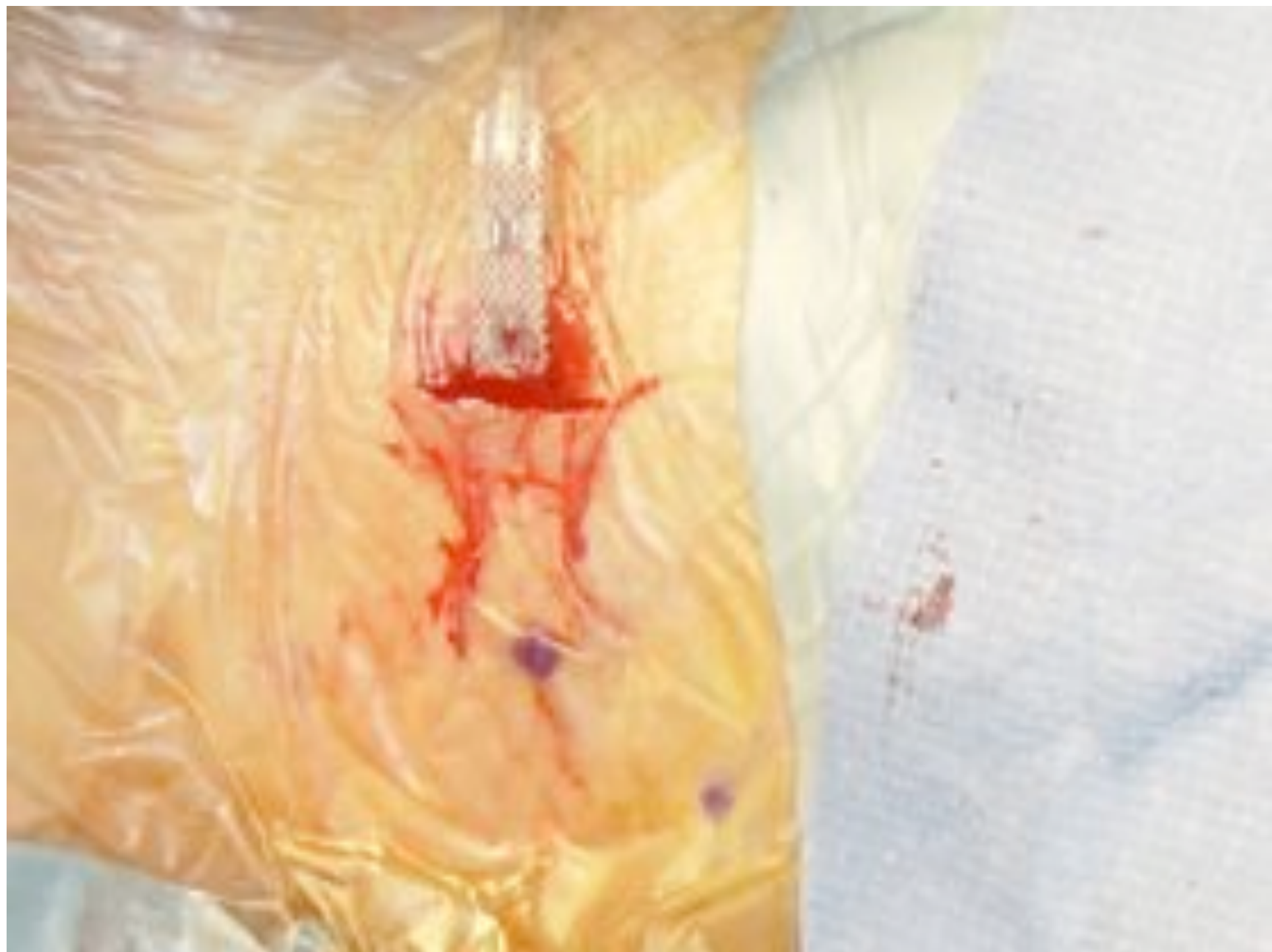








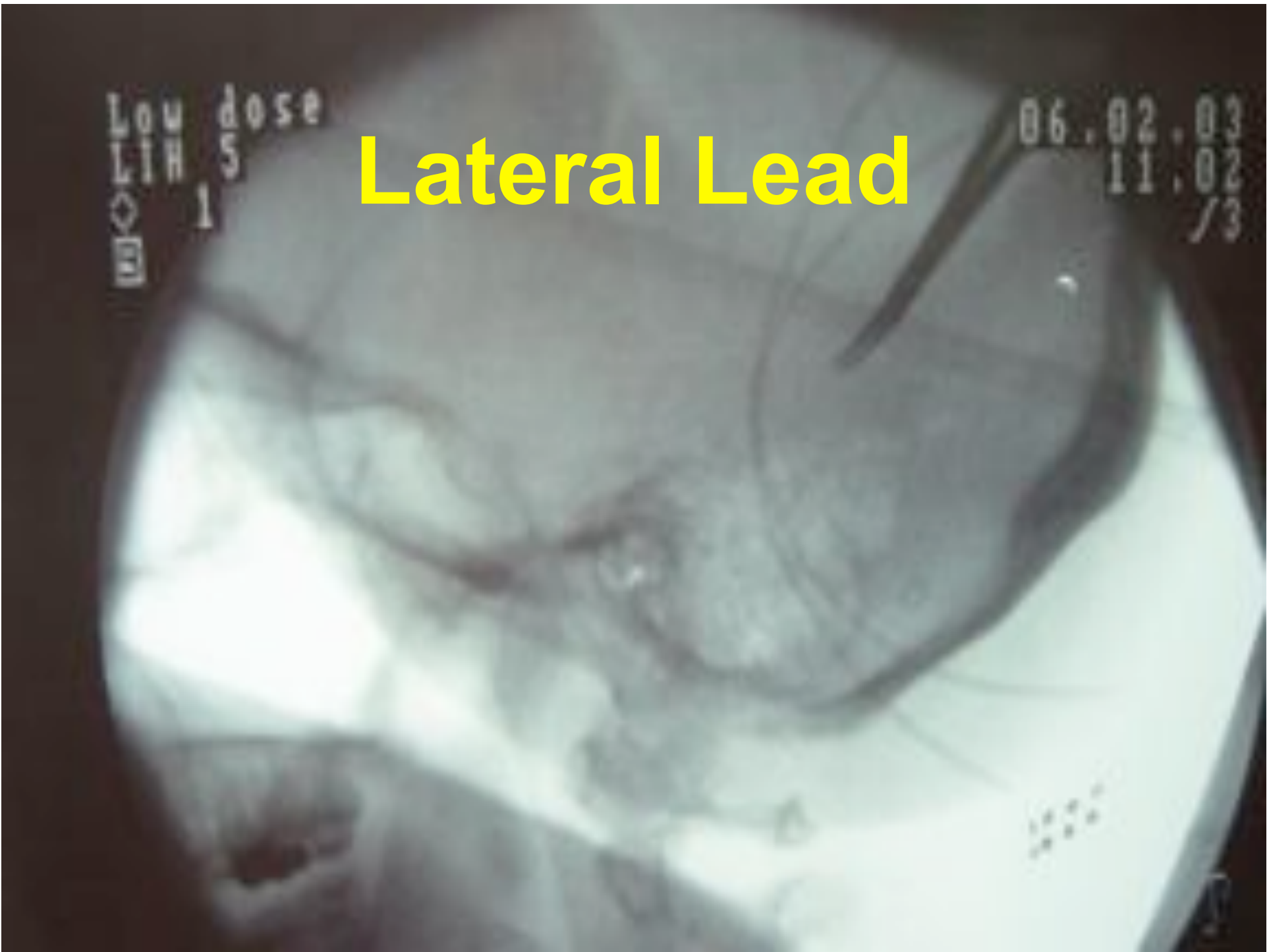




Low dose
LITH 5
1
MOLIM

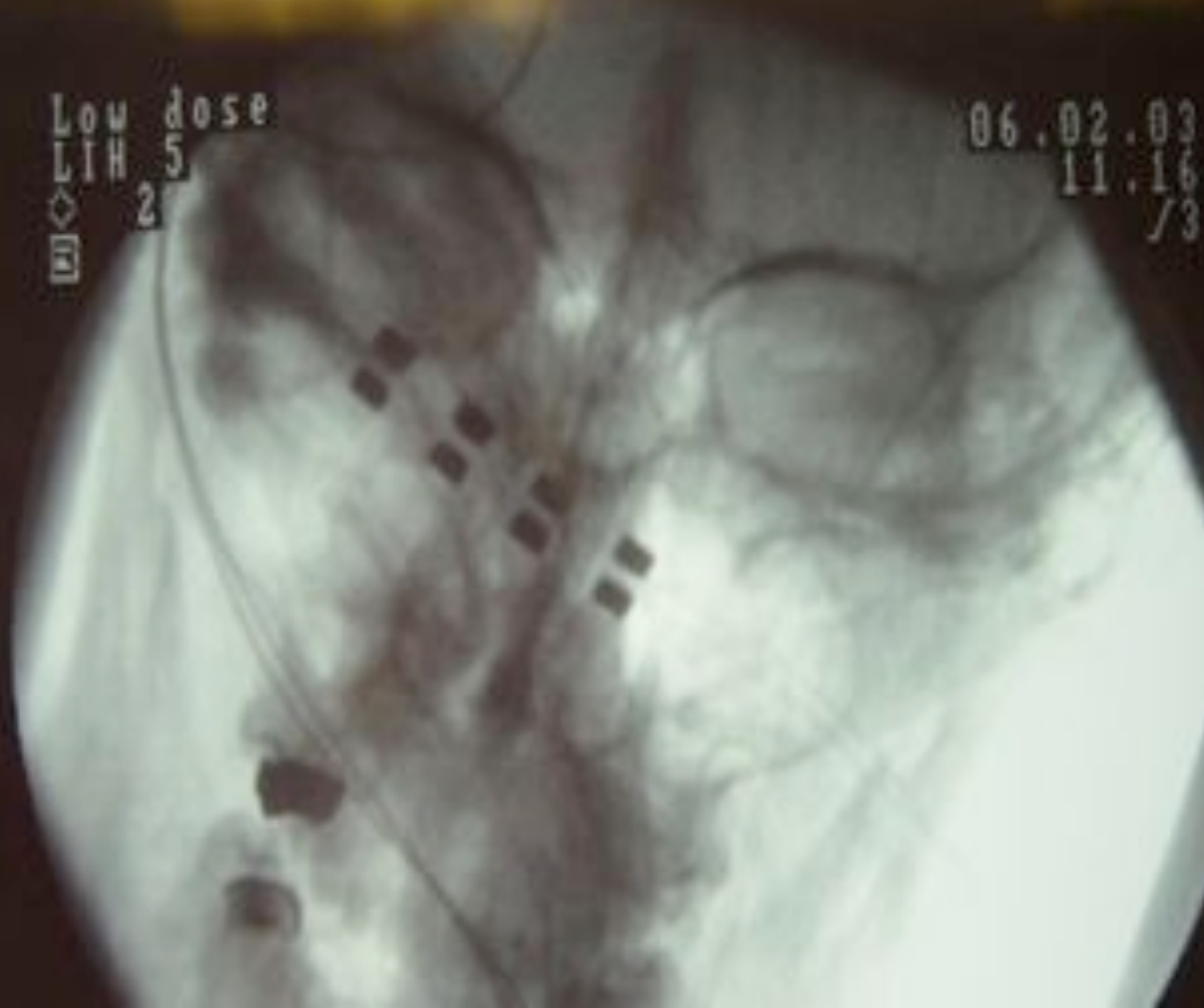
06.02.03
11.02
/3

Lateral Lead



Low dose
LIH 5
◇ 2
E

06.02.03
11.16
/3



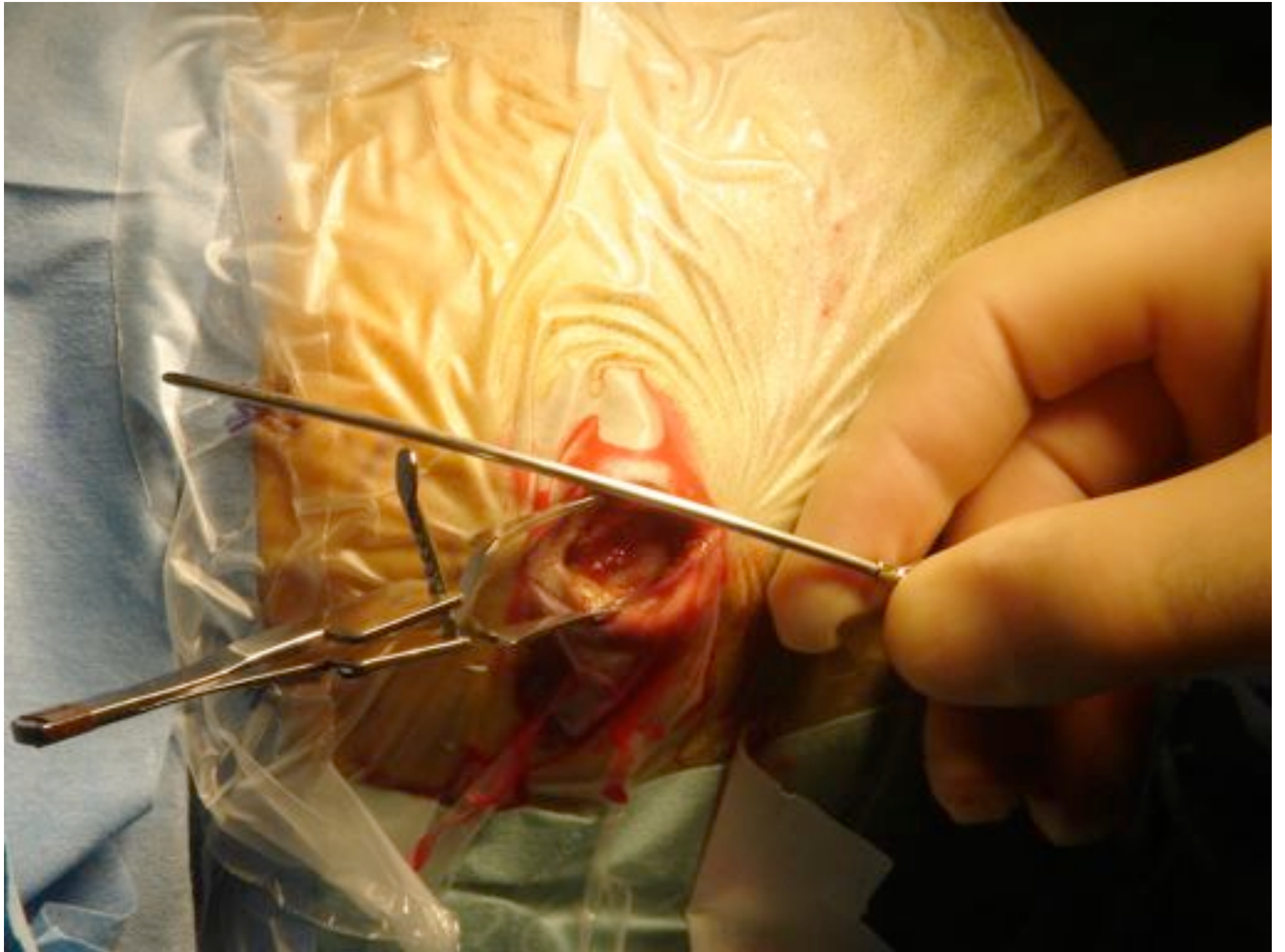
HALO
NEUROSTIMULATION
FOR HEADACHE

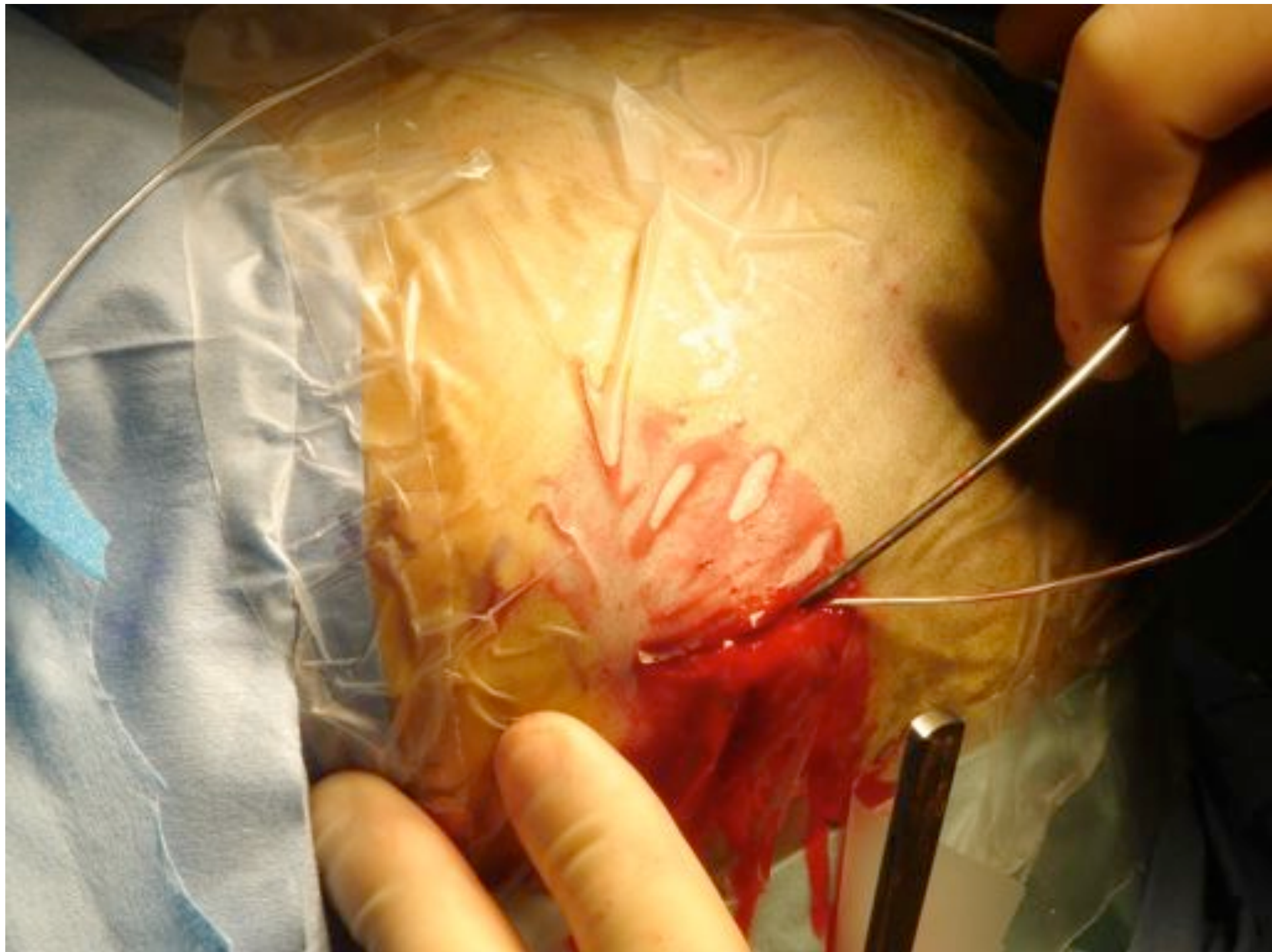






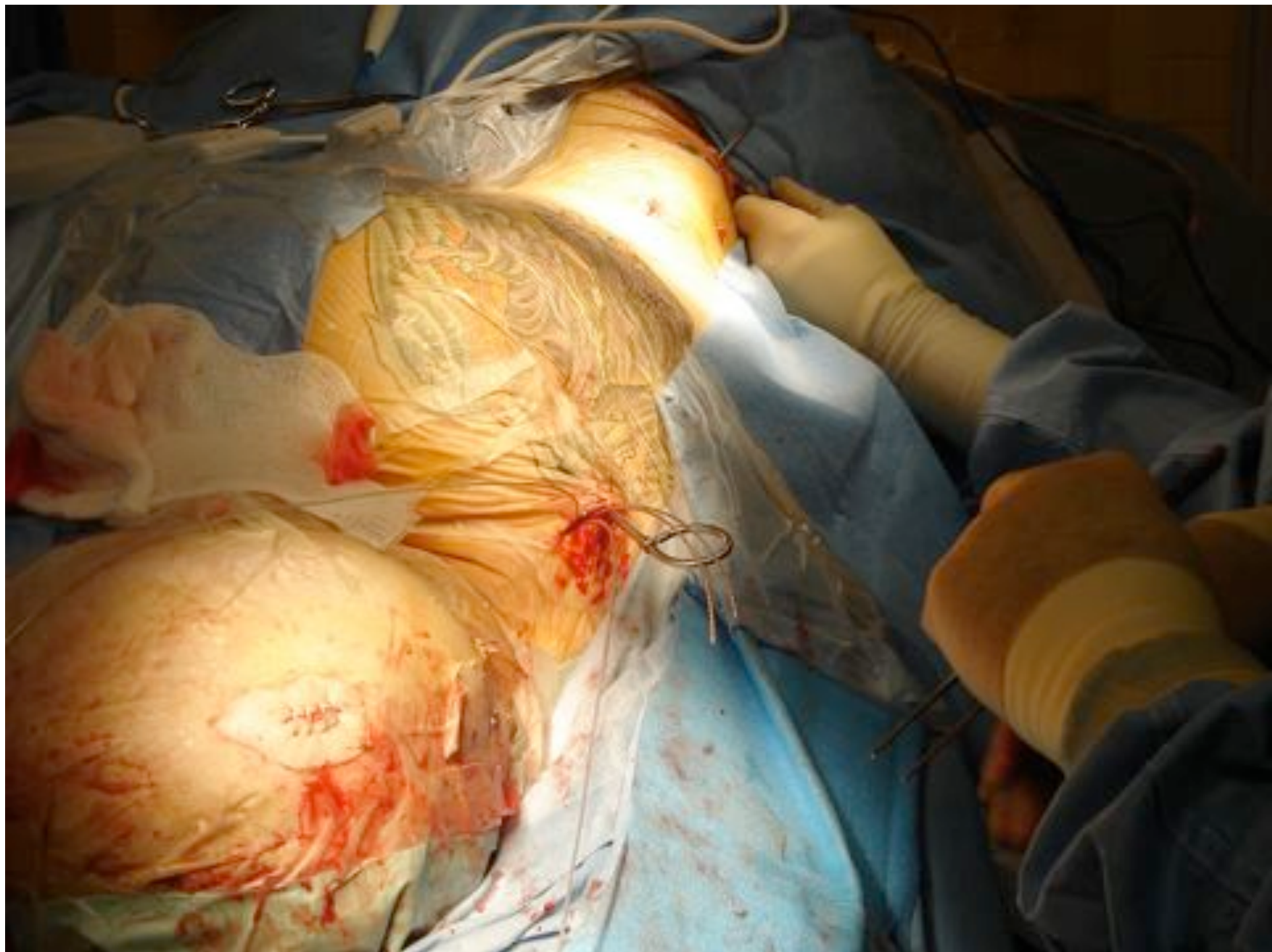














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PRESBYTERIAN HOSPITAL

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Im: 1001/1

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Acc: DOR4055-05

2005 Nov 16

Acq Tm: 10:13:16.047

HEAD



Lin
W:326 L:463

SIZES ARE APPROXIMATE

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Ex:

Se: 1002/2
Im: 1002/1

HEAD

PRESBYTERIAN HOSPITAL

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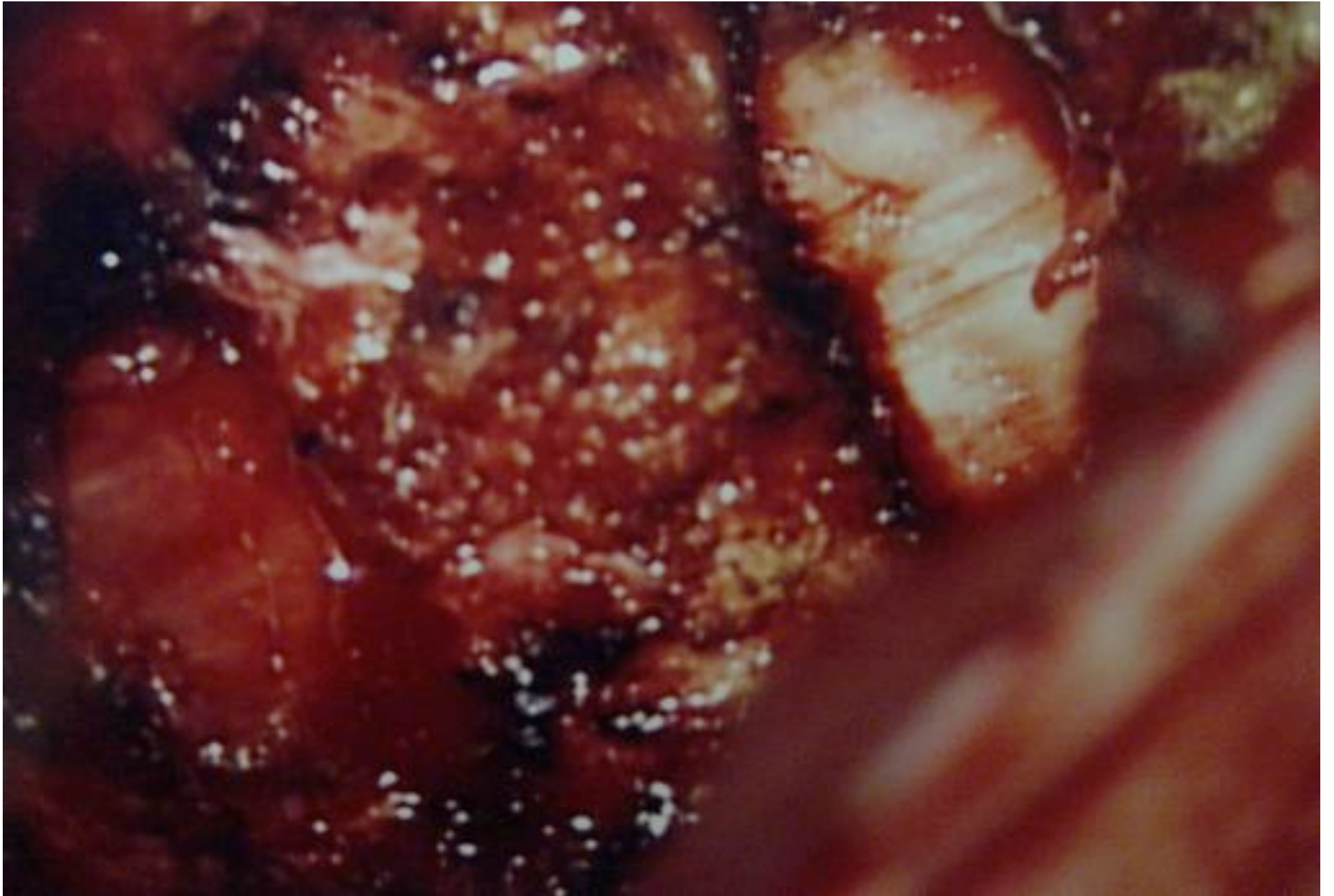
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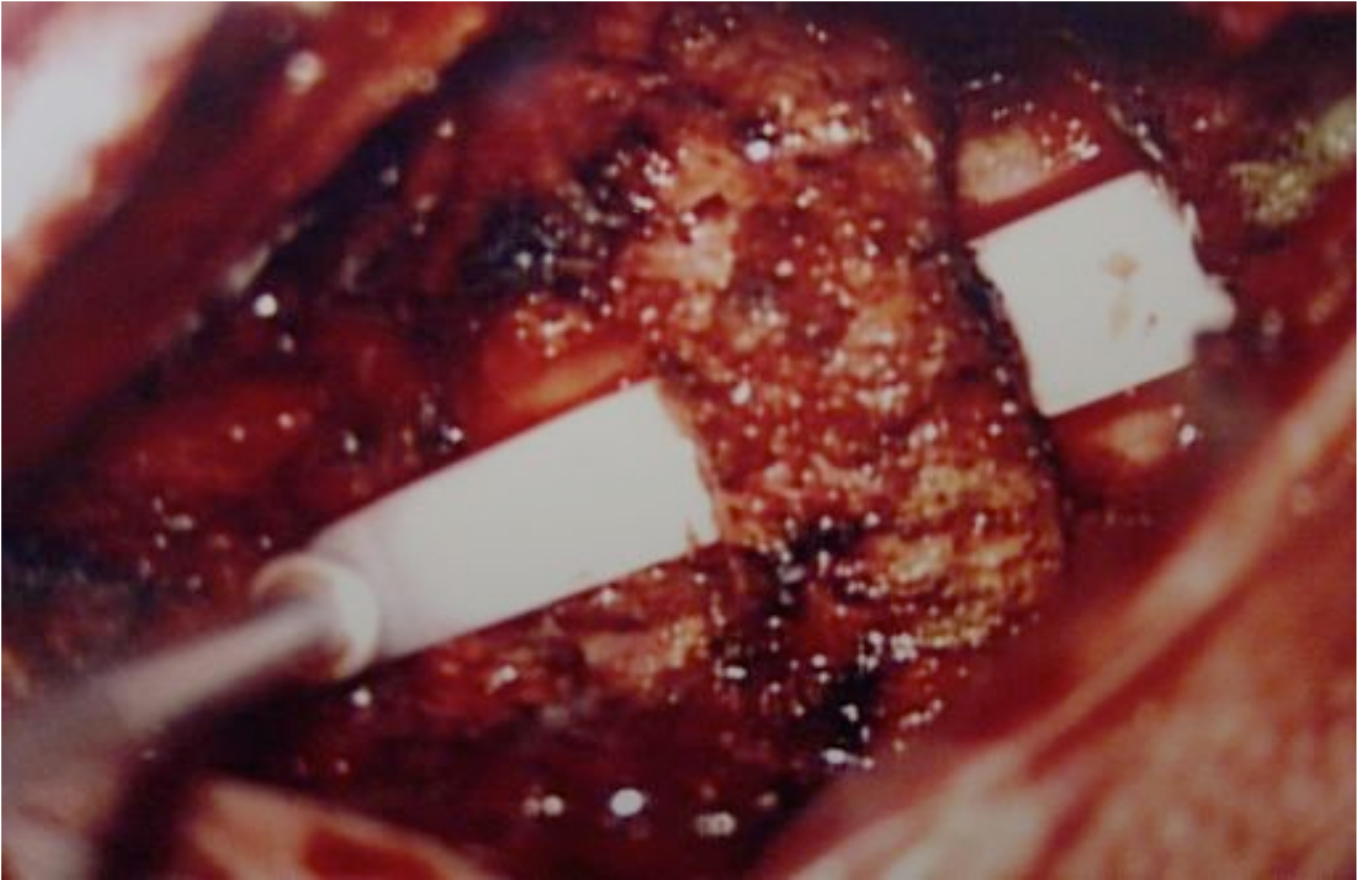


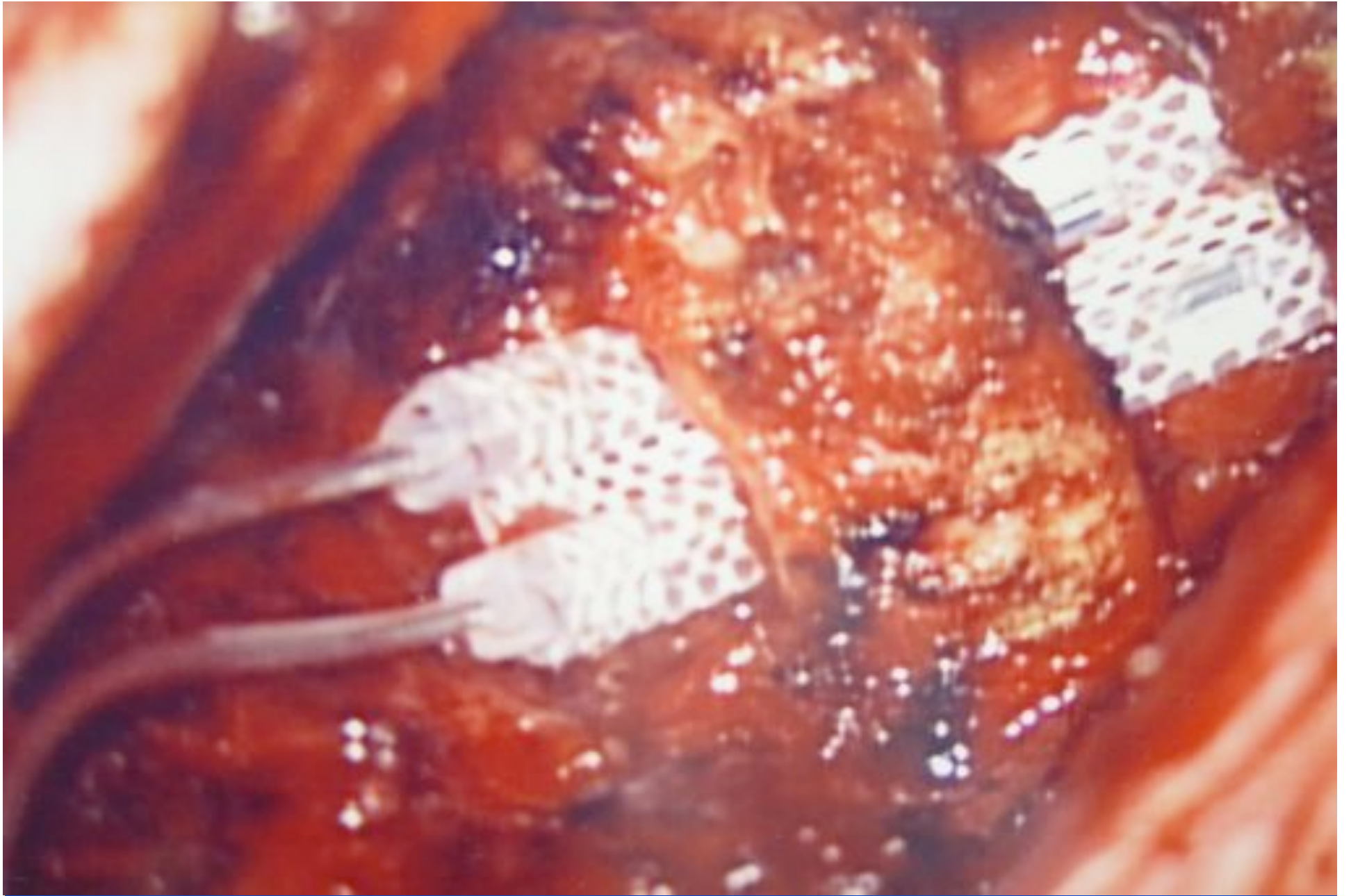
Lin
W:480 L:450

SIZES ARE APPROXIMATE

C1-2 Retro Neurostimulation







V1 Post Herpetic Neuralgia

- 85 y/o W/F with PHN 6 years right V1 forehead
- Unable to wear makeup or wash area
- Unresponsive to topical creams
- Some temporary response to ASA/Chloroform
- Long-term relief with V1 subcutaneous stimulation

Supraorbital electrode placement





Face Pain Disorders

- Trigeminal Neuralgia
 - Typical, Atypical
- Glossopharyngeal Neuralgia
- Postherpetic Neuralgia
- Geniculate Neuralgia
- Vagal / Superior Laryngeal Neuralgia
- Occipital Neuralgia
- “MS-related” face pain
- Cluster headache
- Fibromyalgia
- Anesthesia Dolorosa
- Atypical Odontalgia
- Hemi-facial spasm
- TMJ
- Facial Tendonitis
- Sinusitis, Dental Problems
- Migraine variants
- **“Atypical Facial Pain Syndrome” - PIFP**

Persistent Idiopathic Facial Pain

- Pain along trigeminal nerve pathway but poorly localized
- Does not fit classic neuralgia presentation/no sensory loss
- Continuous or near continuous
- Unilateral, no autonomic signs/symptoms
- Severe ache, crushing or burning sensation
- Normal workup





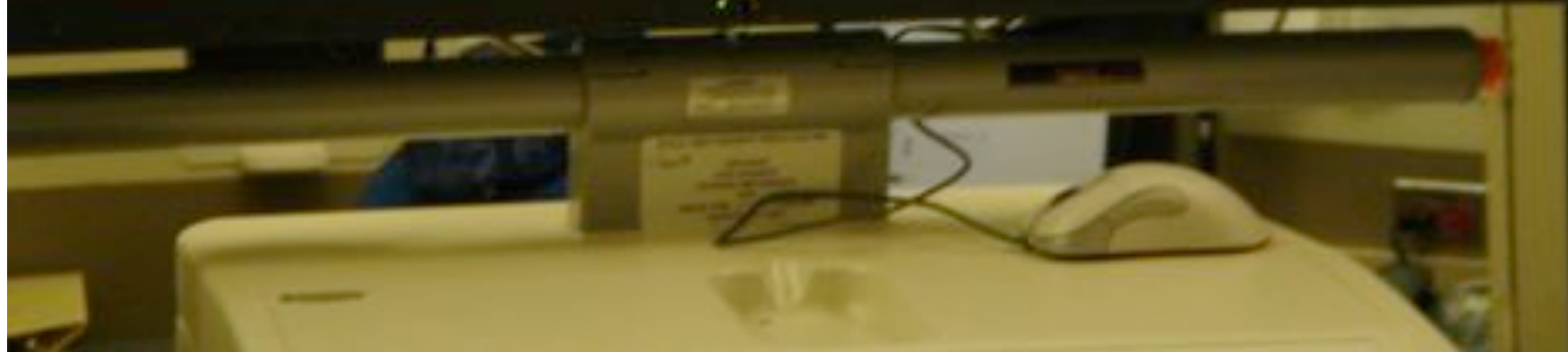
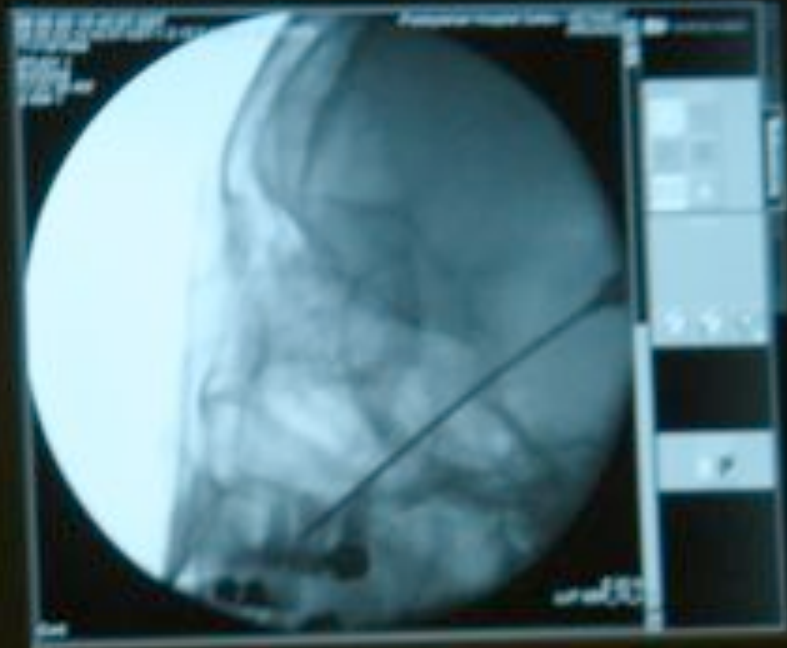




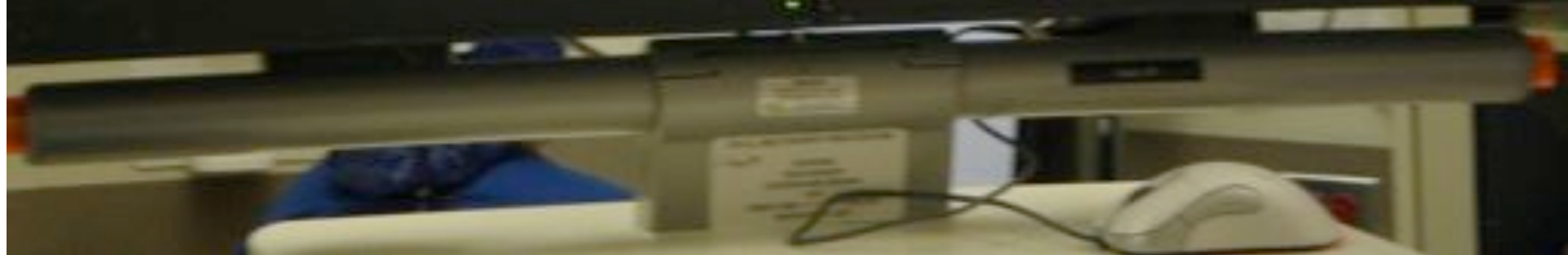
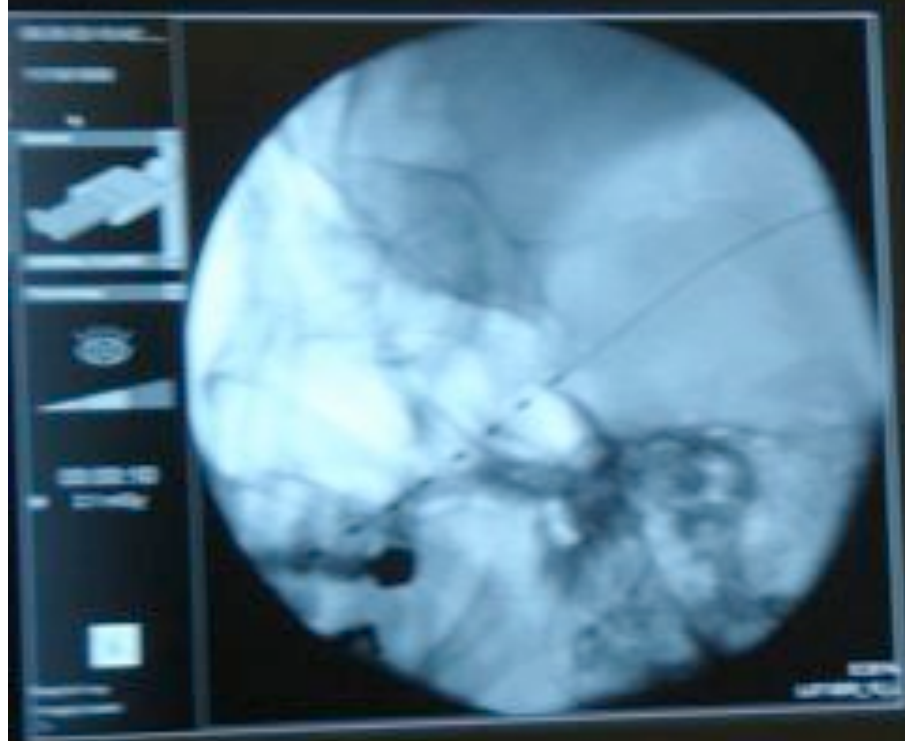




DO NOT UNPLUG C-ARM UNTIL BOTH MONITORS ARE COMPLETELY SHUT DOWN

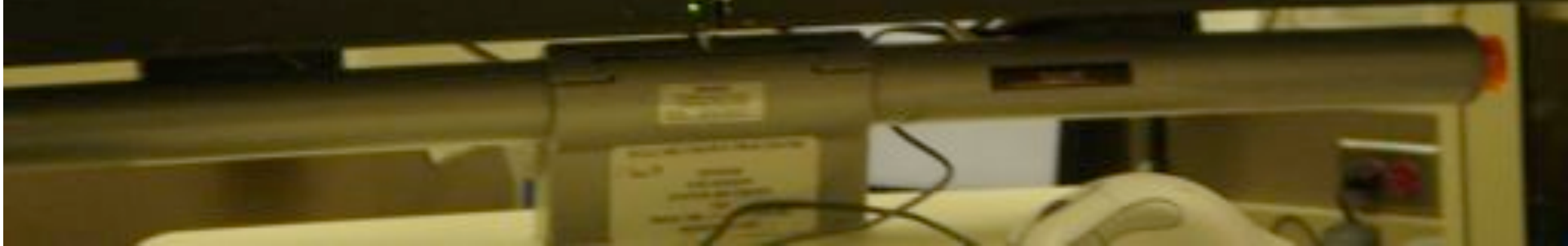


DO NOT UNPLUG C-ARM UNTIL BOTH MONITORS ARE COMPLETELY SHUT DOWN





DO NOT UNPLUG C-ARM UNTIL BOTH MONITORS ARE COMPLETELY SHUT DOWN









IMPLANT COMPLICATIONS

- Migration
- Infection
- Loss of Pain Control
- Altered response to stim
- Wrong Patient





Headache Variations in Reponders

- Abort intermittent paroxysmal pain
- Attenuate migraine trigger
- Block chronic and intermittent daily pain
- Block exacerbations of chronic pain

Occipital Neurostimulation Outcomes 1994 - 2009

- **70 to 75% long term success rate**
- **Reduction in narcotic and tryptan meds**
- **Improved quality of life**
- **VAS Score mean reduction approx 9 to 3**

Mechanisms of Action

- Subcutaneous Electrical Conduction
- Local Innervation
- Dermatomal Stimulation
- Myotomal Stimulation
- Sympathetic Stimulation
- Neurochemistry
- Blood Flow Alteration
- Trigeminovascular System

TRIGEMINOVASCULAR COMPLEX

- Descending Tract of V
- Convergence with C2, C3
- Primary relay center to thalamus for head and neck mechanoreceptors and nociceptors

ONS MECHANISMS

The therapeutic benefit of neurostimulation appears to depend on the production of an agreeable sensation in the distribution of the major pain components associated with the affected occipital nerve innervation

This sensation is actually activation of Ab (large afferent) mechanoreceptive fibers in the occipital nerve trunk or its distribution

Headache pain is modulated in two ways:

- Pain inhibition

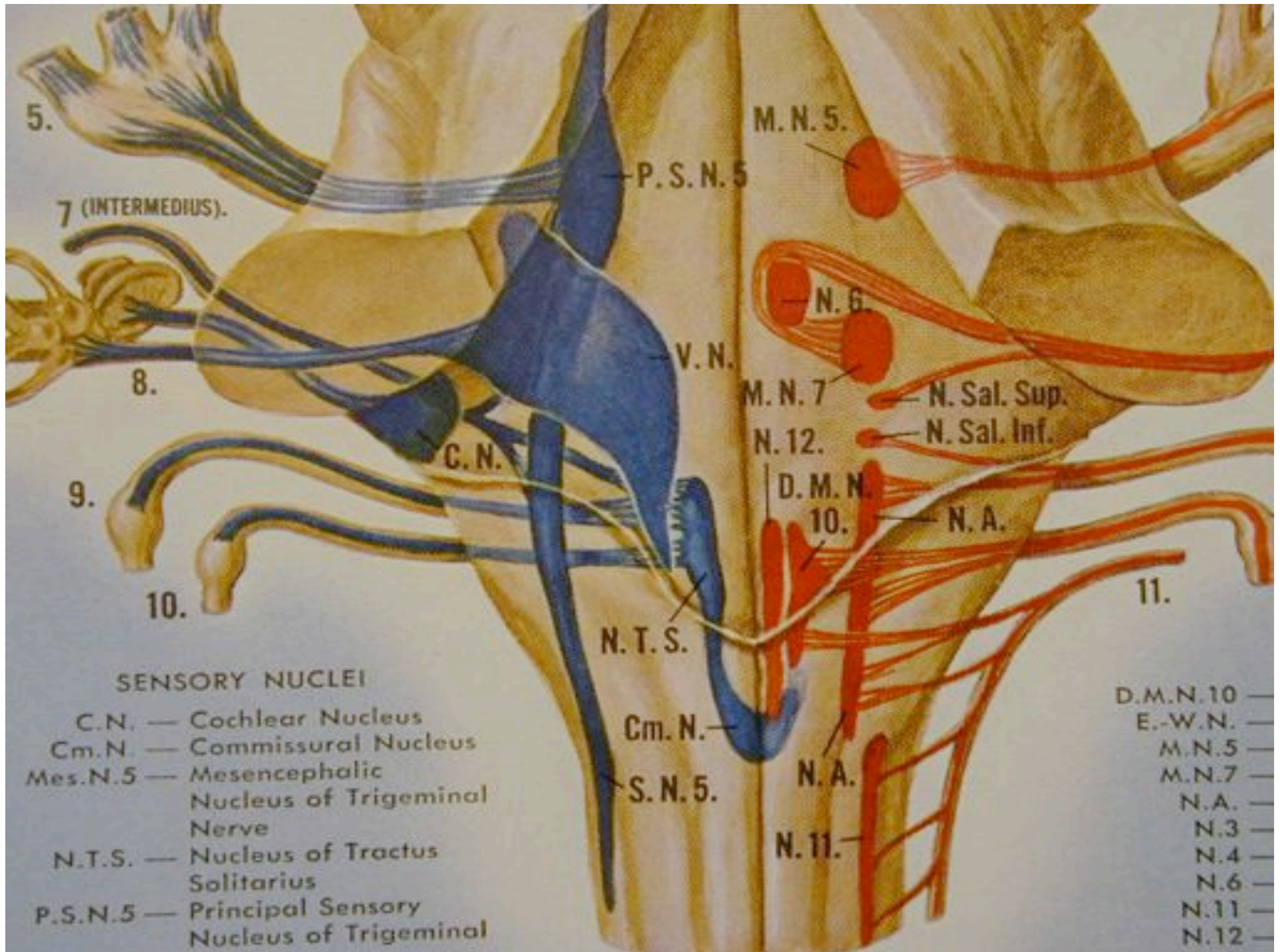
- Modulation of perception (attention)

PAIN INHIBITION

- Ab stimulation inhibits c fiber transmission
- Pain control when mechanoreceptors and nociceptors converge in same sensory level or sensory nuclei
- Migraine and other headache pains thought to have major meningeal nociceptor component which converge with V1 and occipital nerves
- Convergence to TVC, relay to thalamus
- ONS suppresses TVC signals before reaching thalamus

MODULATION OF PERCEPTION (ATTENTION)

- ONS modulation influences higher brain perception of central pain signals (descending control)
- Migraine - disturbance of subcortical sensory modulation systems
- PET studies show brain pays too much attention to trigeminal nociceptive signals
- ONS might distract the brain from excessive nociception input



Chronic Migraine



PET rCBF Interpretation

- Brainstem is “generator” of migraine attacks rather than activated by pain
- This region specific to Migraine
- PAG – GABA modulation of descending pain inhibitory pathways

Conclusions

- **Attention to the upper cervical roots and occipital nerve tributaries during surgical dissection might help reduce the incidence of post operative occipital neuropathy**
- **Subcutaneous peripheral nerve stimulation localized to the C1 level of one or more occipital nerves can effectively control medically refractory C2 mediated occipital headaches and is a safe and uncomplicated procedure for consideration**
- **Subcutaneous stimulation can be applied to many chronic pain conditions about the trunk, limbs and head**



