First Annual Cedars-Sinai Intracranial Hypotension Symposium - October 14, 2017: Developments in Surgical Approaches

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- Anesthesiology

  Charles Louy, M.D., Ph.D.

  

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  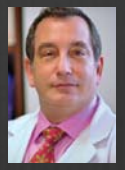

Spontaneous intracranial hypotension November 1991

My first patient

Memre L. DOS: 11-24-1991

22 year-old woman

6 week history of orthostatic headaches

CT brain: “normal”

CT-myelogram: single thoracic nerve root cyst

Treatment: surgery

Outcome: complete recovery, no recurrence (follow-up: 23 years)

J Neurosurg 80:736–739, 1994

Surgical treatment of spontaneous intracranial hypotension associated with a spinal arachnoid diverticulum

Case report

WOUTER I. SCHIEVINK, M.D., RONALD REIMER, M.D., AND W. NEATH FOLGER, M.D.

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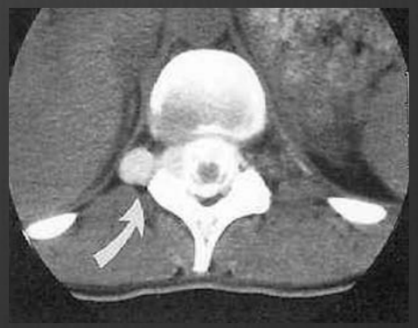
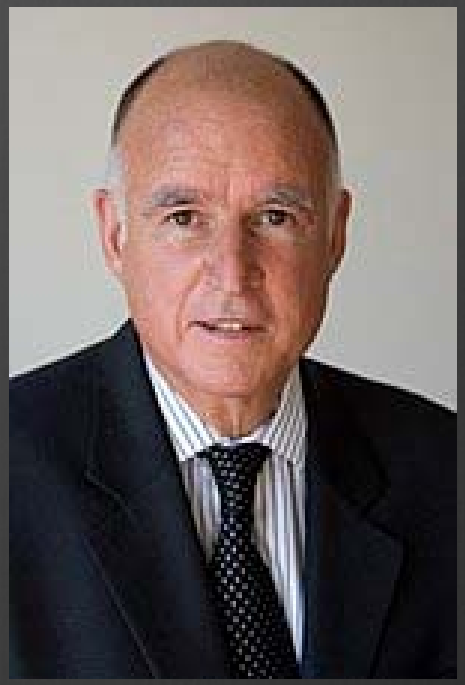


Spontaneous Intracranial Hypotension October 2017

- Routine practice?



Spontaneous intracranial hypotension
Cedars-Sinai Medical Center (1-1-2001 to 6-30-2017)

- Approximately 1450 patients evaluated

977 patients met ICHD-III criteria:

CSF leak on spinal imaging

Brain MRI with sagging/meningeal enhancement/SDH

Opening pressure less than 6.0

First 107 patients evaluated: 89 (83%) met ICHD-III criteria

Last 107 patients evaluated: 26 (24%) met ICHD-III criteria

Diagnostic evaluation

Towards a “non-invasive” diagnostic work up

i.e., no spinal tap and minimizing ionizing radiation

MRI or CT brain

MRI spine/MRMyelography

Epidural blood patching

Percutaneous fibrin glue placement

Surgery

Advances in surgical treatment for SIH

- Understanding the anatomy of CSF leaks

  Through – advances in imaging

  advances in imaging

  advances in imaging

  intraoperative observations

- Developments of novel treatments

Advances in treatment of SIH

- 1953 Epidural blood patch (Nosik, JAMA 1955)
- 1997 Bony microspurs (Vishteh, Schievink, Baskin, et al: J Neurosurg 1998)
- 2001 High volume epidural blood patching (Louy, Schievink – not published)
- 2003 Percutaneous glue (Schievink, Maya, Moser: J Neurosurg 2004)
- 2003 Dynamic CT-myelography (Luetmer, Mokri: AJNR 2003)
- 2003 False localizing leaks @ C1-2 (Schievink, Maya, Moser: J Neurosurg 2004)
- 2008 Digital subtraction myelography (Hoxworth, Patel, Bosch: AJNR 2009)
- 2010 False localizing leaks @ CTJx (Schievink, Maya, Moser: Neurology 2015)
- 2013 CSF-venous fistulas (Schievink, Moser, Maya: Neurology 2014)

Cause of intracranial hypotension is

- **Spinal CSF leak**

- **Pooling of CSF**

- Inadequate CSF production?
- Rapid CSF absorption?

- ? CSF rhinorrhea–otorrhoea ?

NEVER

Lack of causal association between spontaneous intracranial hypotension and cranial cerebrospinal fluid leaks

Clinical article

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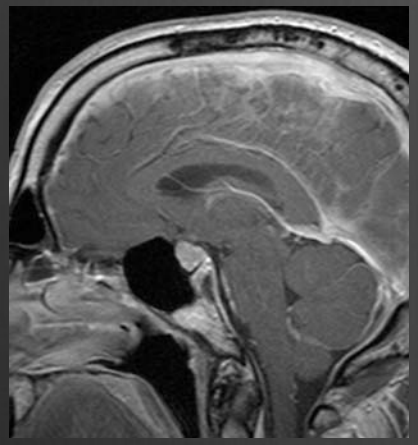
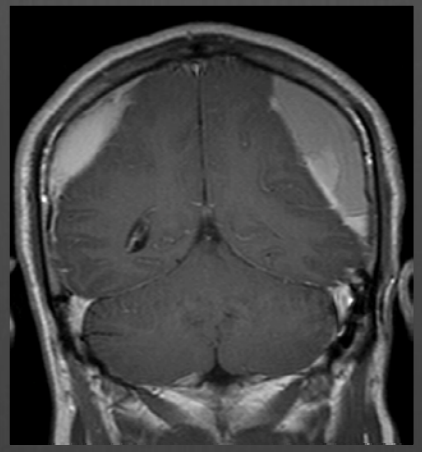
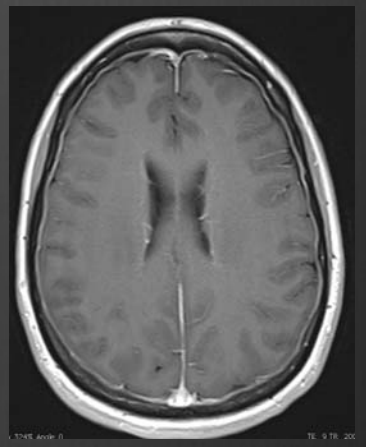
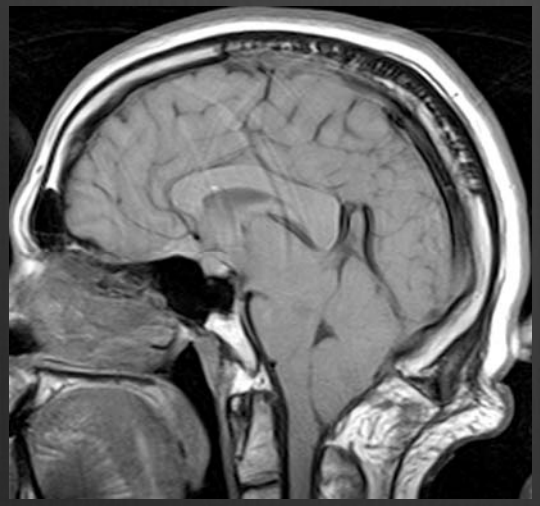
Departments of [1]Neurosurgery and [3]Radiology, Cedars-Sinai Medical Center; [2]House Clinic, Los Angeles, California; and [4]Department of Neurology, Geisinger Specialty Clinic, Wilkes-Barre, Pennsylvania

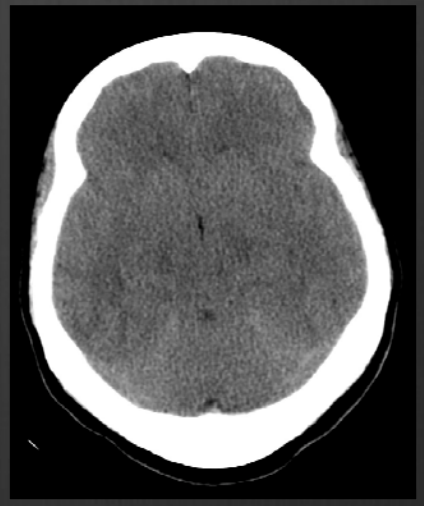
Misfortunes in spontaneous intracranial hypotension











Detection of CSF Leak

- MRI/MR-myelography
- ~~Radionuclide Cisternography~~
- ~~CT-Myelography~~/Digital Subtraction Myelography (DSM)
- Intrathecal gado-enhanced MRI

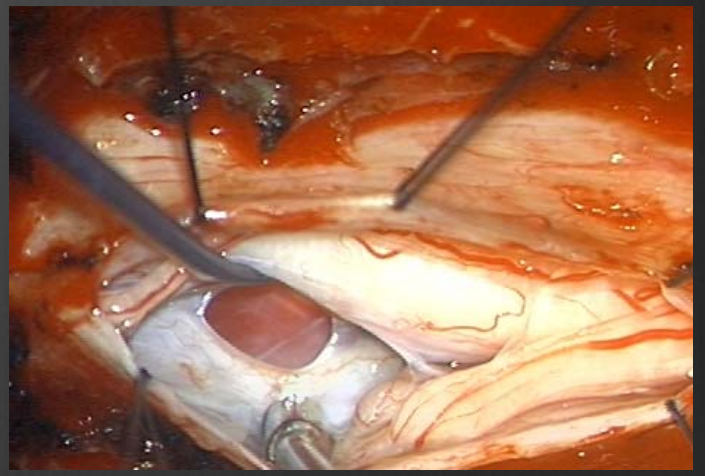
Classification of Spontaneous Spinal CSF Leaks (n=568)

- Type 1: Dural tear
- Type 2: Arachnoid cyst
- Type 3: CSF-venous fistula
- Type 4: Indeterminate

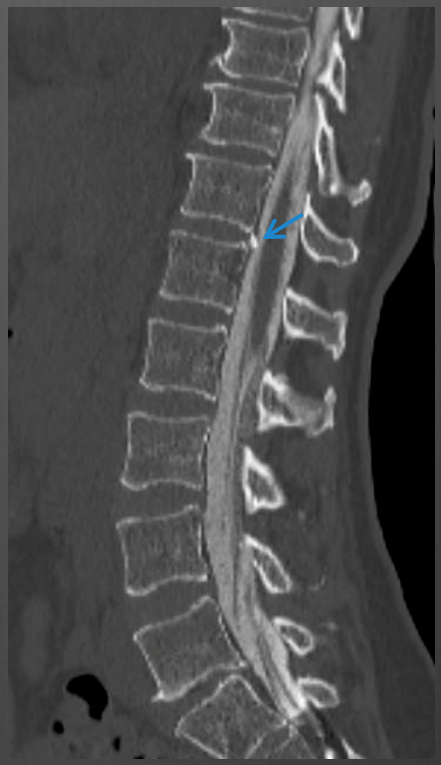
Type 1 CSF leak

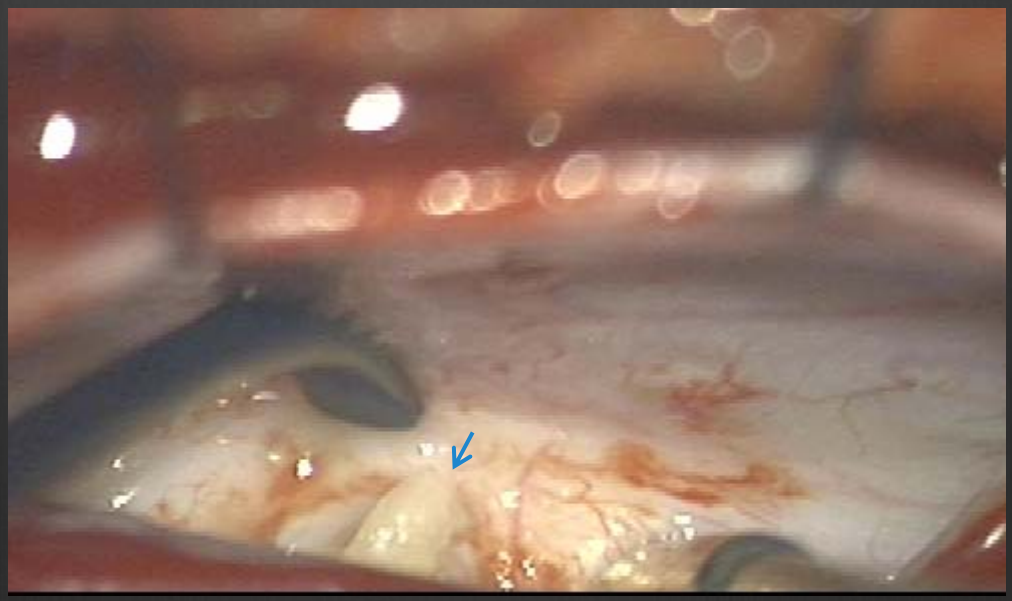
n=151 (26.6%)

- 1 a = ventral leak 145 (96%)
- 1 b = postero-lateral leak 6 (4%)

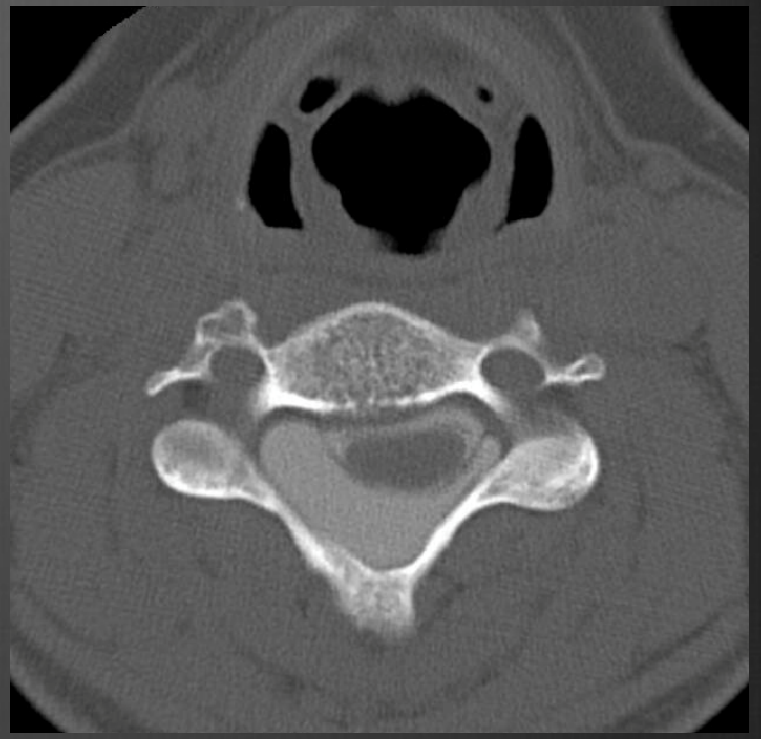


Type 1a





Type 1a



Type 1b

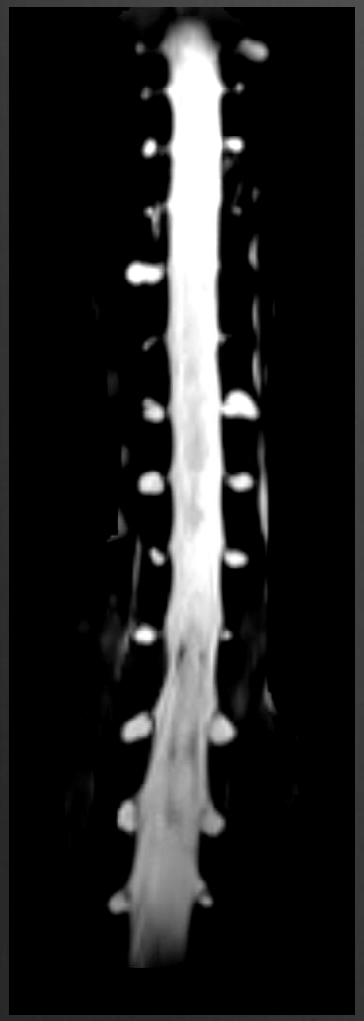
Type 1 CSF leak

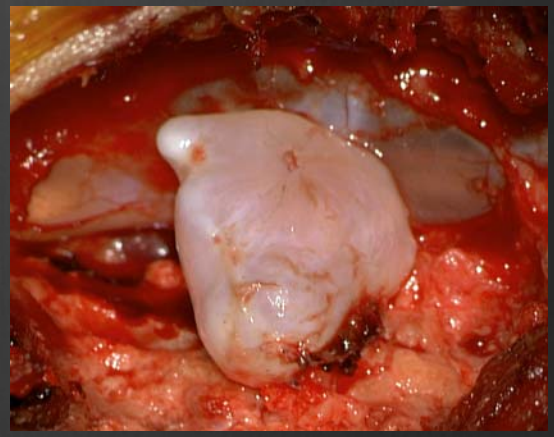
- Surgery in 125/145 (86%) patients with type 1a CSF leak
- Surgery in 5/6 (83%) patients with type 1b CSF leak

Type 2 CSF leak

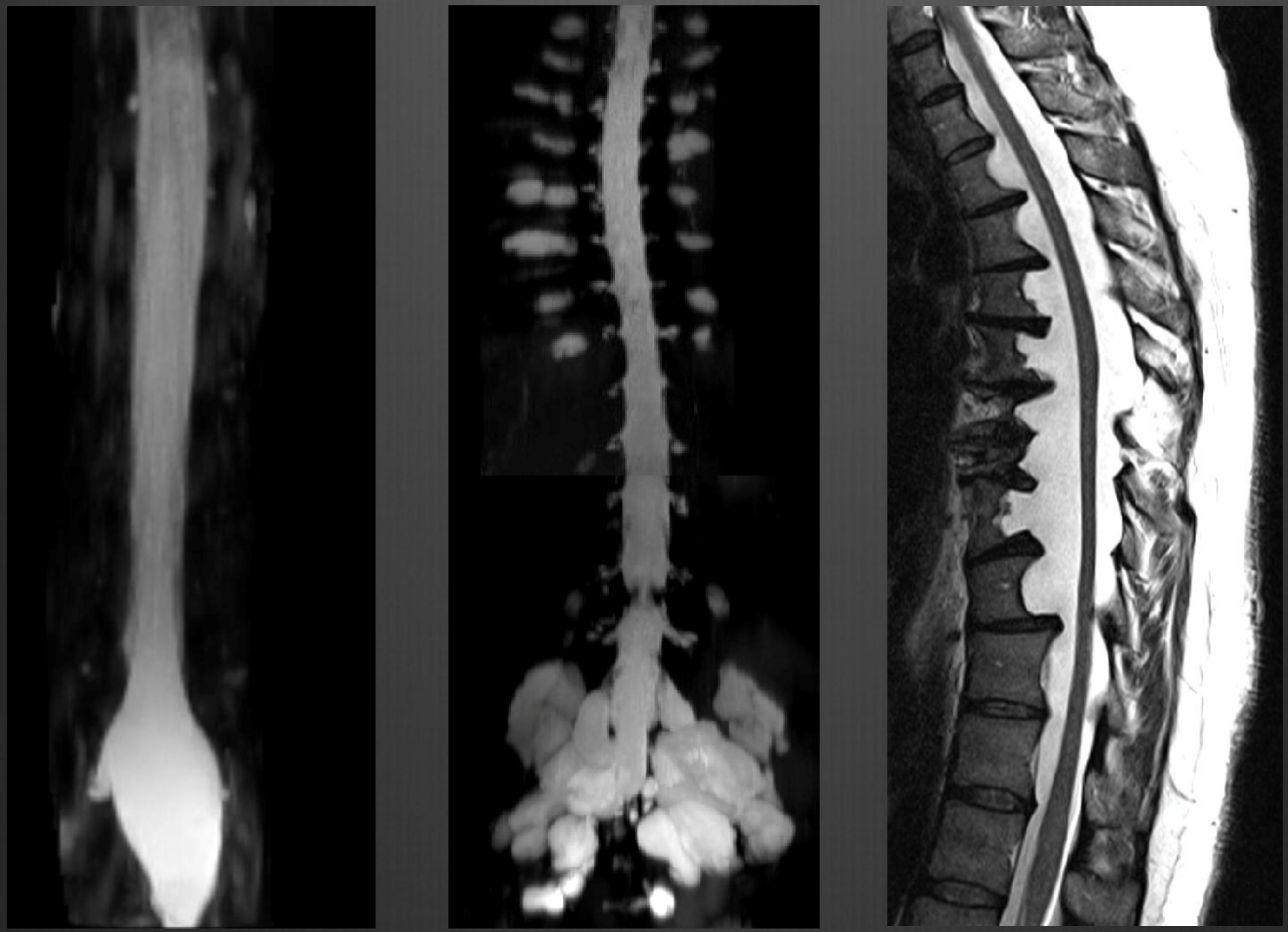
n = 240 (42.3%)

- 2 a = simple meningeal diverticulum n= 218 (91%)
- 2 b = complex meningeal diverticulum/ dural ectasia n=22 (9%)





Type 2a



Type 2b

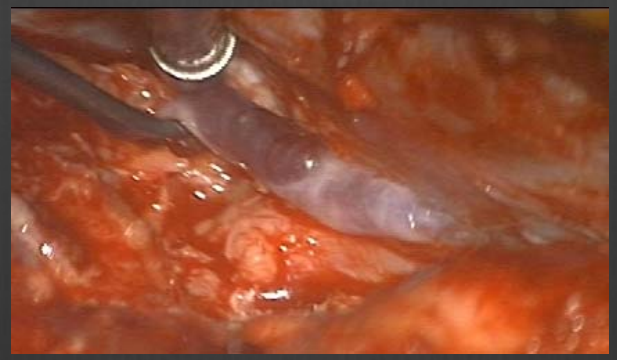
Type 2 CSF leak

- Surgery in 110/218 (51%) patients with type 2a CSF leak
- Surgery in 9/22 (41%) patients with type 2b CSF leak

Type 3 CSF leak

N = 14 (2.5%)



Type 3

Type 3 CSF leak

- Surgery in 12/14 (86%) patients with type 3 CSF leak

Type 4 CSF leak

N=163 (28.7%)

Type 4 CSF leak

- Surgery in 23/163 (14%) patients with type 4 CSF leak

False localizing signs in SIH

J Neurosurg 100:639–644, 2004

False localizing sign of C1–2 cerebrospinal fluid leak in spontaneous intracranial hypotension

Wouter I. Schievink, M.D., M. Marcel Maya, M.D., and James Tourje, M.D.

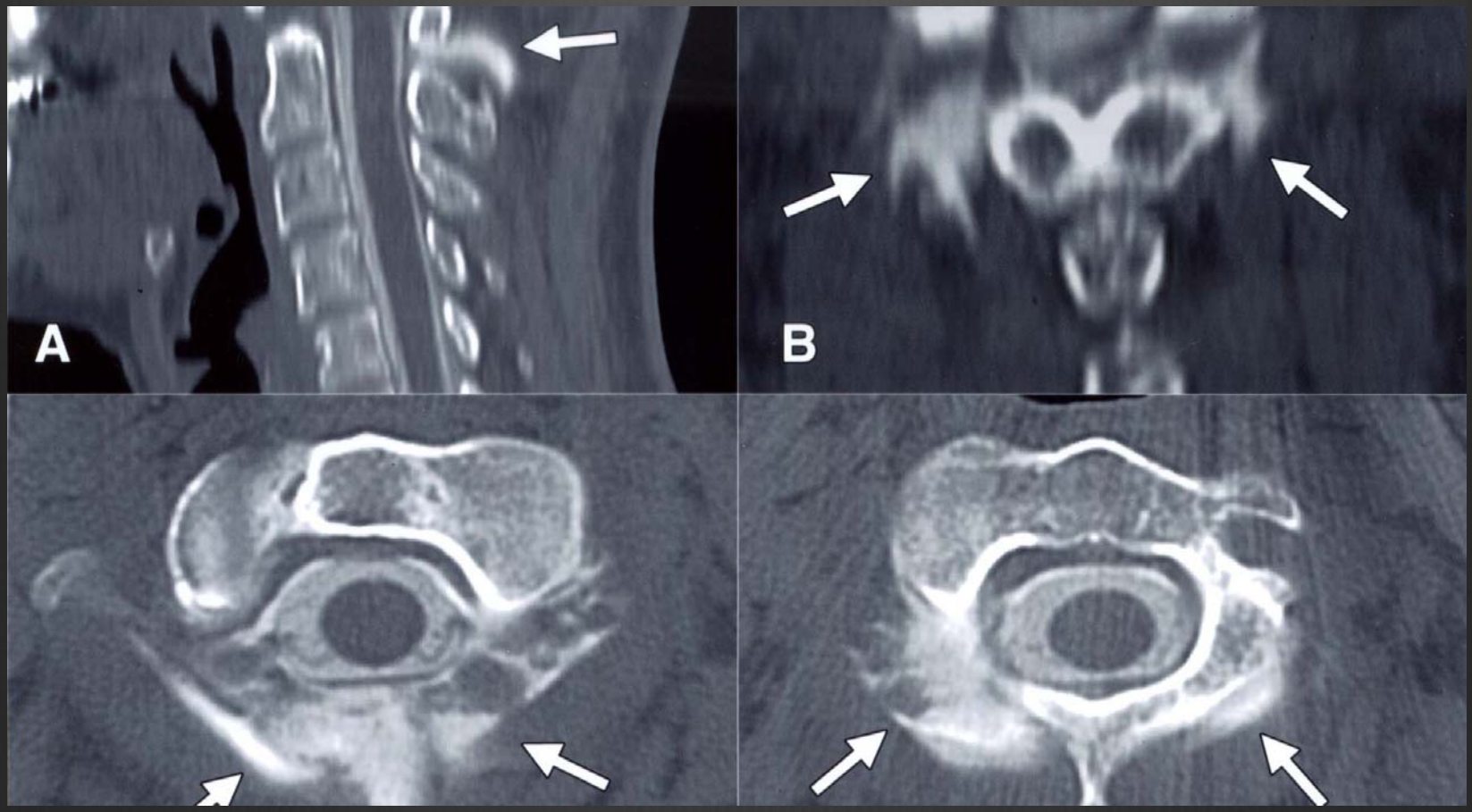
Maxine Dunitz Neurosurgical Institute and Imaging Medical Group, Cedars-Sinai Medical Center, Los Angeles, California

Object. Spontaneous intracranial hypotension due to a spinal cerebrospinal fluid (CSF) leak is an important cause of new daily persistent headaches. Spinal neuroimaging is important in the treatment of these patients, particularly when direct repair of the CSF leak is contemplated. Retrospinal C1–2 fluid collections may be noted on spinal imaging and these are generally believed to correspond to the site of the CSF leak. The authors undertook a study to determine the significance of these C1–2 fluid collections.

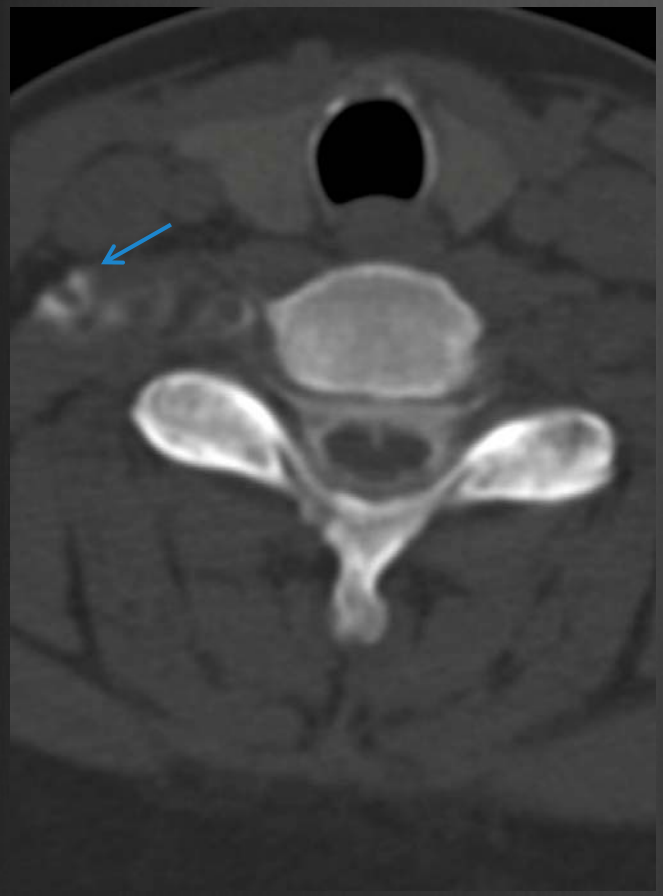
Methods. The patient population consisted of a consecutive group of 25 patients (18 female and seven male) who were evaluated for surgical repair of a spontaneous spinal CSF leak. The mean age of the 18 patients was 38 years (range 13–72 years). All patients underwent computerized tomography myelography. Three patients (12%) had extensive retrospinal C1–2 fluid collections; the mean age of this woman and these two men was 41 years (range 39–43 years). The actual site of the CSF leak was located at the lower cervical spine in these patients and did not correspond to the site of the retrospinal C1–2 fluid collection.

Conclusions. A retrospinal fluid collection at the C1–2 level does not necessarily indicate the site of the CSF leak in patients with spontaneous intracranial hypotension. This is an important consideration in the treatment of these patients because therapy may be inadvertently directed at this site.

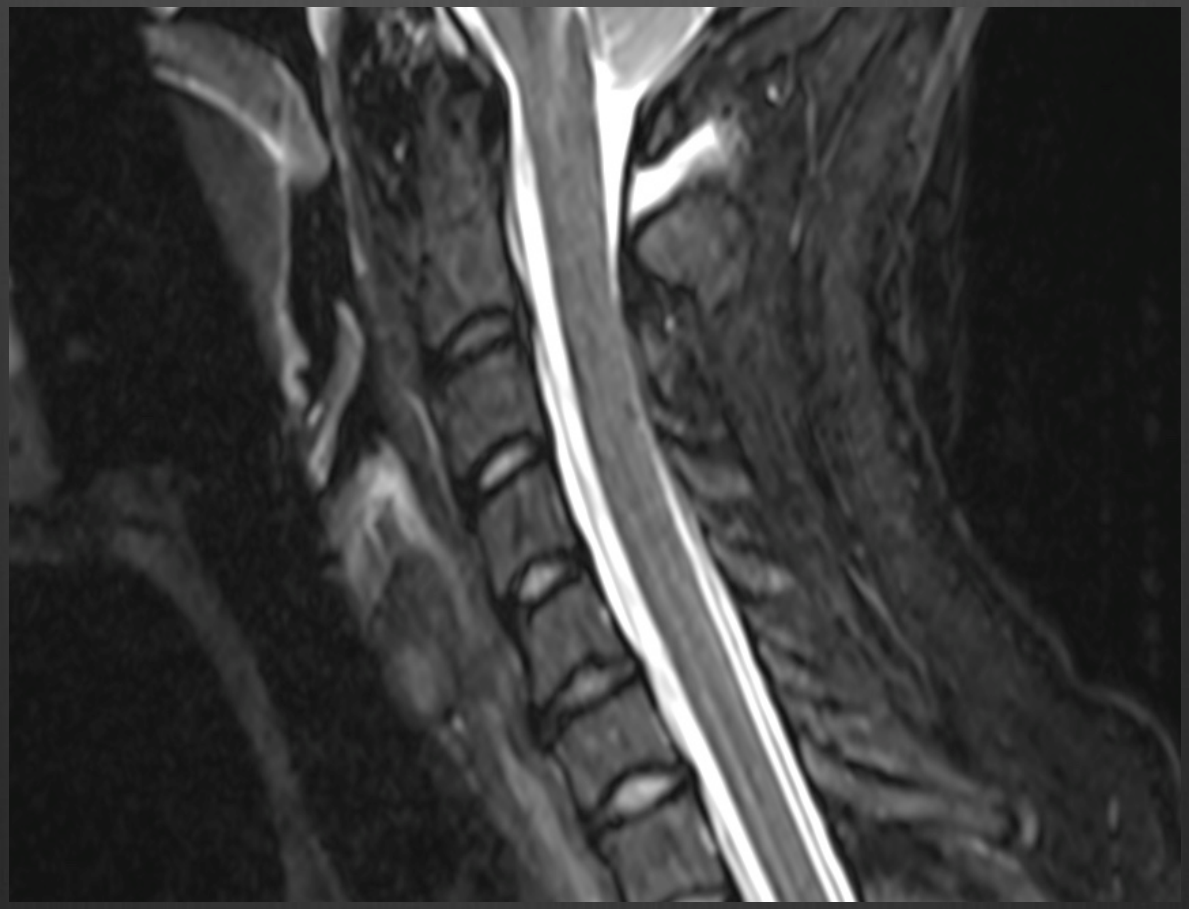
C1-2 false localizing sign



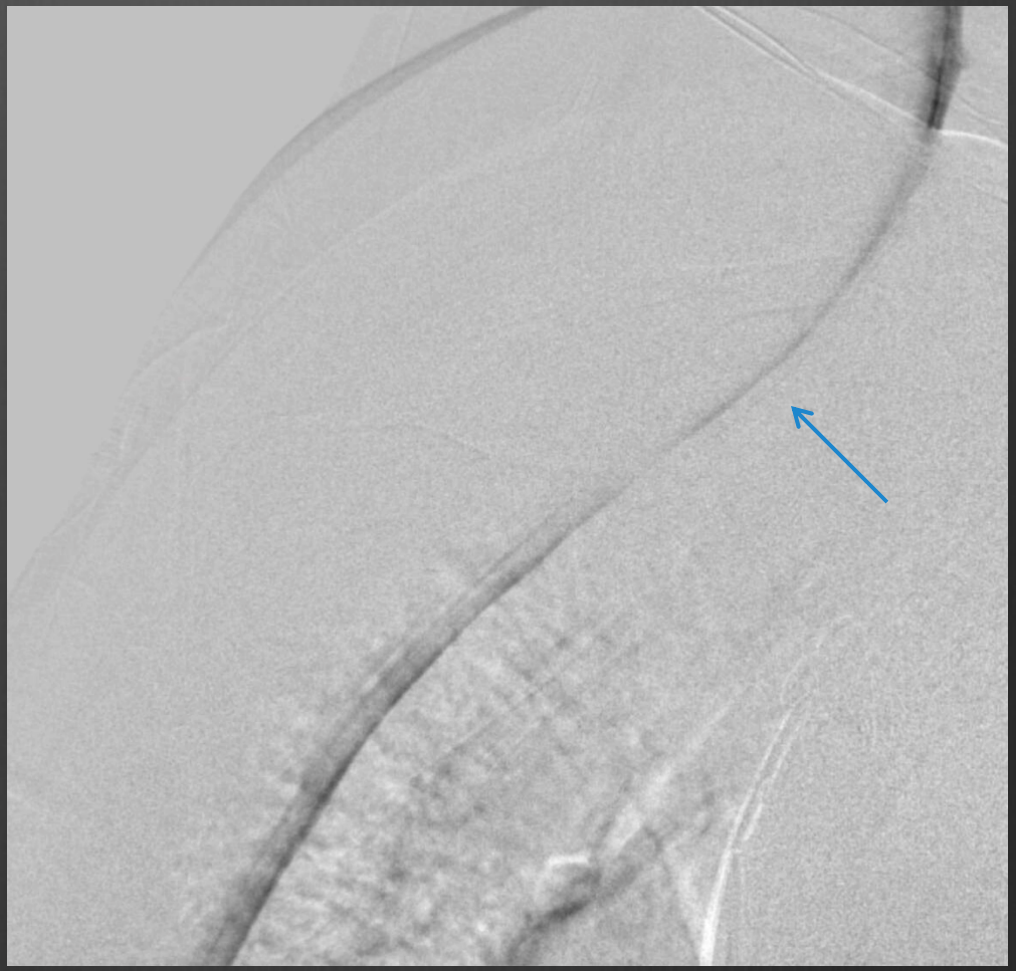
Cervico-thoracic false localizing sign

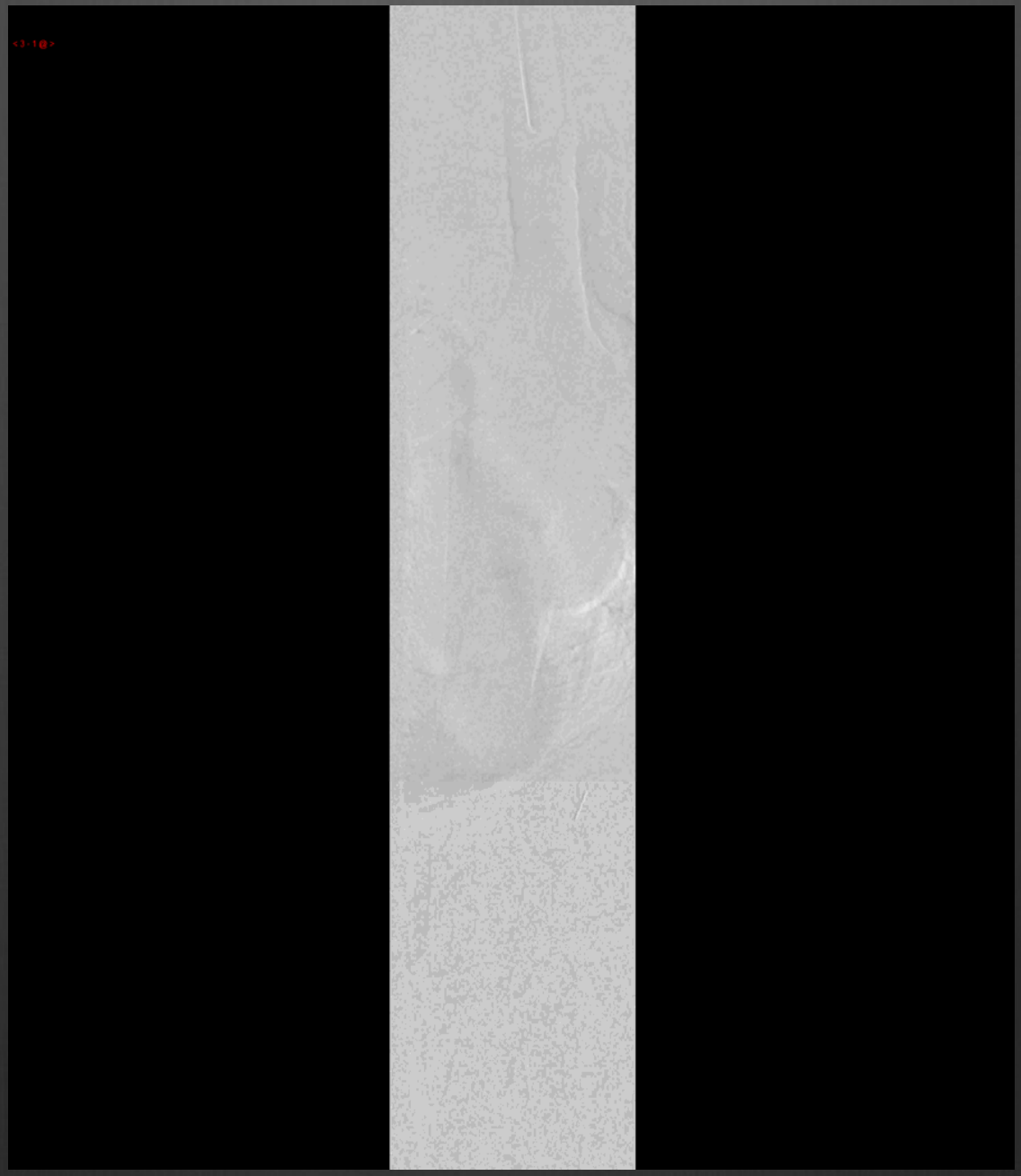


C1-2 false localizing sign



Ventral spinal CSF leaks – Digital subtraction myelography





Looking for a ventral CSF leak

- DSM
- DSM
- Dynamic CT-myelogram
- Bony spicule

Bony spicule as cause of type 1a ventral CSF leak

J Neurosurg 89:483–484, 1998

Cervical bone spur presenting with spontaneous intracranial hypotension

Case report

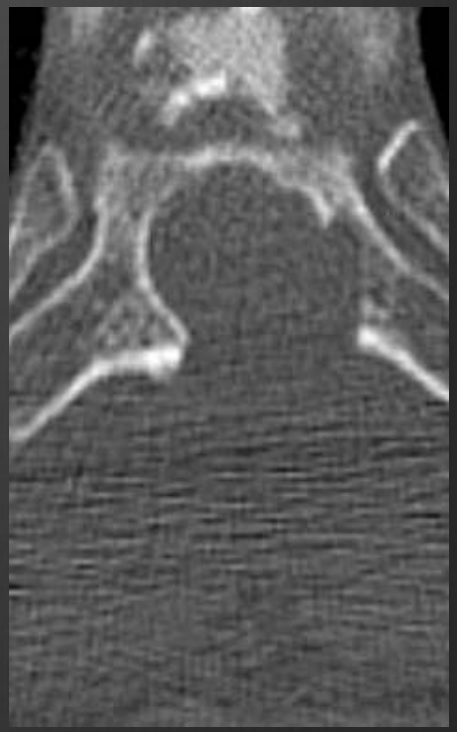
A. Giancarlo Vishteh, M.D., Wouter I. Schievink, M.D., Jonathan J. Baskin, M.D., and Volker K. H. Sonntag, M.D.

Division of Neurological Surgery, Barrow Neurological Institute, Mercy Healthcare Arizona, Phoenix, Arizona

Spontaneous intracranial hypotension due to a spinal cerebrospinal fluid (CSF) leak is a rare but increasingly recognized cause of postural headaches. The exact cause of these CSF leaks often remains unknown. The authors treated a 32-year-old man with a unique cause of spontaneous intracranial hypotension. He suffered an excruciating headache that was exacerbated by his being in an upright position. The results of four-vessel cerebral angiography were negative; however, magnetic resonance (MR) imaging of the brain revealed pachymeningeal enhancement and hindbrain herniation. A presumptive diagnosis of spontaneous intracranial hypotension was made. Myelography revealed extrathecal contrast material ventral to the cervical spinal cord as well as an unusual midline bone spur at C5–6. The patient's symptoms did not resolve with the application of epidural blood patches, and he subsequently underwent an anterior approach to the C5–6 spur. After discectomy, a slender bone spur that had pierced the thecal sac was found. After its removal, the dural rent was closed using two interrupted prolene sutures. The patient was discharged home 2 days later. On follow up his symptoms had resolved, and on MR imaging the pachymeningeal enhancement had resolved and the cerebellar herniation had improved slightly.

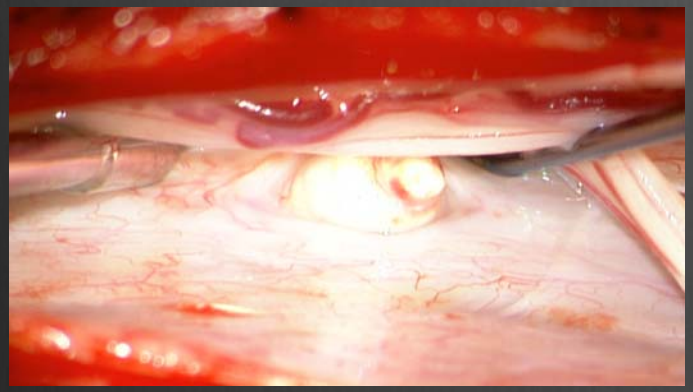
Bony spicules in SIH

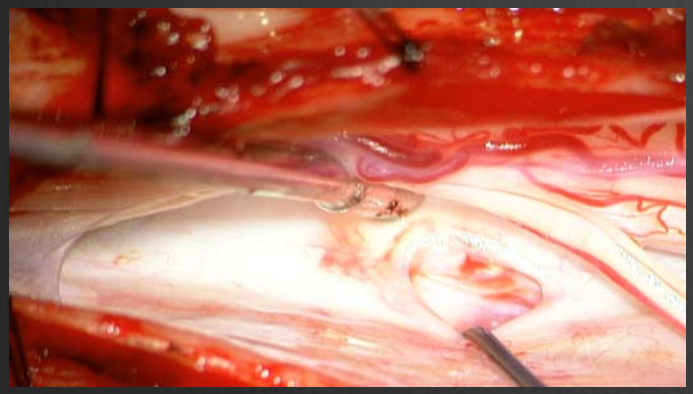
Pre-op



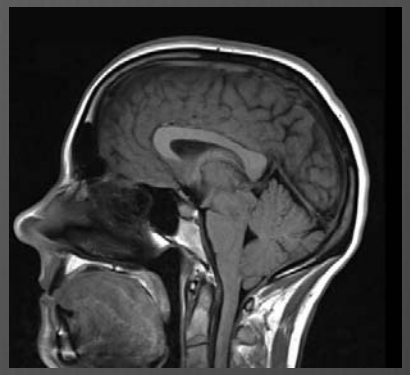
Post-op

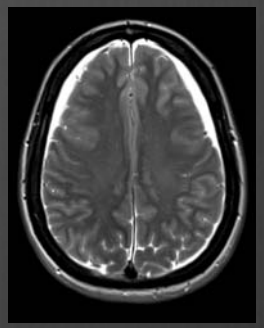
Intra-op



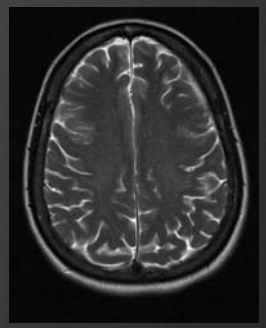


Pre-op





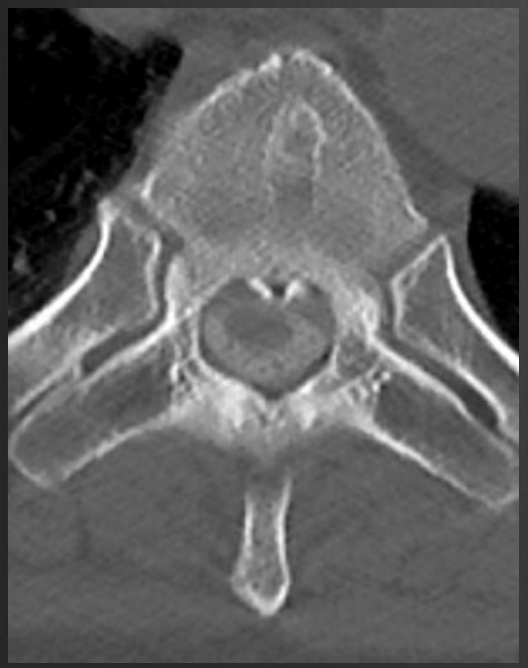
Post-op



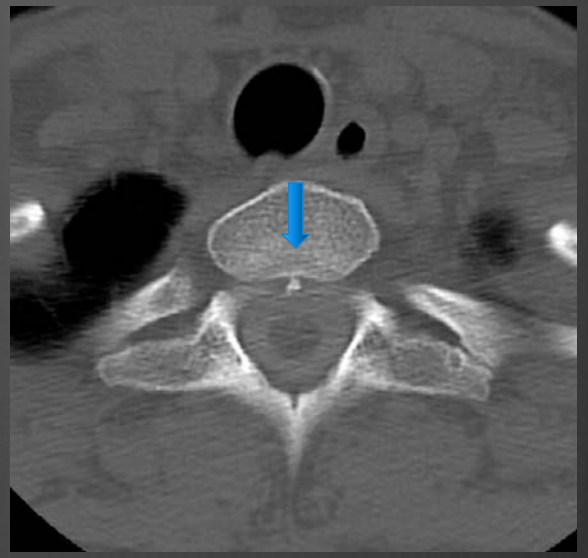
Caveats in identification of bony spicule as source of ventral type 1a CSF leak

- Present in 82% of patients (91/111 patients)
- Multiple spicules – not always the largest
- Absorption of spicule over time

Not always the largest spicule



Absorption of spicule over time



8 months

Surgical Repair

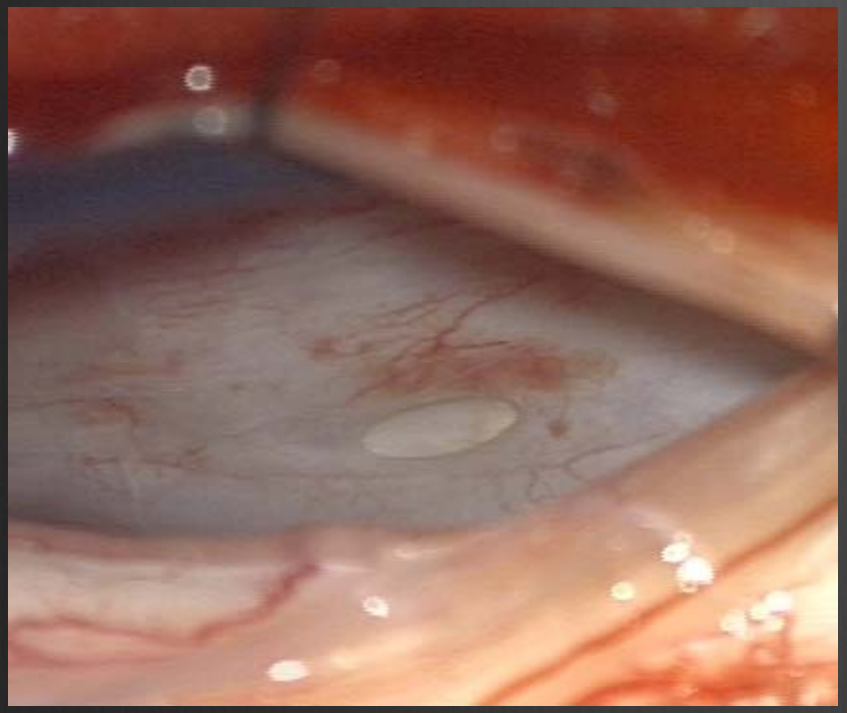
- Suturing
- Muscle graft
- Clipping of cyst

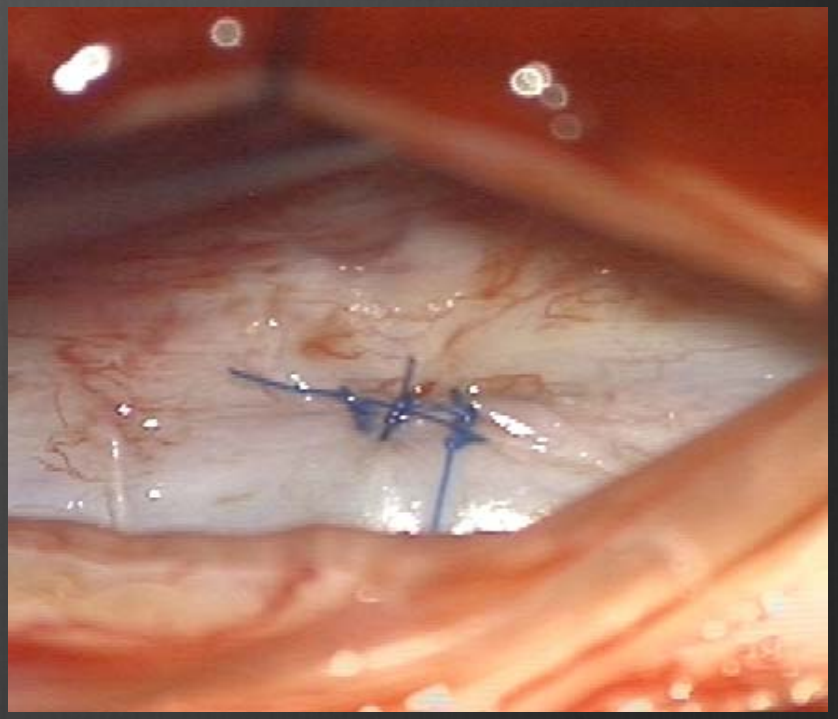
2017

- Fibrin glue/blood
- Gel foam

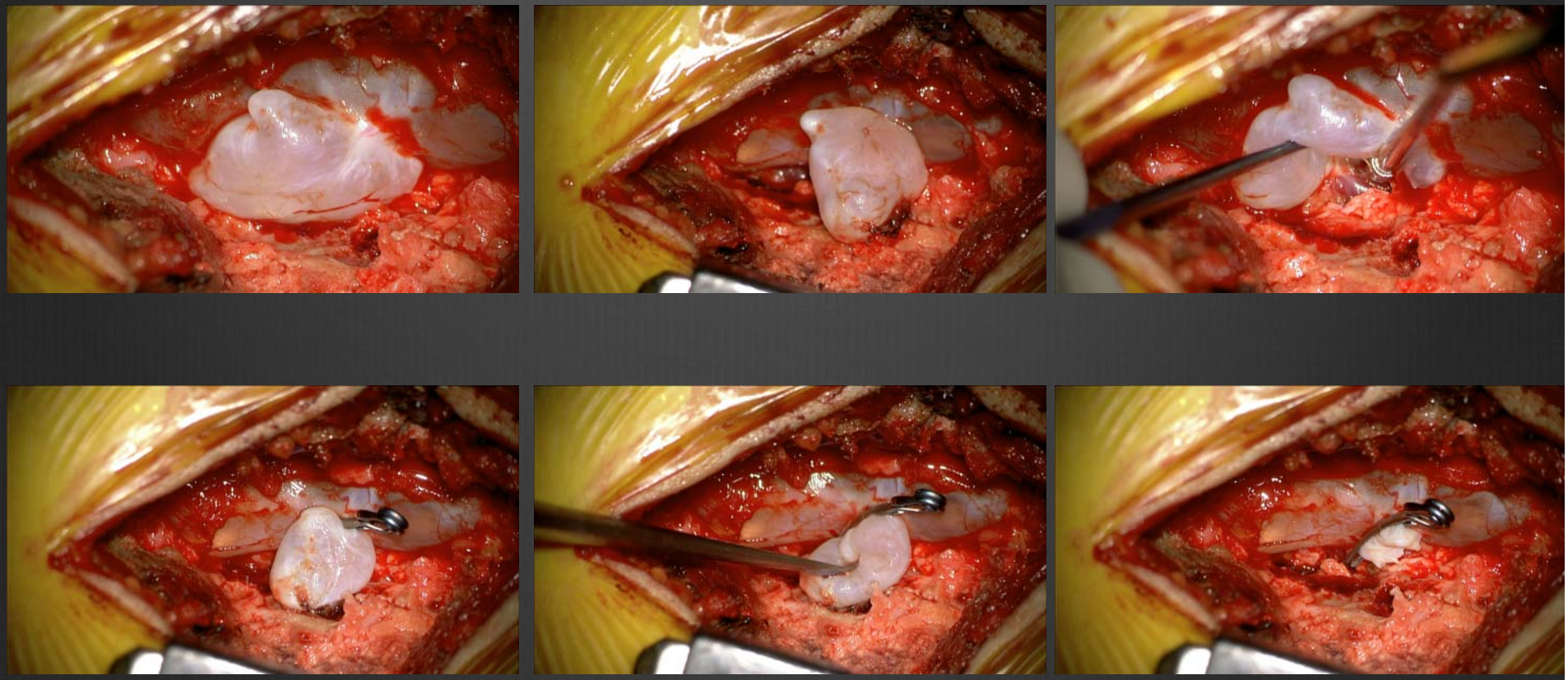
20th century

Ventral leak – surgical repair

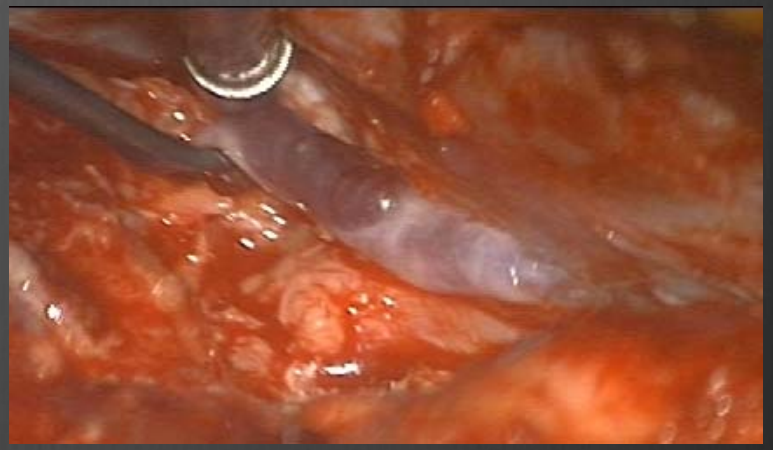


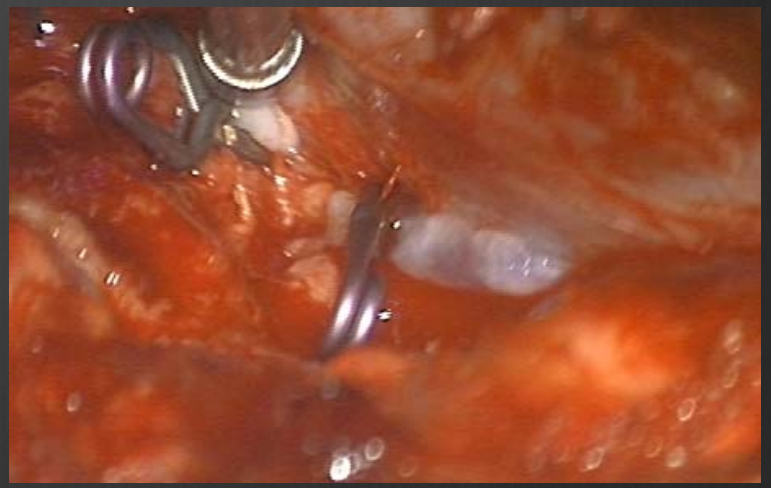


Arachnoid cysts – surgical repair



CSF–venous fistula – surgical repair



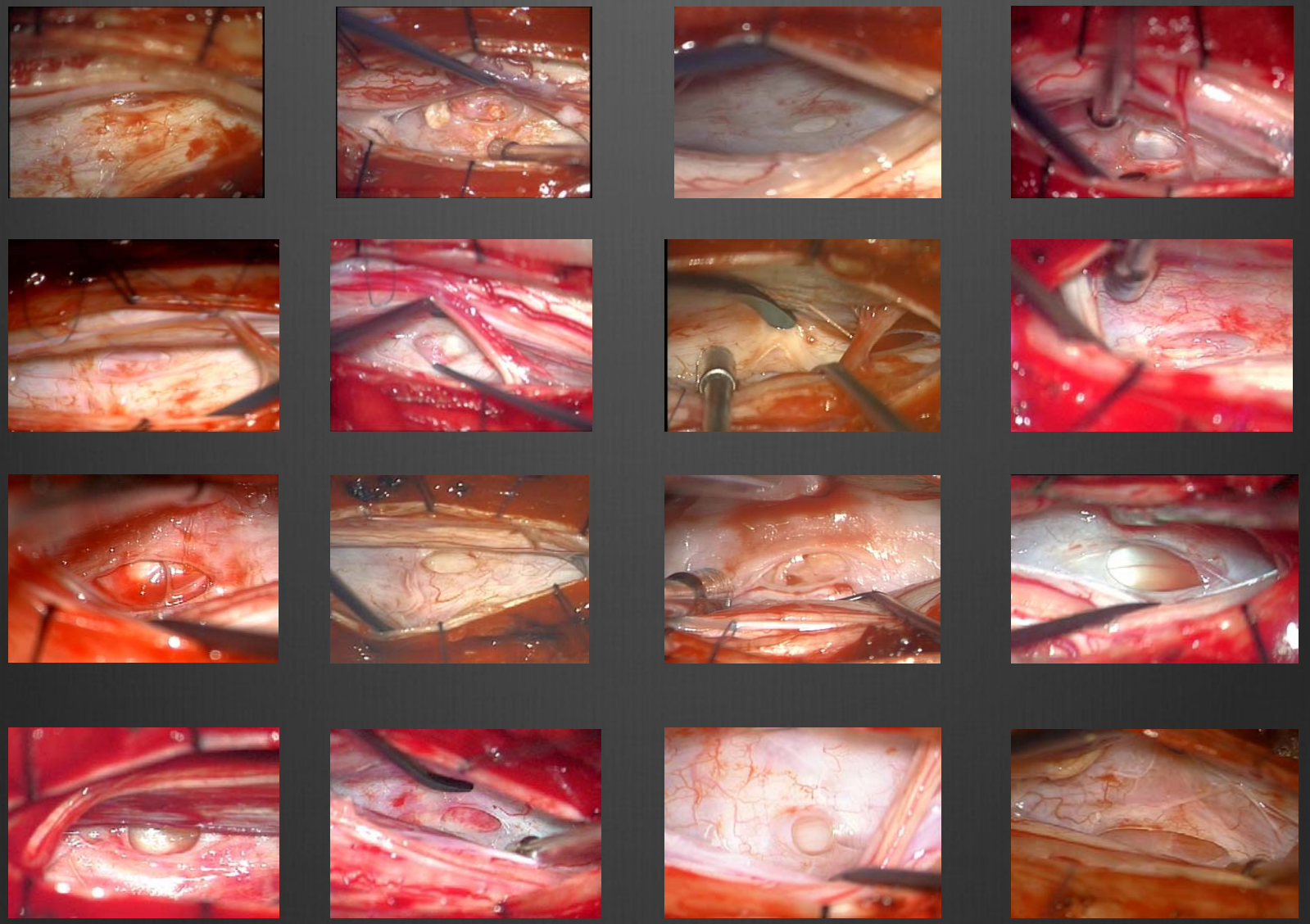


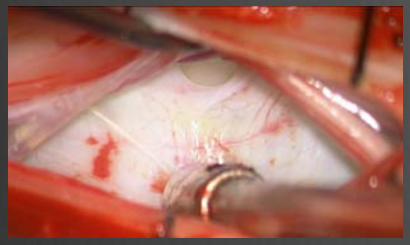
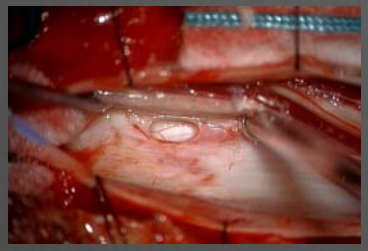
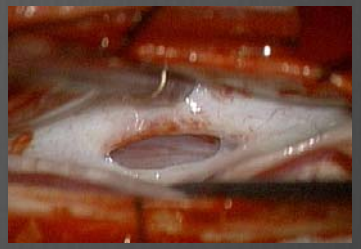
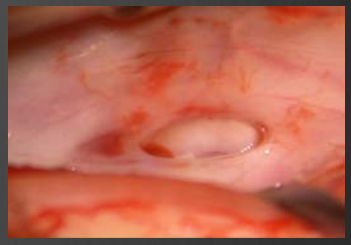
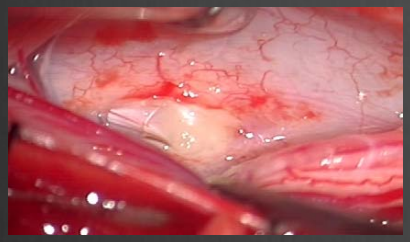
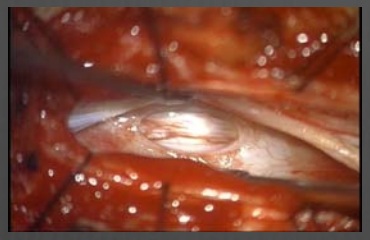
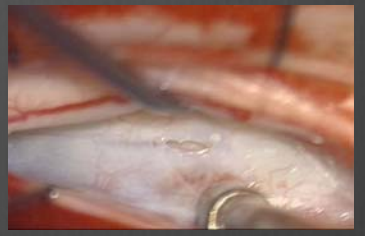
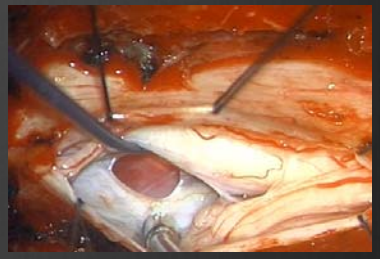
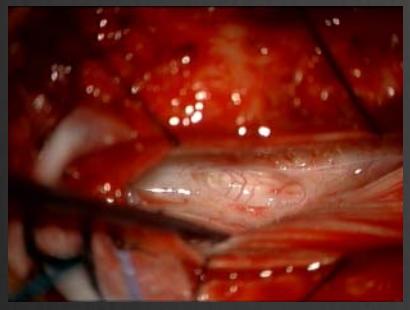
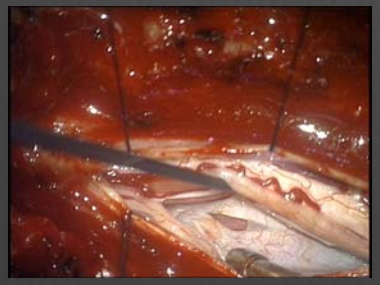
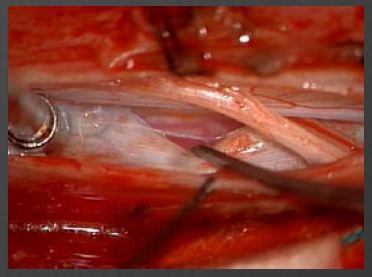
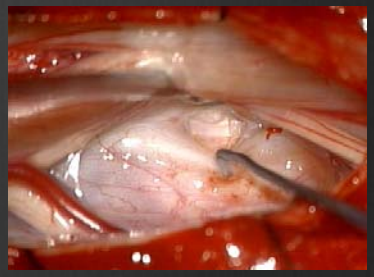
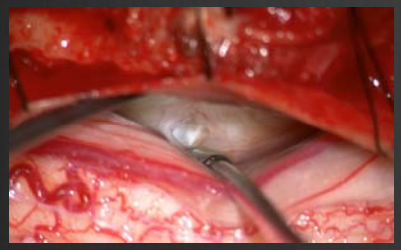
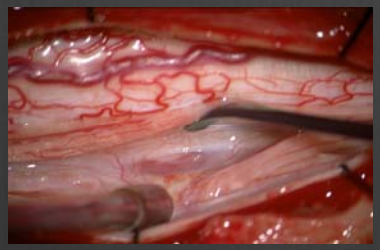
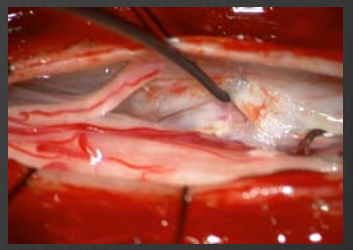
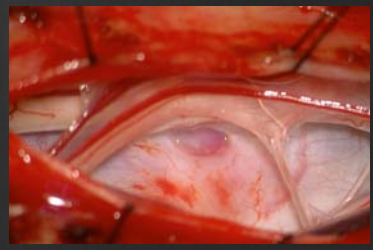
Surgery for spontaneous intracranial hypotension

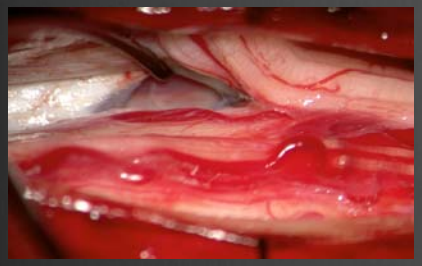
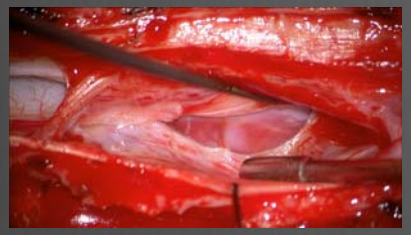
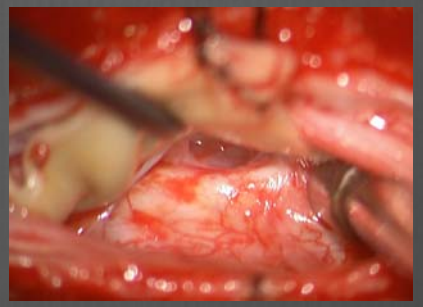
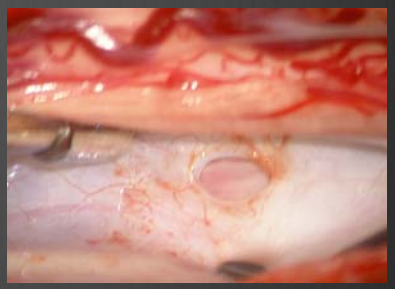
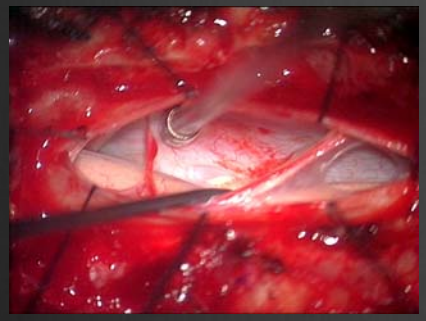
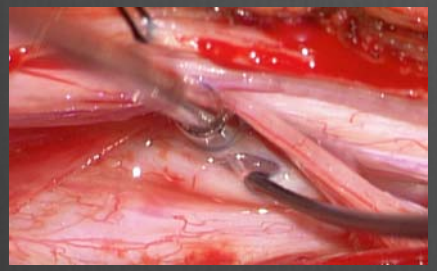
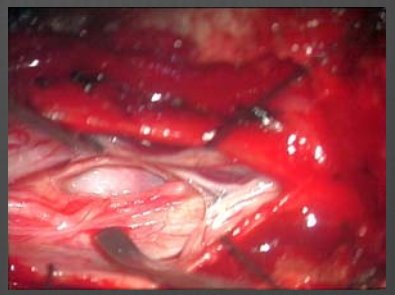
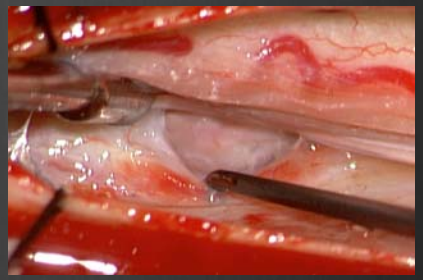
Surgery - cyst + leak:	90% cure rate
- cyst only:	75% cure rate
- ventral/intradural:	95% cure rate
- ventral/extradural:	25% cure rate

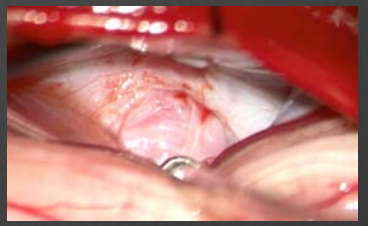
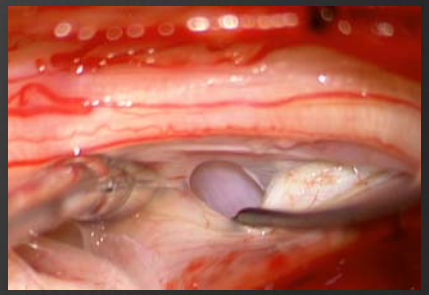
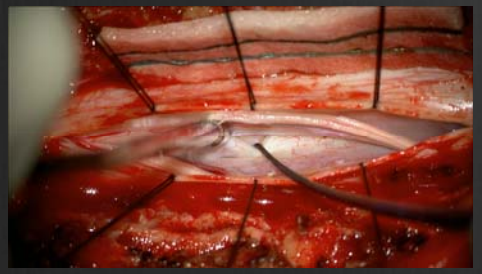
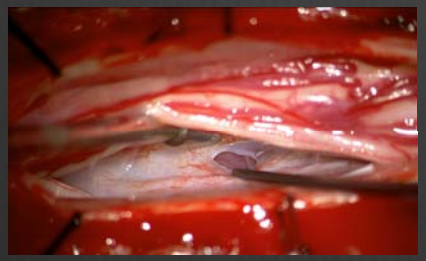
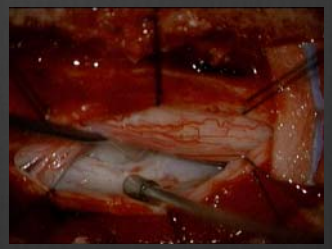
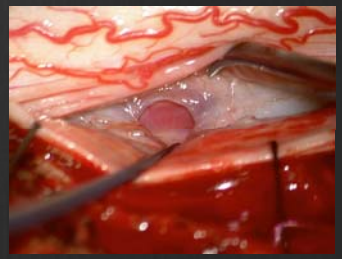
Risks of treatment

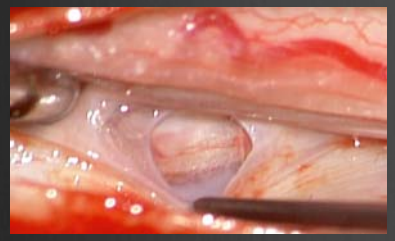
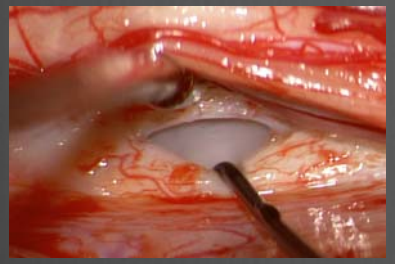
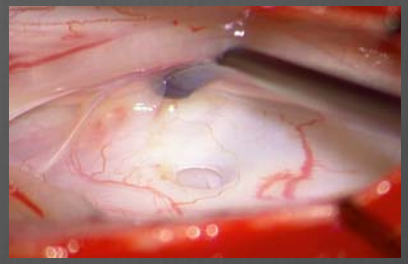
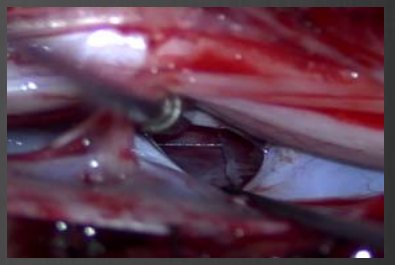
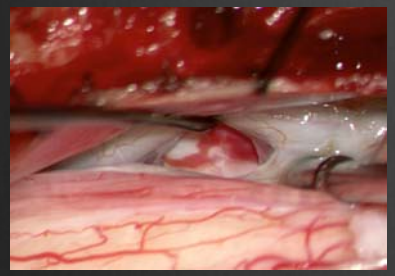
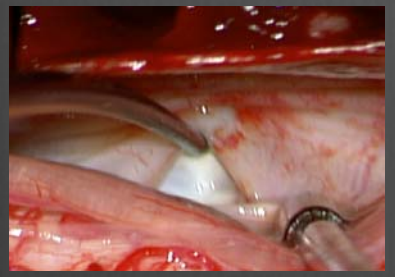
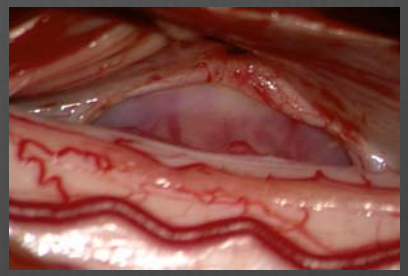
- Surgery (n=600):
  - 1% infection
  - 0.8% neurologic deficit
  - 2.7% pseudomeningocele
  - 0.8% presyrinx formation

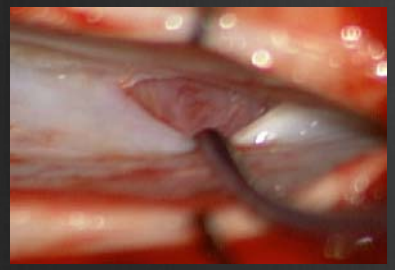
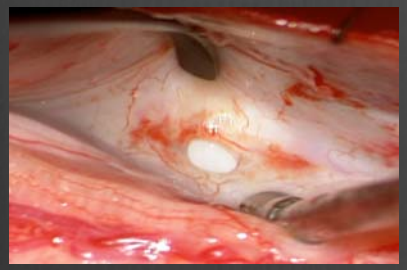
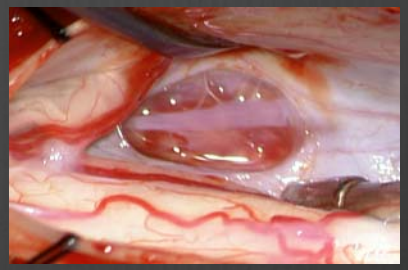
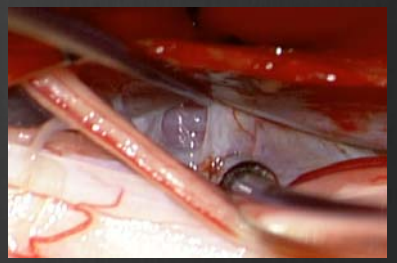
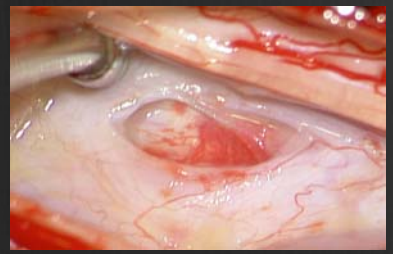
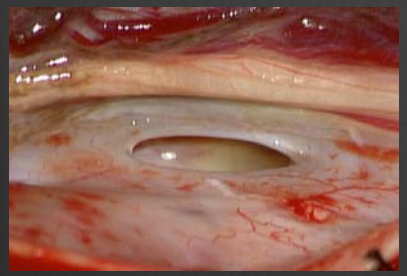
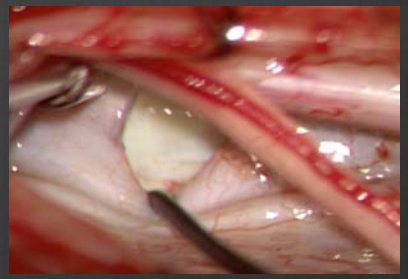


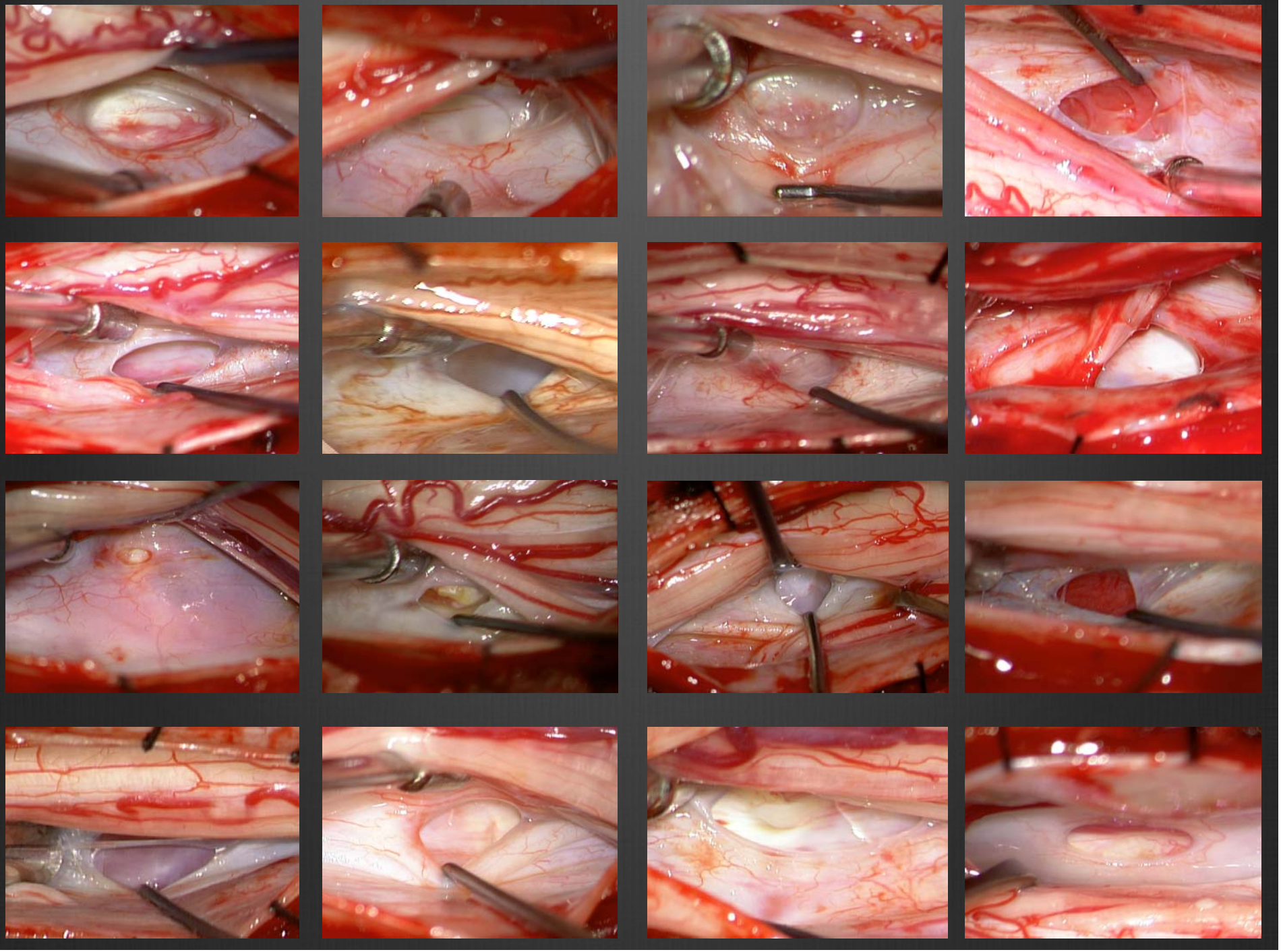

















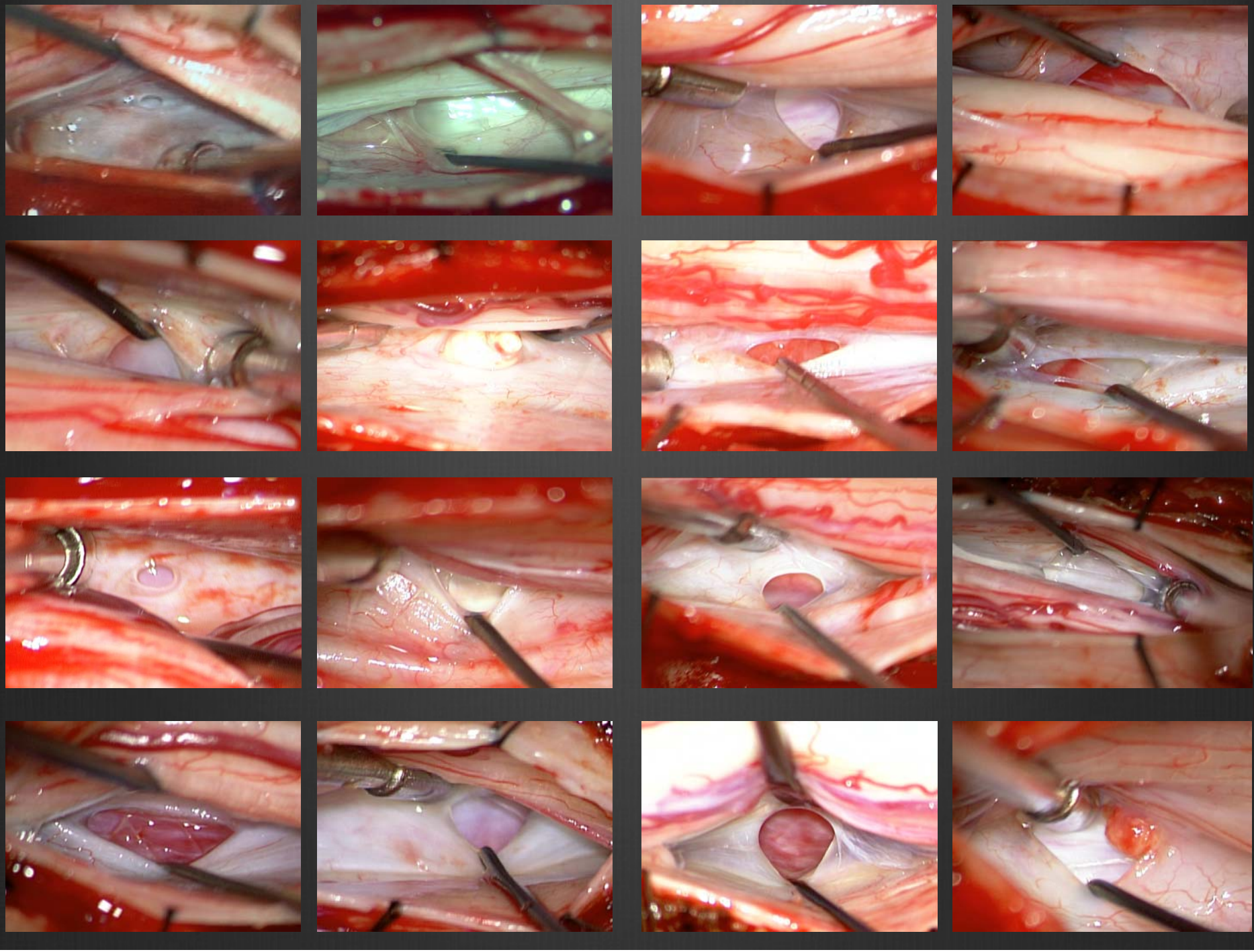









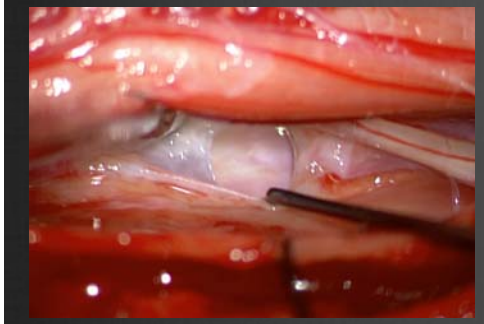
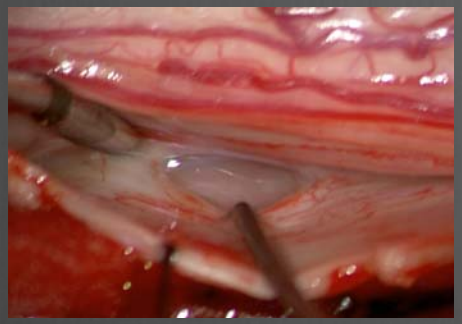
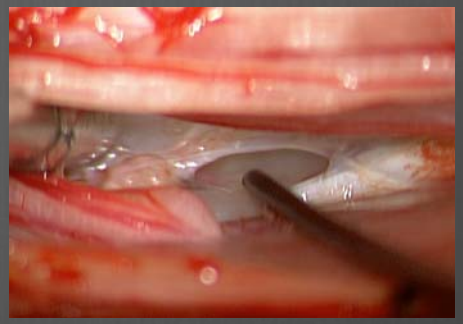
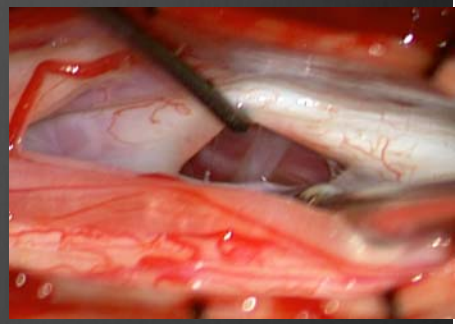
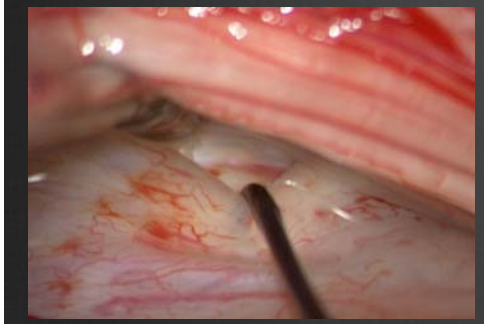
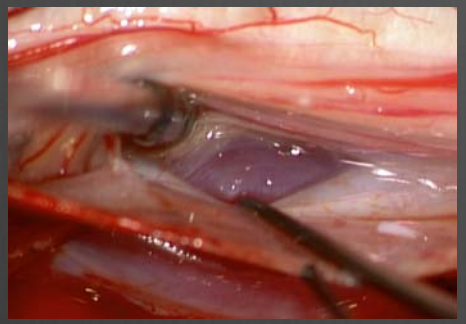
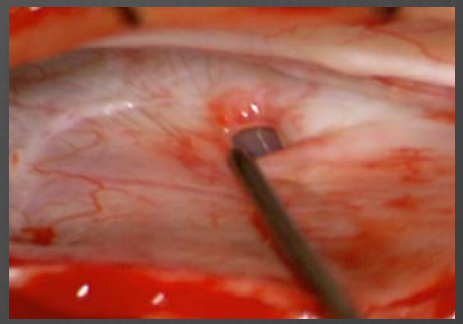








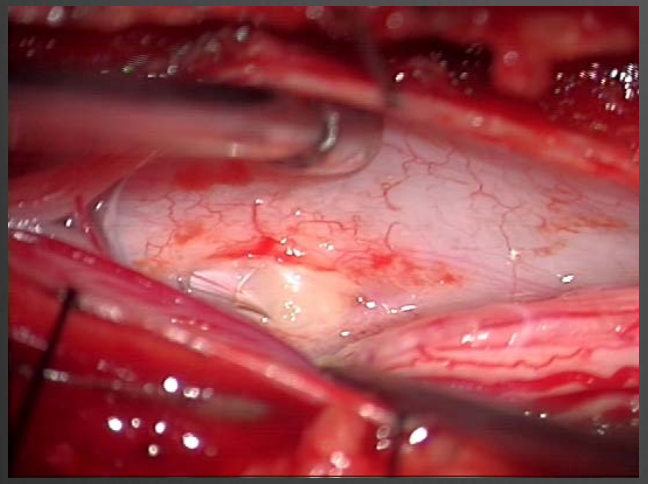








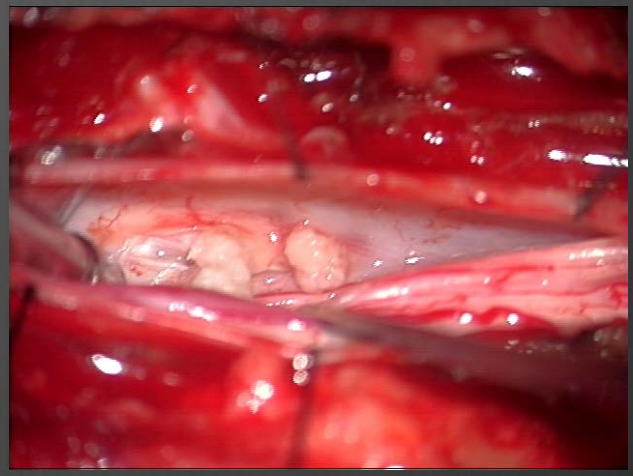



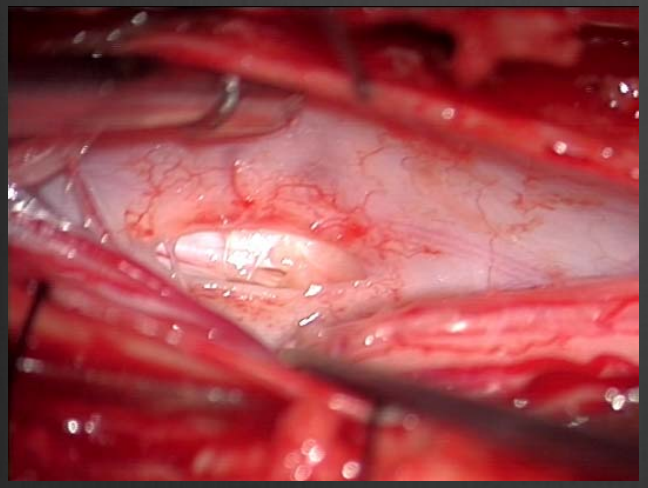


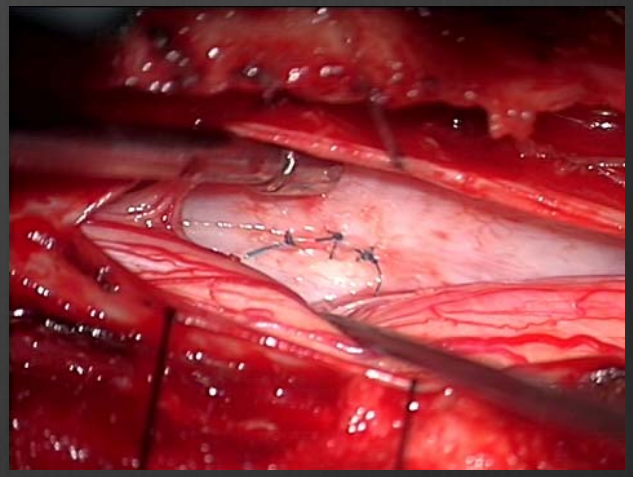








Resection of transdural disc herniation and repair ventral tear

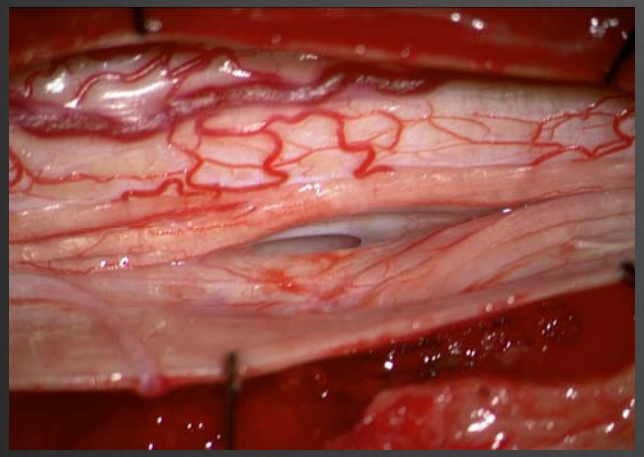


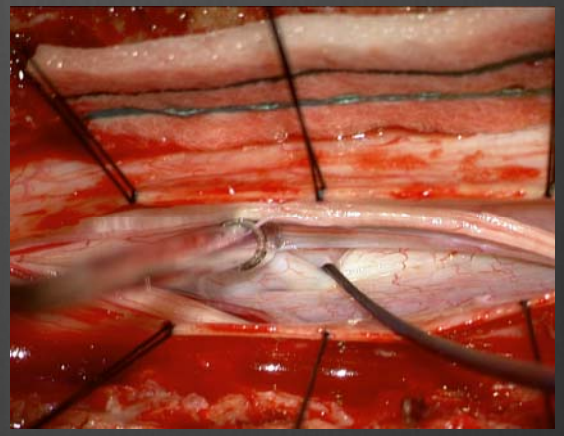


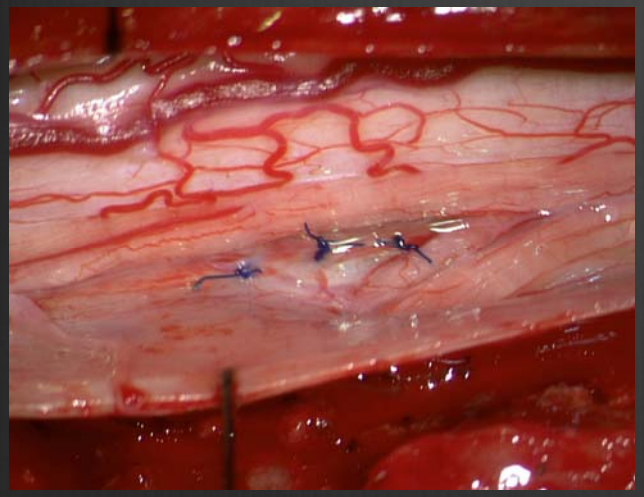


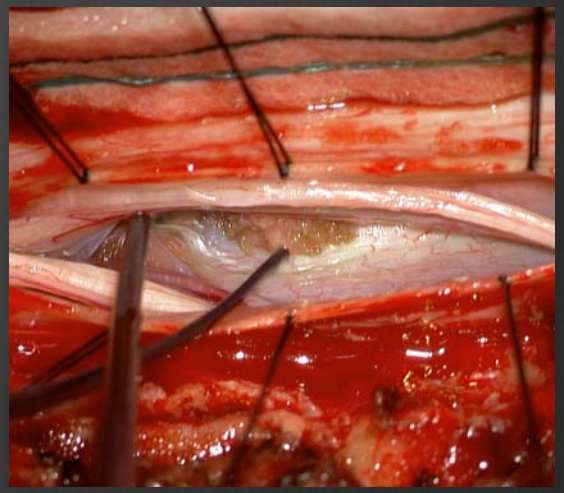


Ventral dural tear: sutures vs muscle repair

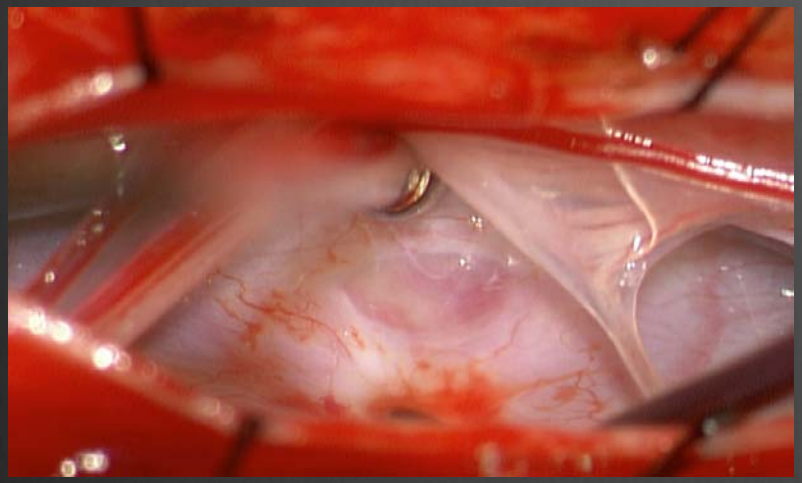


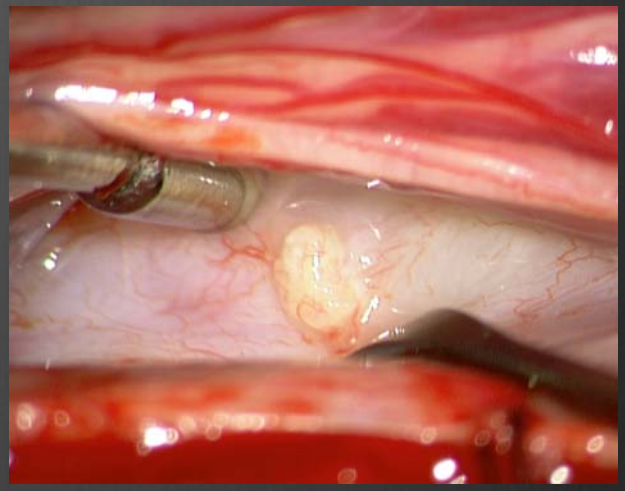


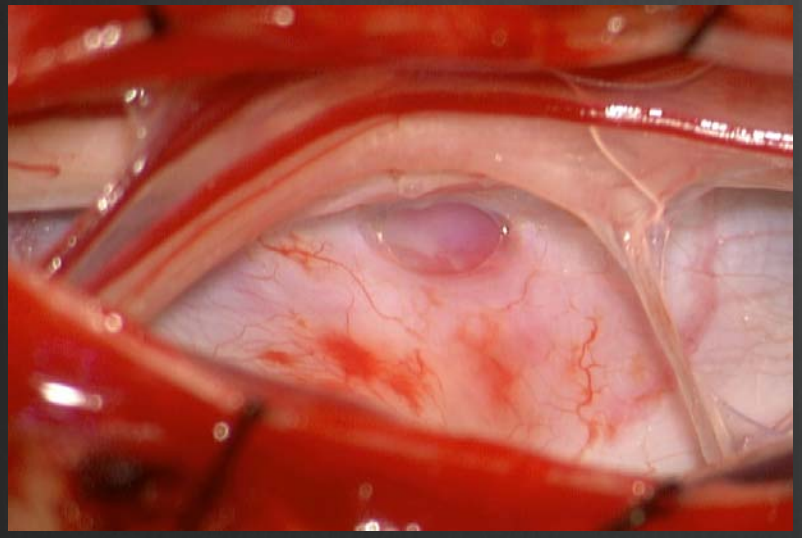


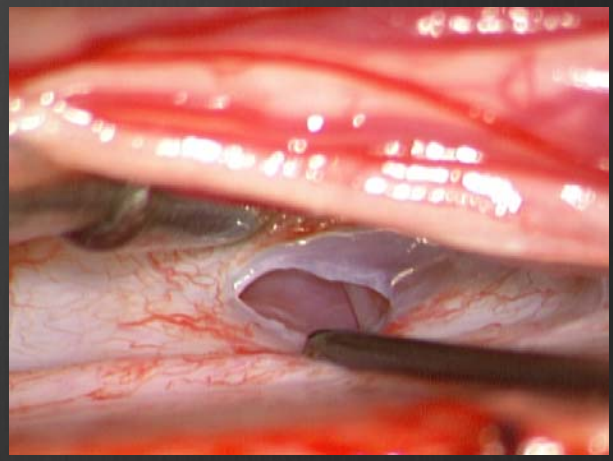


Ventral dural tear without CSF leak (Type 1a-)





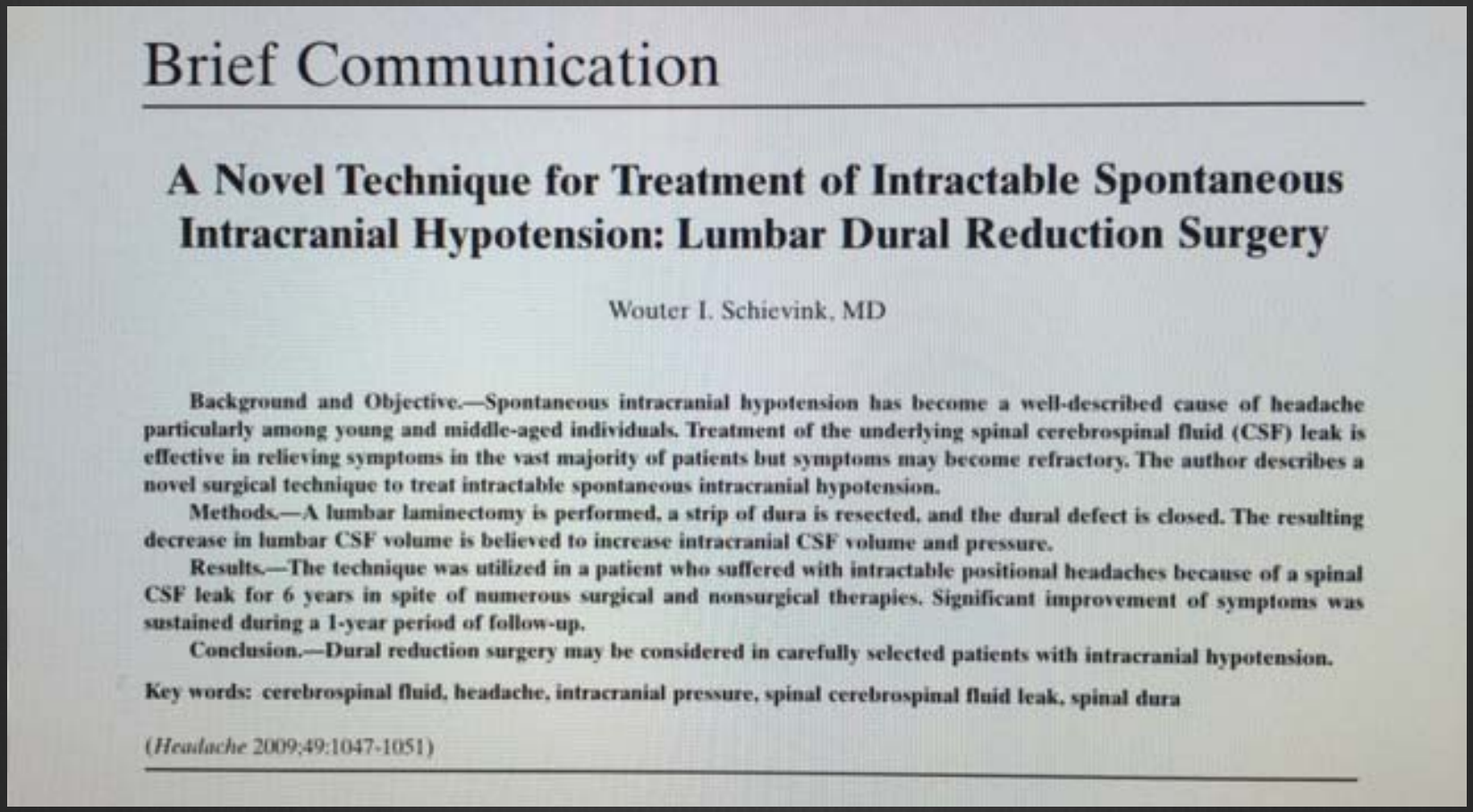




Surgical solutions for the recalcitrant patient

- Lumbar dural reduction surgery
- Wearable epidural saline infusion catheter system

Dural reduction surgery



Brief Communication

A Novel Technique for Treatment of Intractable Spontaneous Intracranial Hypotension: Lumbar Dural Reduction Surgery

Wouter I. Schievink, MD

Background and Objective.—Spontaneous intracranial hypotension has become a well-described cause of headache particularly among young and middle-aged individuals. Treatment of the underlying spinal cerebrospinal fluid (CSF) leak is effective in relieving symptoms in the vast majority of patients but symptoms may become refractory. The author describes a novel surgical technique to treat intractable spontaneous intracranial hypotension.

Methods.—A lumbar laminectomy is performed, a strip of dura is resected, and the dural defect is closed. The resulting decrease in lumbar CSF volume is believed to increase intracranial CSF volume and pressure.

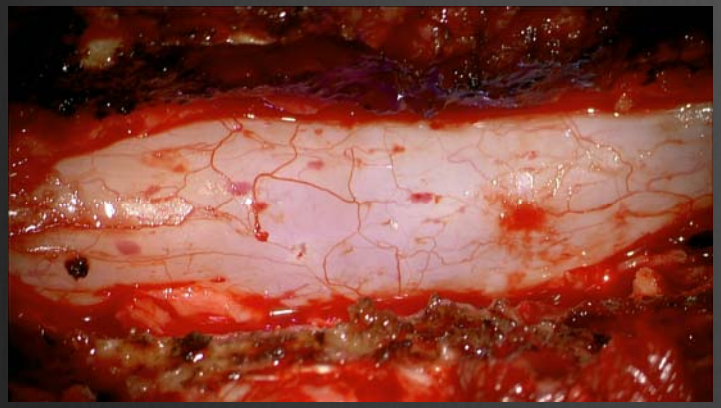
Results.—The technique was utilized in a patient who suffered with intractable positional headaches because of a spinal CSF leak for 6 years in spite of numerous surgical and nonsurgical therapies. Significant improvement of symptoms was sustained during a 1-year period of follow-up.

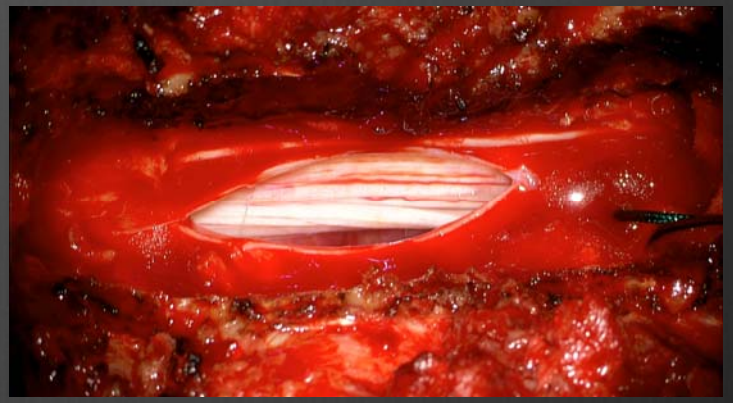
Conclusion.—Dural reduction surgery may be considered in carefully selected patients with intracranial hypotension.

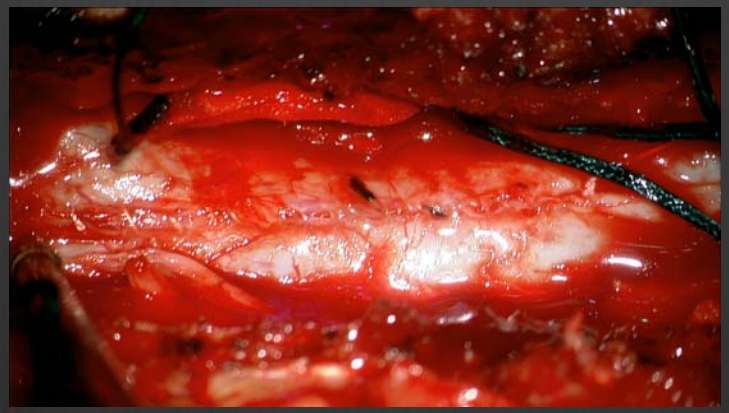
Key words: cerebrospinal fluid, headache, intracranial pressure, spinal cerebrospinal fluid leak, spinal dura

(*Headache* 2009;49:1047-1051)

Dural reduction surgery







Dural reduction surgery*

- N = 52
- 40 women and 12 men (most “without” SIH)
- Age: 21 – 72 years
- Good outcome: 31 (60%)
- Complications: Pseudomeningocele: 5 (10%)

  Suicide: 1 (2%)

  Infection/sepsis: 1 (2%)

Implantation of a wearable epidural spinal infusion system

A Wearable Epidural Catheter Infusion System for Patients With Intractable Spontaneous Intracranial Hypotension

Wouter I. Schievink, MD, Howard L. Rosner, MD,† and Charles Louy, MD, PhD†*

Background and Objectives: Spontaneous intracranial hypotension is an important cause of secondary headaches, and most patients respond well to epidural blood patching or direct repair of the underlying spinal cerebrospinal fluid leak. However, options are limited for those patients who have exhausted these traditional treatments, especially when spinal imaging is normal. We describe a wearable epidural catheter infusion system for patients with intractable spontaneous intracranial hypotension.

Methods: Six patients with intractable spontaneous intracranial hypotension (4 women and 2 men; mean age, 53 years; mean duration of symptoms, 50 months) underwent placement of a permanent indwelling spinal epidural catheter attached to an external infusion pump. The Migraine Disability Assessment questionnaire was used to assess the severity of the symptoms, before and during treatment.

Results: The infusion resulted in complete or near-complete symptom relief in 5 of 6 patients (Migraine Disability Assessment score decreased from grade IV to grade I or II). However, the epidural catheter infusion system was removed in 2 patients because of infection, in 1 patient because of delayed failure to provide adequate symptom control, and in 1 patient because of minimal symptom relief. Two patients reported excellent and sustained symptom relief over 27 and 36 months of follow-up.

Conclusions: This wearable epidural catheter infusion system showed promising efficacy results but the high rate of complications limits its use to a very select group of patients.

(*Reg Anesth Pain Med* 2015;40: 49–51)

catheter infusion system for patients with intractable spontaneous intracranial hypotension.

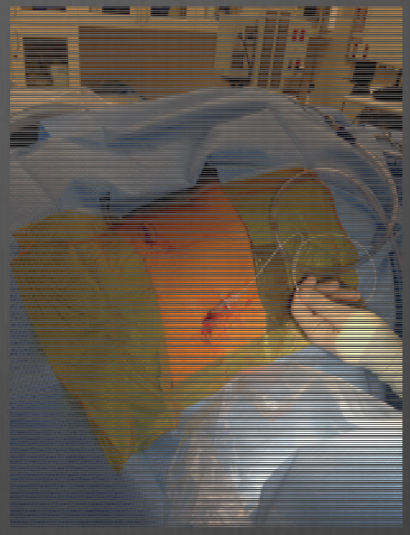
METHODS

Patients

Six patients with spontaneous intracranial hypotension were recruited for this trial (Table 1). The insertions of the spinal epidural catheters were performed between June 2009 and January 2010. Four of the patients were women and the mean age of the group was 53 years (range, 40–79 years). Duration of symptoms varied from 24 to 105 months (mean, 50 months). Orthostatic headache was the most prominent complaint in all patients. Neurologic examination and brain magnetic resonance imaging (MRI) findings were normal in all patients. Initial opening pressure at time of lumbar puncture was below normal in all patients (range, negative to 5 cm H_2O). Spinal MRI and computed tomography-myelography was performed in all patients and showed an extensive CSF leak in 1 patient and multiple spinal meningeal diverticula in 2 patients. Spinal imaging was entirely normal in the remaining 3 patients. Thus, the presence of a spinal CSF leak could not be established in 5 of the 6 patients. All patients had undergone 2 or more epidural blood patches. Three patients had undergone 1 or more surgical treatments directed at the CSF leak or largest spinal meningeal di-

A

B



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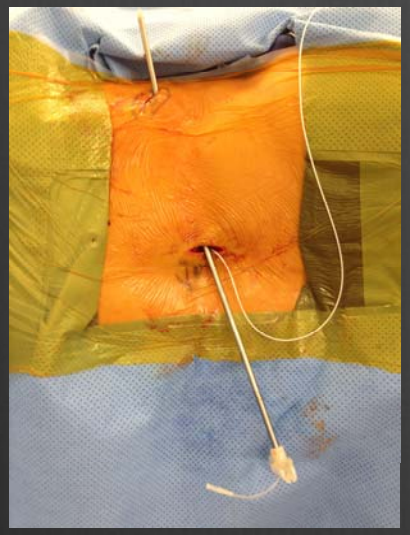

F

G

H

Spinal epidural infusion system

- N = 12
- 7 women and 5 men (most “without” SIH)
- Age: 40 – 79 years
- Good outcome: 10 (83%)
- Complications: Infection: 2 (17%)

  Hardware failure: 5 (42%)

Thank you


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