

Indications of Decompressive craniectomy, It's place in TBI treatment (RESCUEIcp, DECRA study)

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Focus of this lecture

- ▶ Indications for decompressive craniectomy
 - ▶ Traumatic
 - ▶ Non-Traumatic
- ▶ Accepted techniques and criteria
- ▶ Patient's outcome
- ▶ Use of DC in our everyday practice

TBI

- ▶ SDH, EDH, ICH etc..
 - ▶ Primary DC at the time of hematoma evacuation
 - ▶ Secondary DC due to exhaustion of standard primary care
- ▶ Not every patient needs a DC
- ▶ Some patient's can benefit from early DC ?
- ▶ Effect of DC on CSF circulation and CBF
- ▶ Axonal Stretch injury?

How can we decide ?

- ▶ Previous protocols, DC was preserved for the last step of managing ICP
 - ▶ Even barbiturate coma and hypothermia were measures used before DC
- ▶ How can we decide to perform a DC or not?
- ▶ Can we rely on picture modalities for the timing of DC ?
- ▶ What are the diagnostic criteria for DC ?
- ▶ Should we decide only based on published studies?

International studies

- ▶ DECRA
- ▶ RESCUEicp
- ▶ Many others

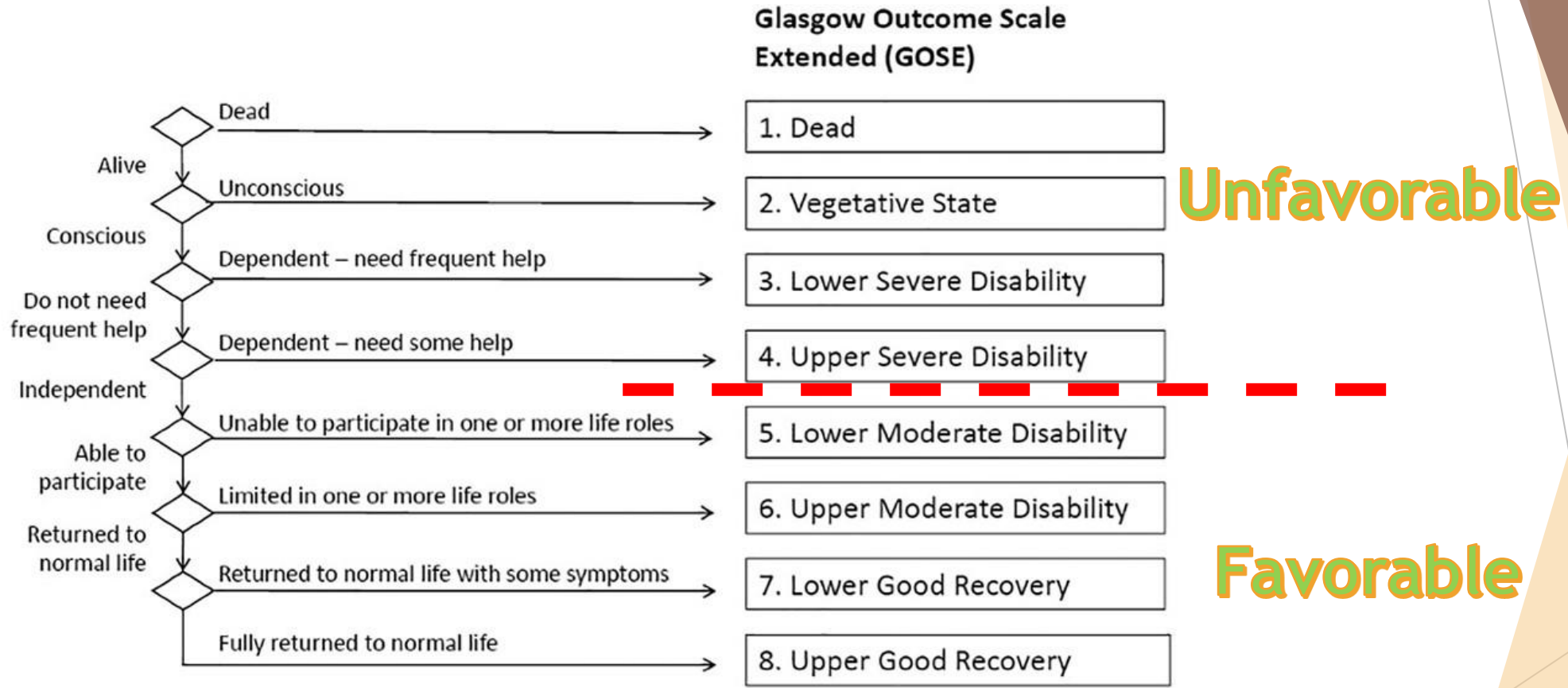


FIG. 1. GOSE hierarchy of outcomes (adapted from Maas and colleagues⁴ with permission) GOSE, Glasgow Outcome Scale-Extended.

DECRA

- ▶ Randomized controlled trial
- ▶ Patients from 2002-2010 , 155 patients (Australia, New Zealand, Saudi Arabia)
- ▶ Under the age of 60 (15-60 years old)
- ▶ Published in 2011
- ▶ Bifrontotemporoparietal craniectomy (bilat. hemicraniectomy)
- ▶ Non penetrating brain injury
- ▶ Upper limit of ICP was 20 mm Hg
- ▶ The goal was to overcome refractory ICP increase

Methods

- ▶ Refractory ICP was defined as:
 - ▶ Spontaneous increase for more than 15 mins (continuously or intermittent)
 - ▶ 1 hour period
 - ▶ Regardless of optimized sedation, CSF drainage, relaxation, Mannitol, pCO₂ manipulation
 - ▶ Randomly assigned to surgery or standard ICU care within the first 72 hours
- ▶ Harvested bone was either stored in abdominal pouch or freezed in -70 degrees of Celsius
- ▶ According to standard practice of surgeon, after resolution of swelling and infections, in 2-3 months cranioplasty was performed.
- ▶ Standard care patients also received second tier treatment
 - ▶ Hypothermia
 - ▶ Barbiturate coma
 - ▶ as a **life saving measure DC**

Conclusion

- ▶ DC group
 - ▶ Decreased and sustained levels of ICP
 - ▶ Decreased ICU stay
 - ▶ Decreased mechanical ventilation
 - ▶ Low rate of surgical complications
 - ▶ Duration of hospital stay was unchanged
 - ▶ Lower median score on GOSE (higher risk of unfavorable outcome)
 - ▶ Axonal damage, altered blood flow and CSF flow, altered metabolism
 - ▶ Unilateral ? Dividing falx and SSS ? (Polin procedure)
 - ▶ Hydrocephalus due to craniectomy or cranioplasty?
 - ▶ Death rate in 6 months
 - ▶ 19% DC
 - ▶ 18% standard care

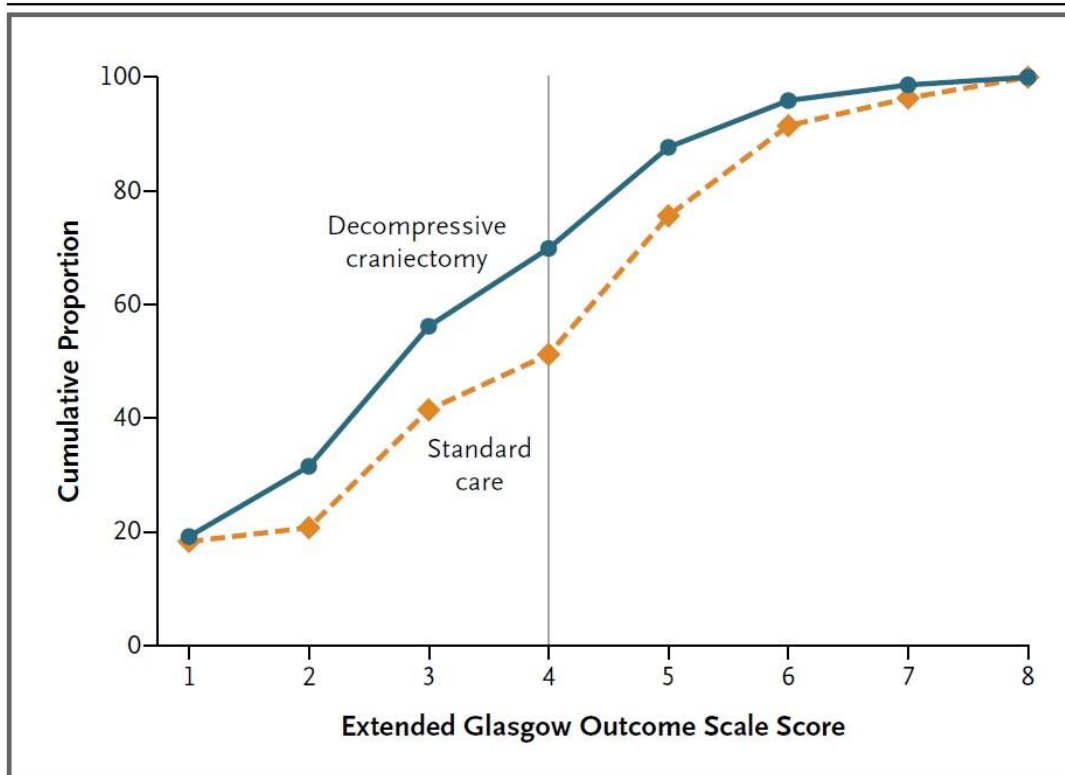


Figure 2. Cumulative Proportions of Results on the Extended Glasgow Outcome Scale.

In this study, an unfavorable outcome was defined as a composite of death, vegetative state, or severe disability, corresponding to a score of 1 to 4 on the Extended Glasgow Outcome Scale, as indicated by the vertical line. According to this measure, an unfavorable outcome occurred in 70% of patients in the craniectomy group and 51% of those in the standard-care group ($P=0.02$). The cumulative proportion is the percentage of all scores that are lower than the given score.

RESCUEicp

- ▶ From 2004-2014
- ▶ 408 patients, 10-65 years
- ▶ Last tier intervention (in contrast with DECRA which was within 72 hours)
- ▶ Continued standard care (same as DECRA)
- ▶ ICP higher than 25 mm Hg for 1-12 hours after failing of standard care
- ▶ Patients who were operated with intracranial hematomas were also included (Despite DECRA)
- ▶ After exclusions, 202 patients surgical 196 Medical group
- ▶ Hemicraniectomy was allowed (despite DECRA)
- ▶ GOSE at 6 months
 - ▶ 26.9% Death surgical
 - ▶ 48.9% Death medical
 - ▶ 8.5% Vegetative surgical
 - ▶ 2.1% Vegetative medical

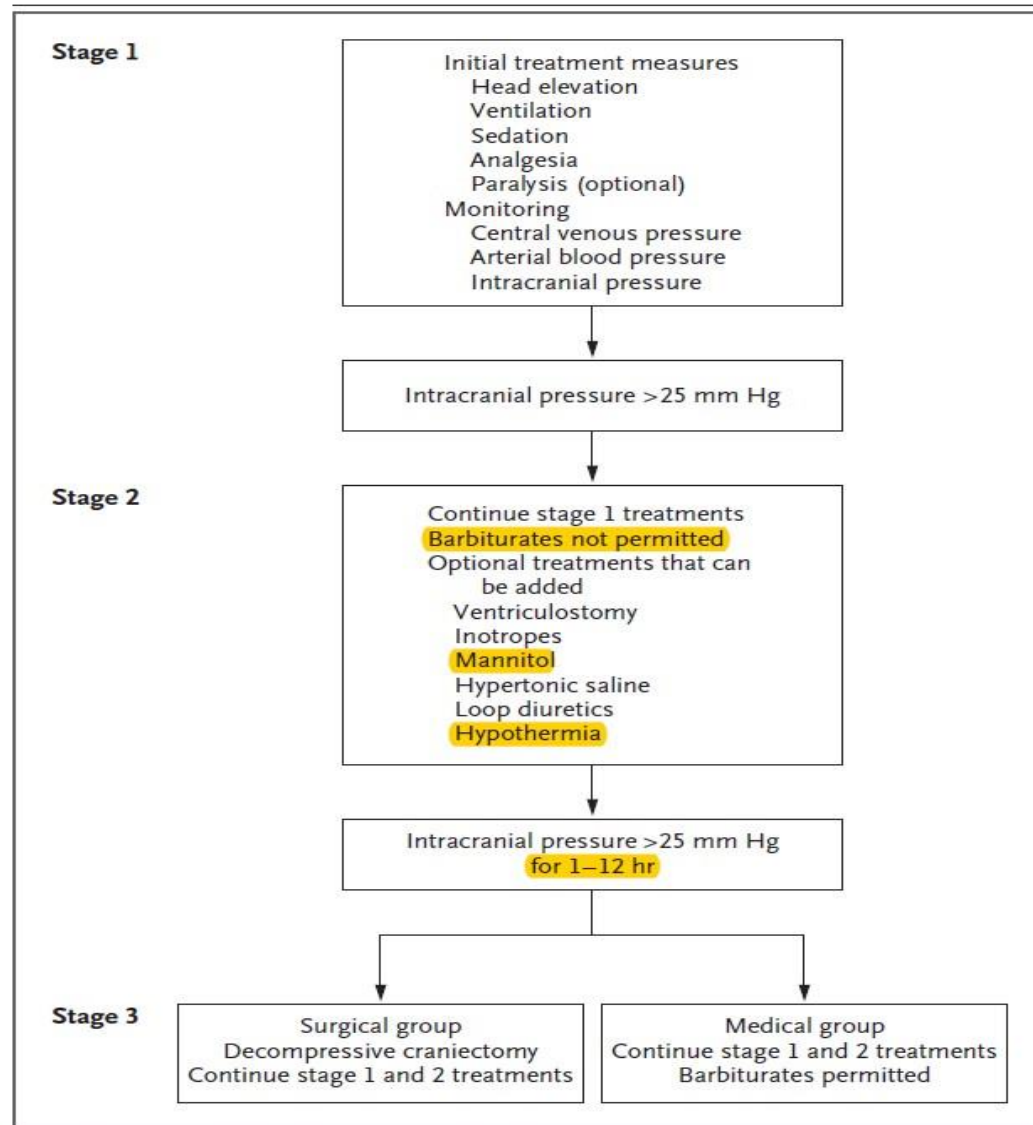


Figure 1. Stages of Therapeutic Management.

Agreement for participation was obtained from the nearest relative or a person who had been designated to give consent preemptively on admission of the patient in order to avoid delays in treatment. Randomization was performed after stage 2 if the intracranial pressure was more than 25 mm Hg for 1 to 12 hours. The protocol stages 1 and 2 reflected the therapeutic protocols that were followed in the participating units.

Conclusion

- ▶ Craniectomy decreases death rate
- ▶ Increase the chance of survival
- ▶ Decreases ICP levels
- ▶ Has a higher rate of vegetative state and upper, lower severe disability than medical treatment group
- ▶ Compared to DECRA, does not state a complete unfavorable outcome of craniectomy

Wrap up

- ▶ The indication of early DC can be challenging
 - ▶ There are studies but results are not completely in favor or against it
- ▶ Depending on the primary scans, patient's status and experience of surgeon maybe an early DC can be advised ?
- ▶ What are the complications of DC?
 - ▶ Rebleeds
 - ▶ Extensive traumatic flap preparation
 - ▶ Wound healing complications
 - ▶ CSF leaks
 - ▶ Hydrocephalus
 - ▶ In general a bad prognosis?

DC in non traumatic cases, Malignant MCA infarction

- ▶ Another challenging topic full of controversy
- ▶ Timing
- ▶ Outcome
- ▶ Previous thrombolysis, thrombectomy, anti platelets etc. etc.
- ▶ Dominant or non dominant hemisphere
- ▶ Rehabilitation of the patient

Our institutional protocol (MCA occlusion, Stroke)

- ▶ Életkor < 65 év
- ▶ Térfogat becslés MRI/DWI 145 ccm, műtéti indikáció felállítása előtt MRI (agytörzsi, thalamus, hypothalamus érintettség kizáró tényező, főként bevérzés esetén)
- ▶ lehetőség szerint 48 órán belül a tünetek kezdete után, DC mindenképp a kritkusan magas ICP értékek (vagy azokra utaló állapot) kialakulása előtt, 25 Hgmm feletti ICP-k esetén, mely minden kezelésre refrakter 20-30 percet meghaladó időtartamban
- ▶ Dominans (<30 év)/ nem domináns félteke
- ▶ A stroke gyógyszeres kezelés kizárólag Na-Heparinnal történhet, ha DC lehetősége felmerül
- ▶ Technikai kivitel: -

Optimal size for DC

- ▶ A retrospective study
- ▶ 2 groups
 - ▶ 21 patients with small flap
 - ▶ 9 patients with large flap
- ▶ Both groups had similar medical treatment and CSF drainage
- ▶ After surgery, the large flap group had a better control of ICP (13.3 mm Hg vs 16.9 mm Hg) the difference was maintained for 96 hours
- ▶ Optimal size suggested by trauma foundation TBI
 - ▶ 11cm x 15 cm or 15cm in diameter (**size of the head is not considered**) !
- ▶ Taking the size of the head into consideration
 - ▶ > 65% ratio is acceptable

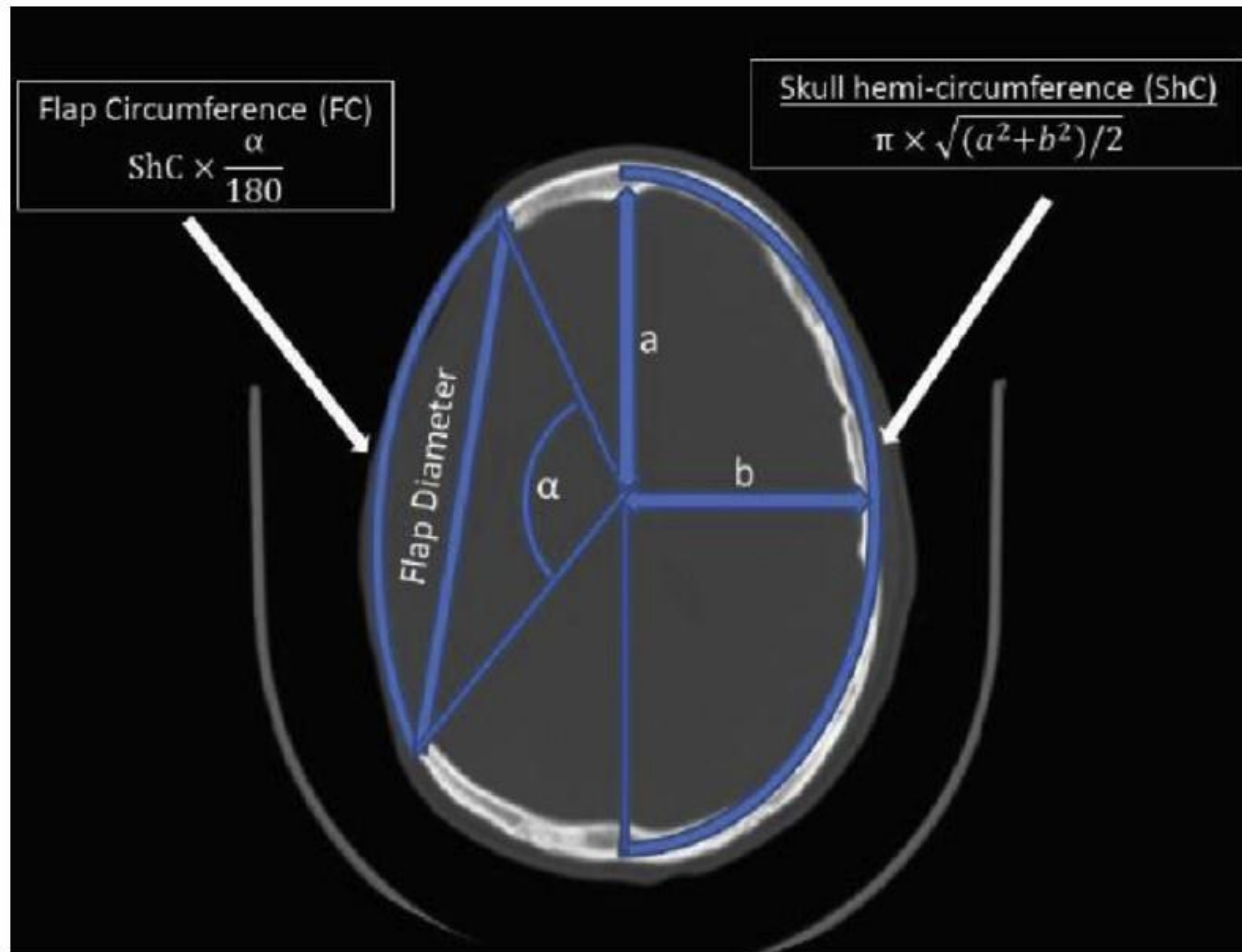
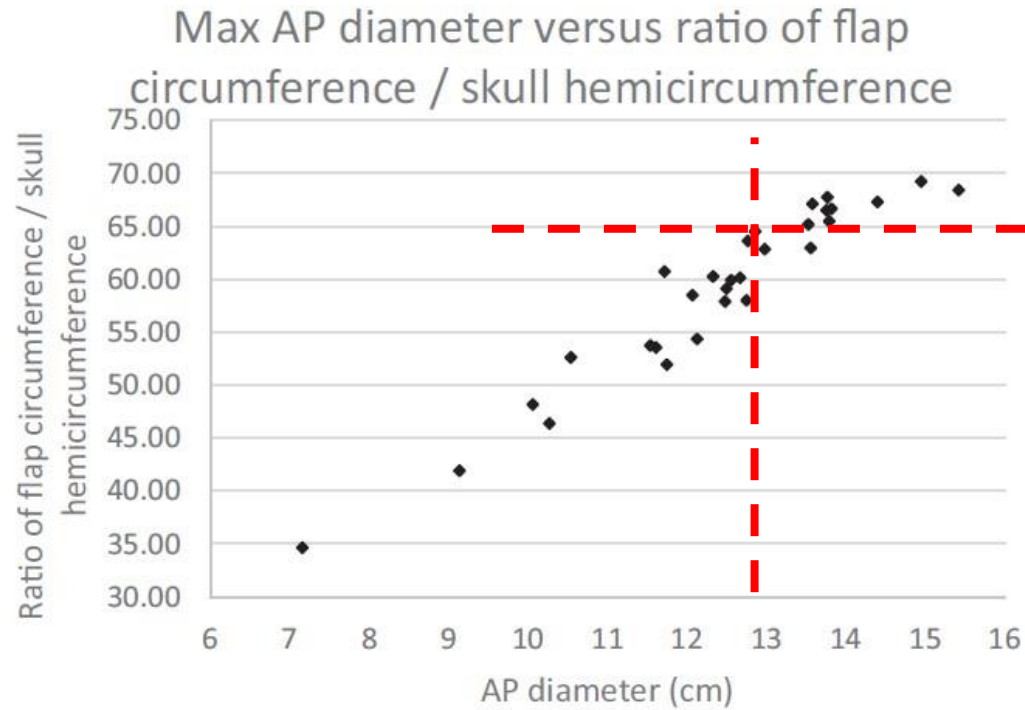


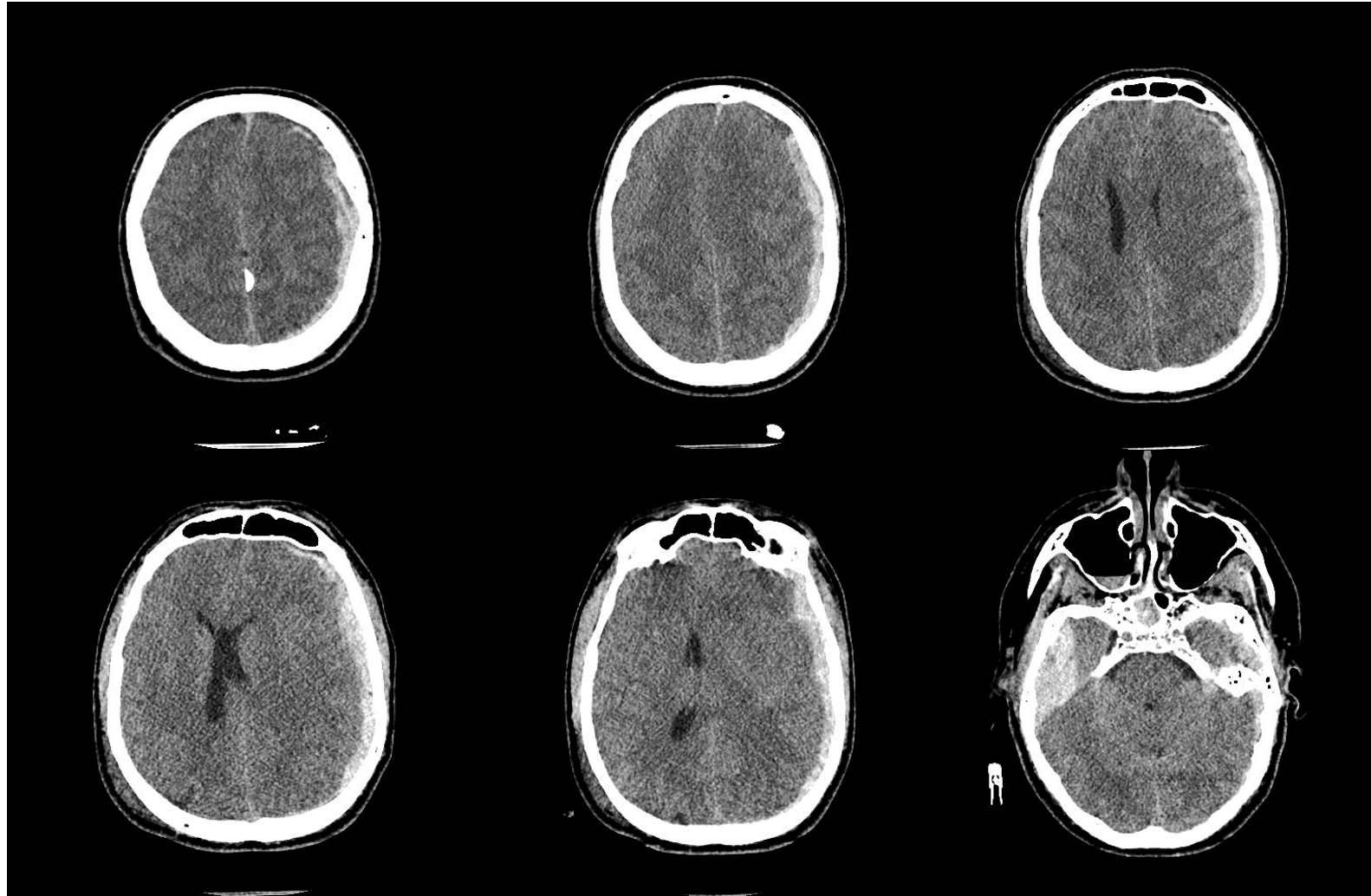
Figure 1. Methodology for flap-to-skull hemicircumference calculation.

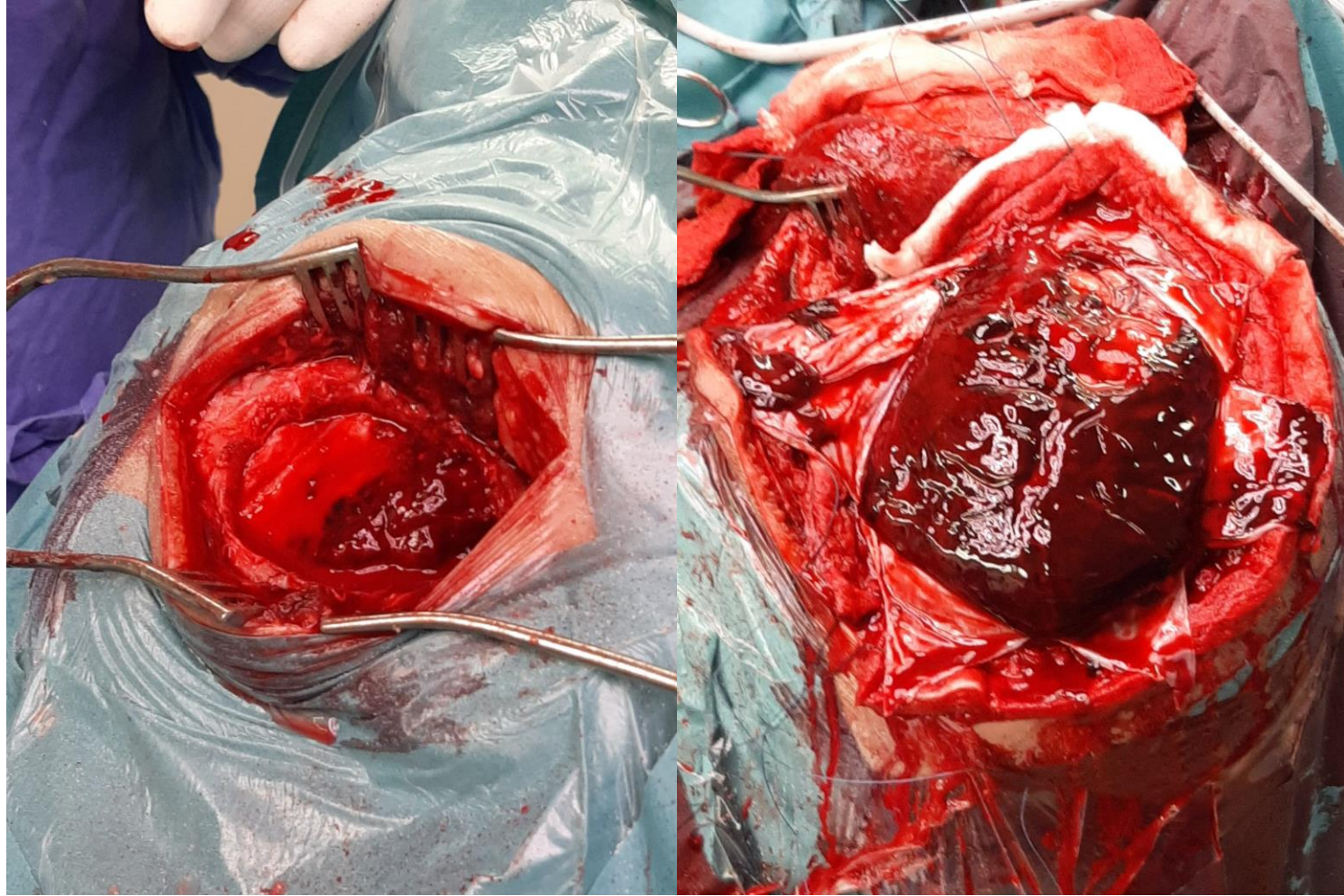


AP: anterior-posterior; cm: centimeter

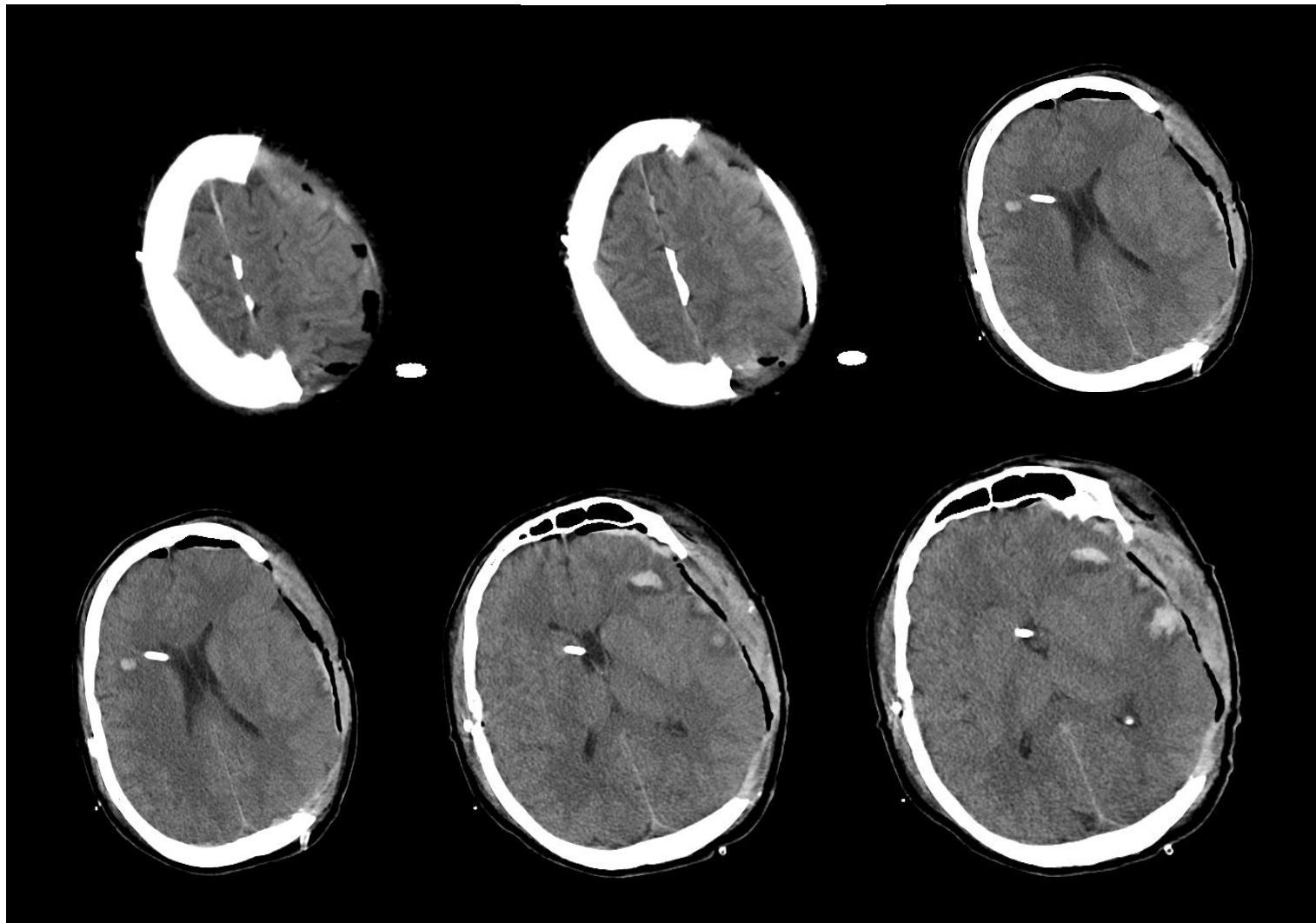
Figure 2. Scatter plot of the maximum anteroposterior (AP) diameter versus the ratio of the flap circumference to skull hemicircumference. The ratio of flap circumference versus skull hemicircumference >65% was reached for AP diameters >13.5 cm.

Cases 1



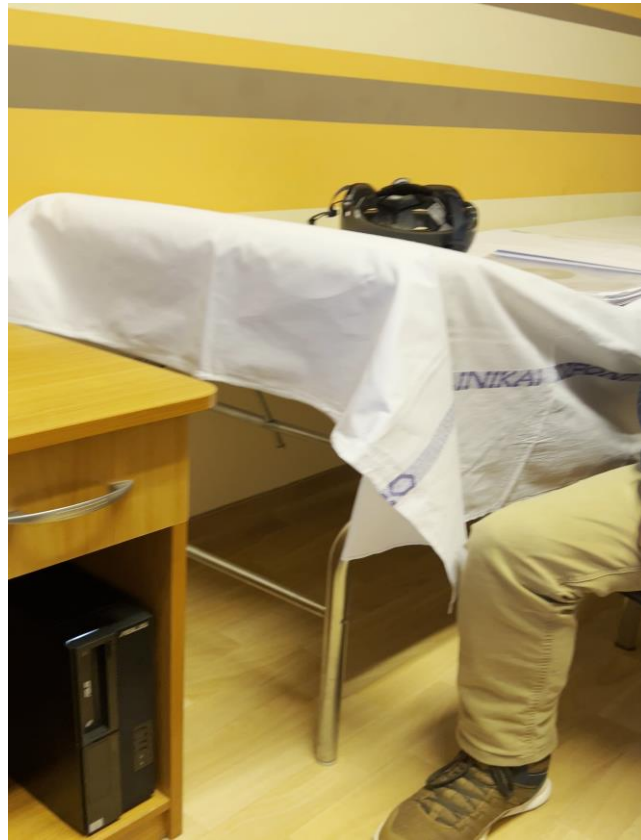


Post Op

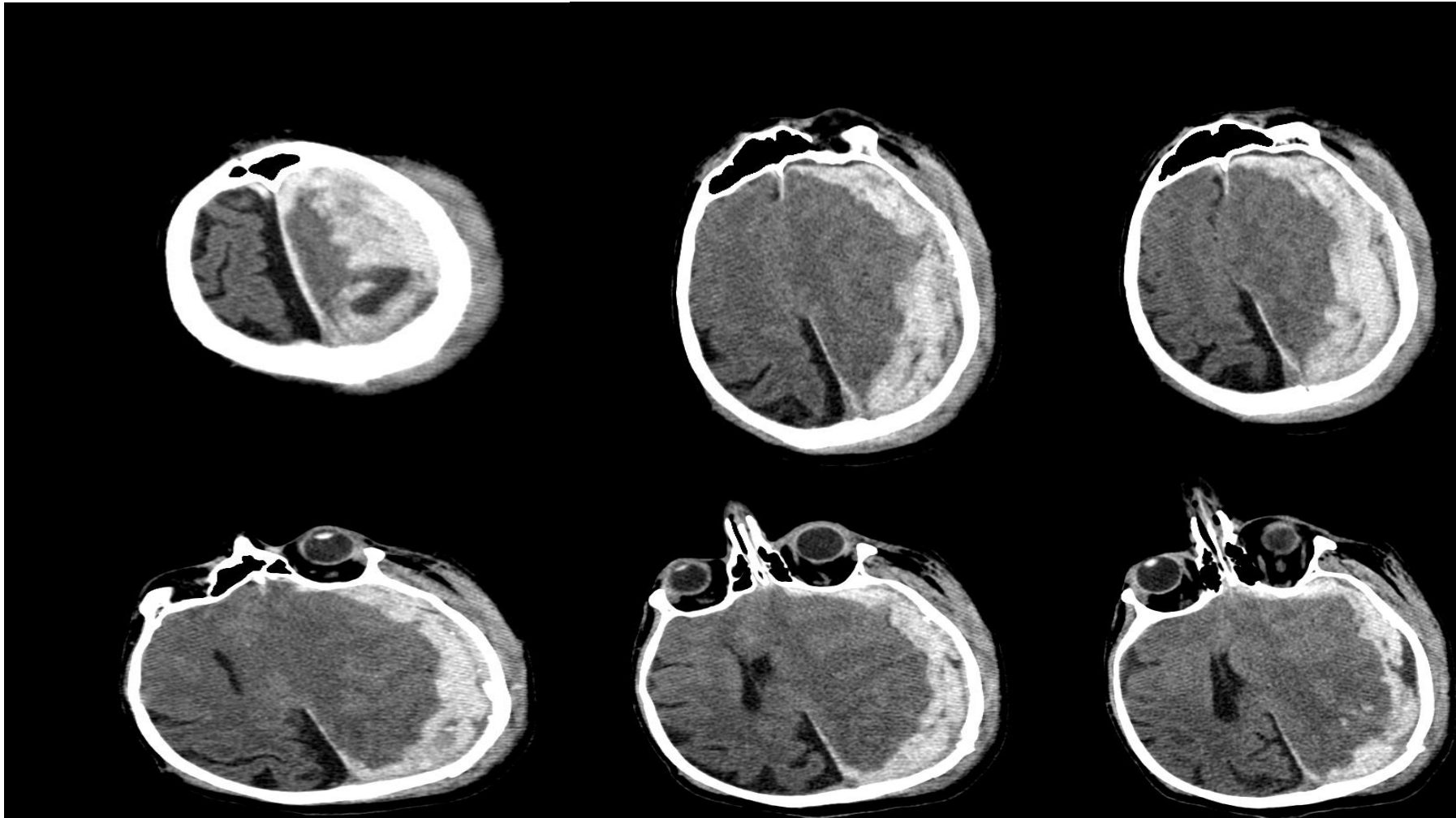


4 Months follow up

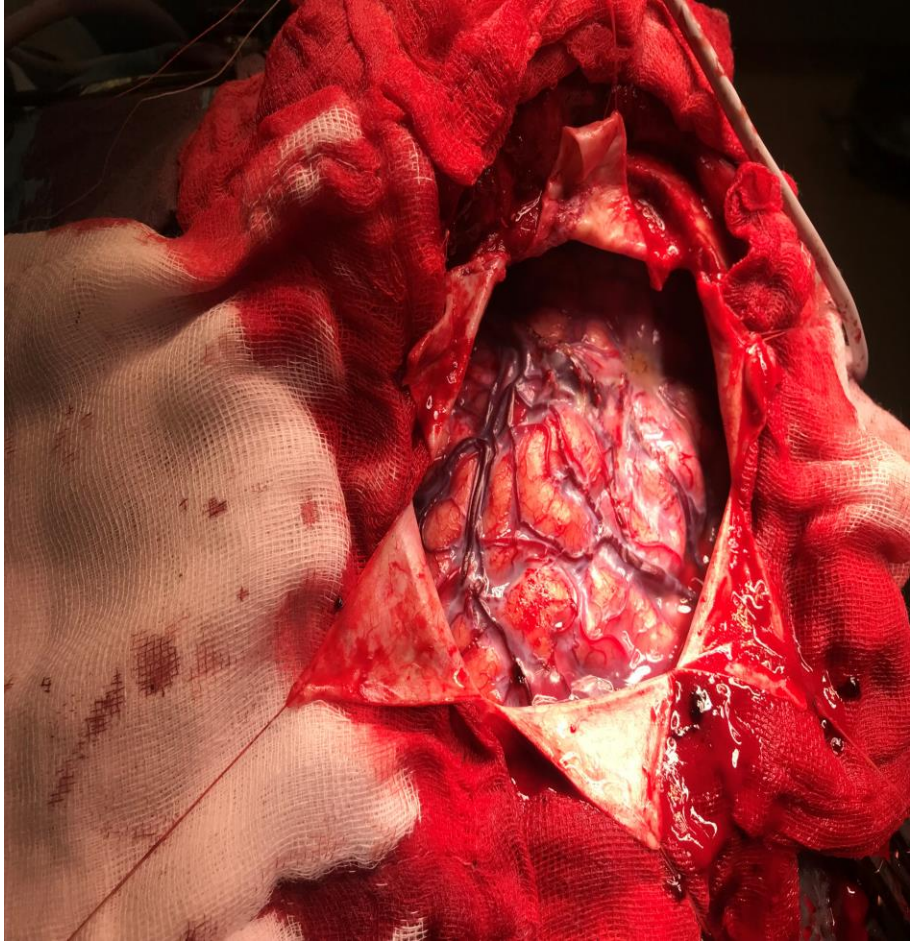
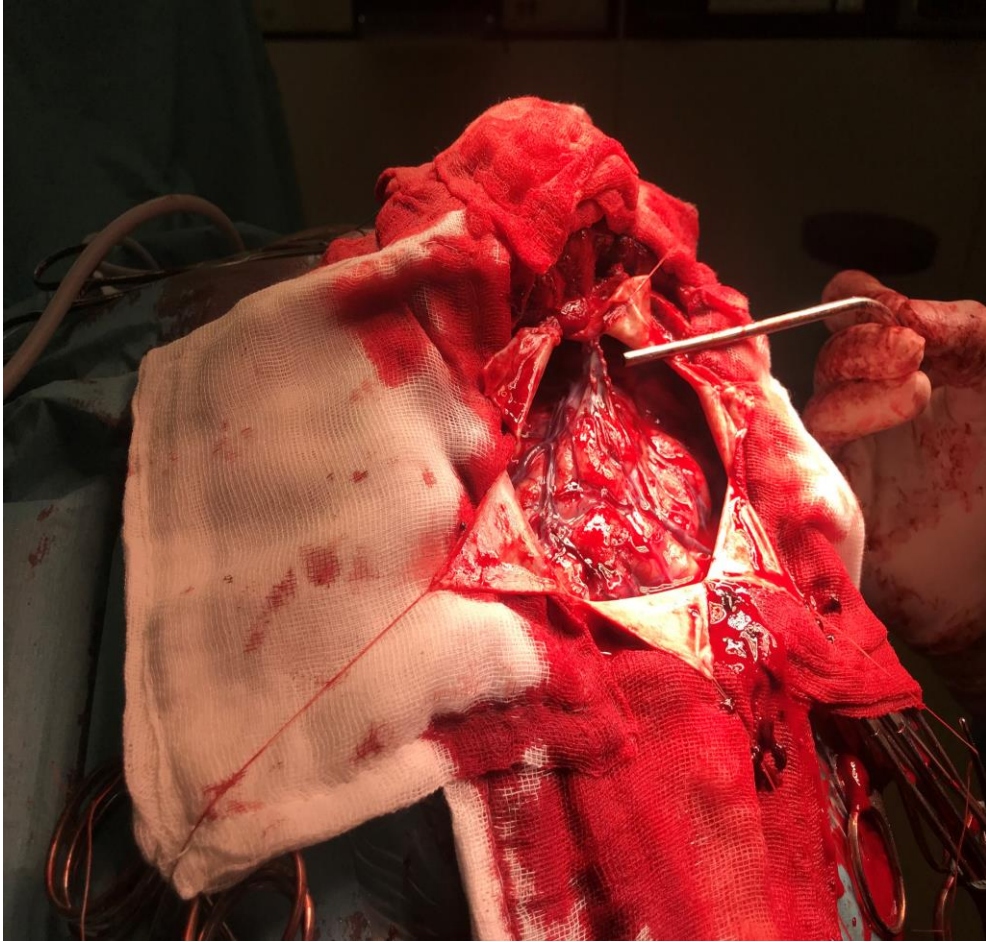
Video

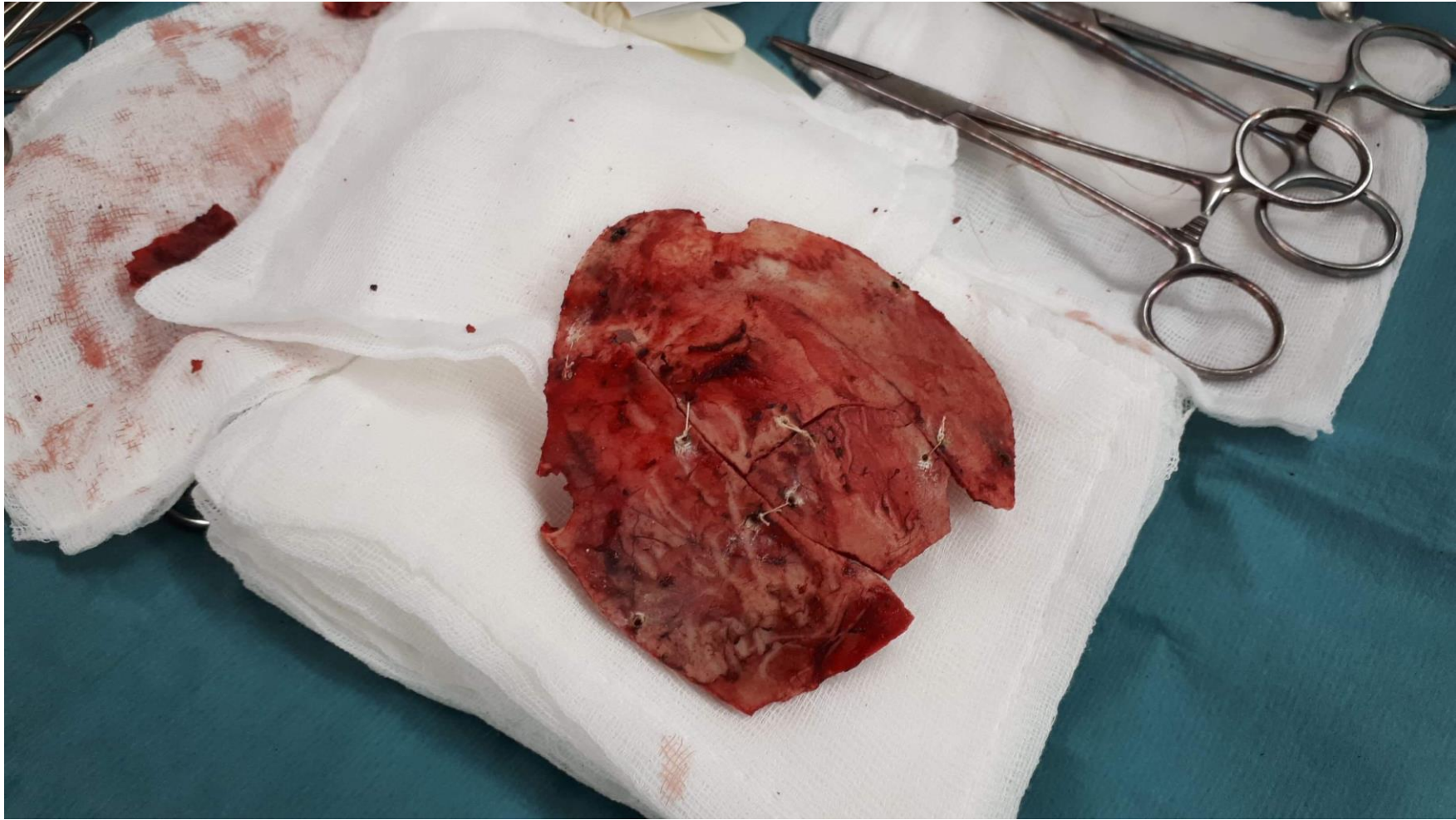


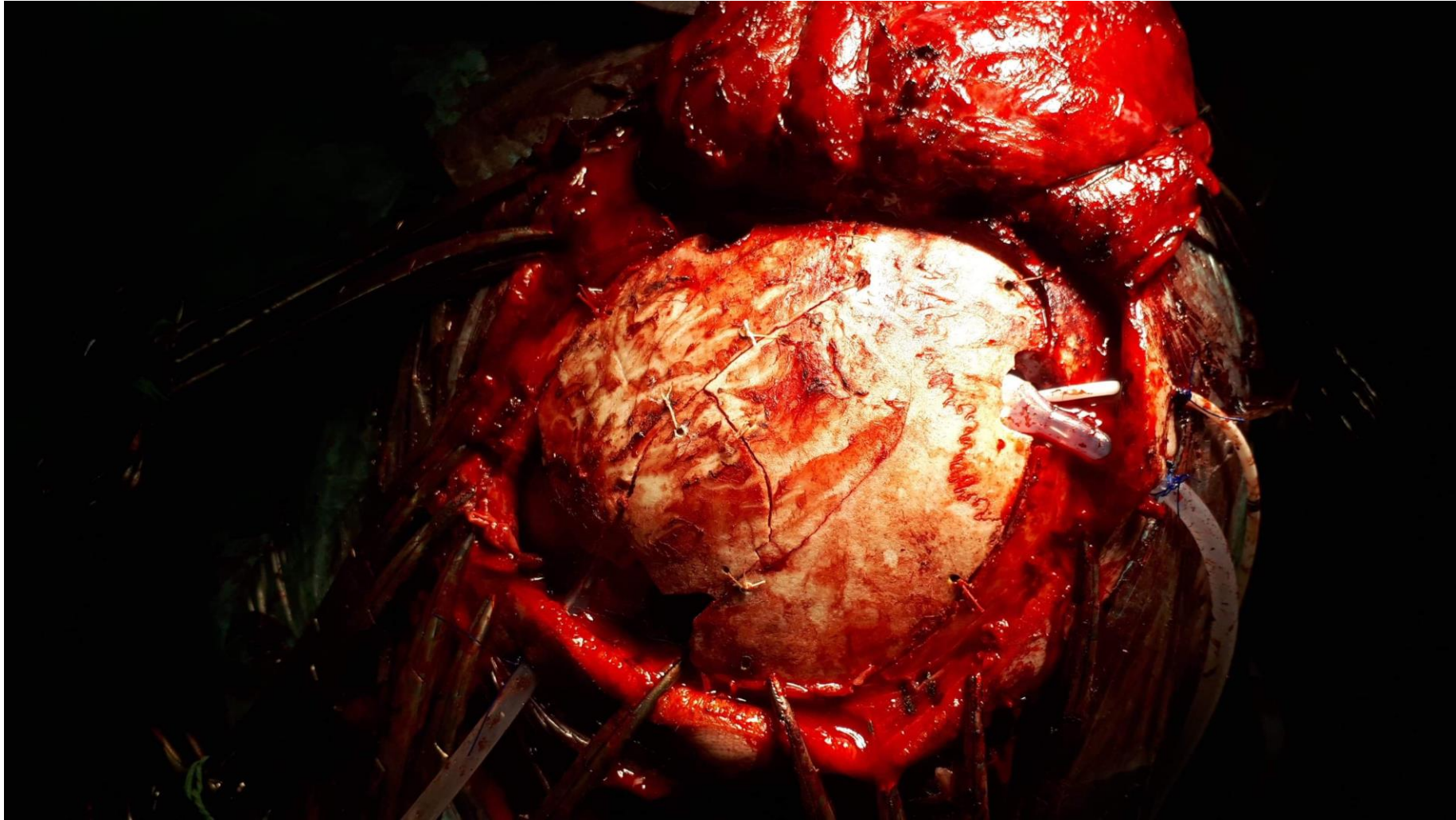
Case 2



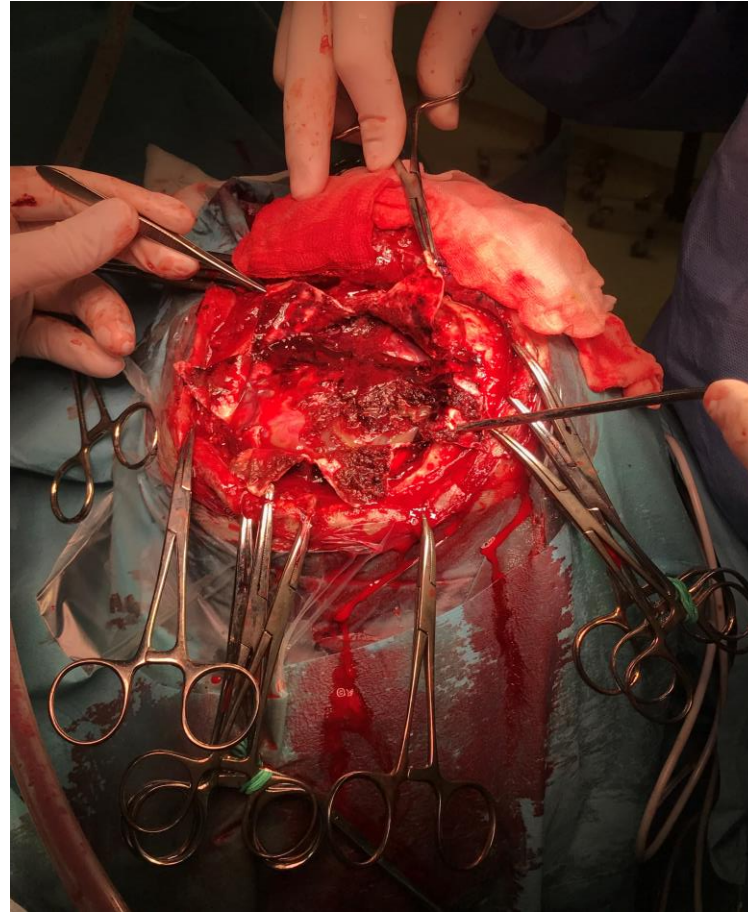
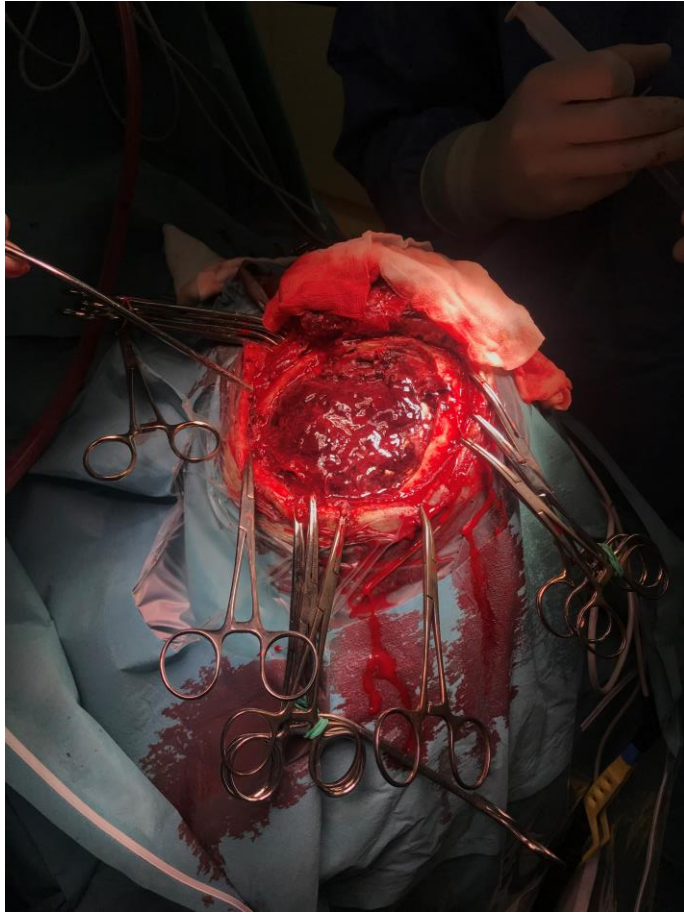








Re-bleed

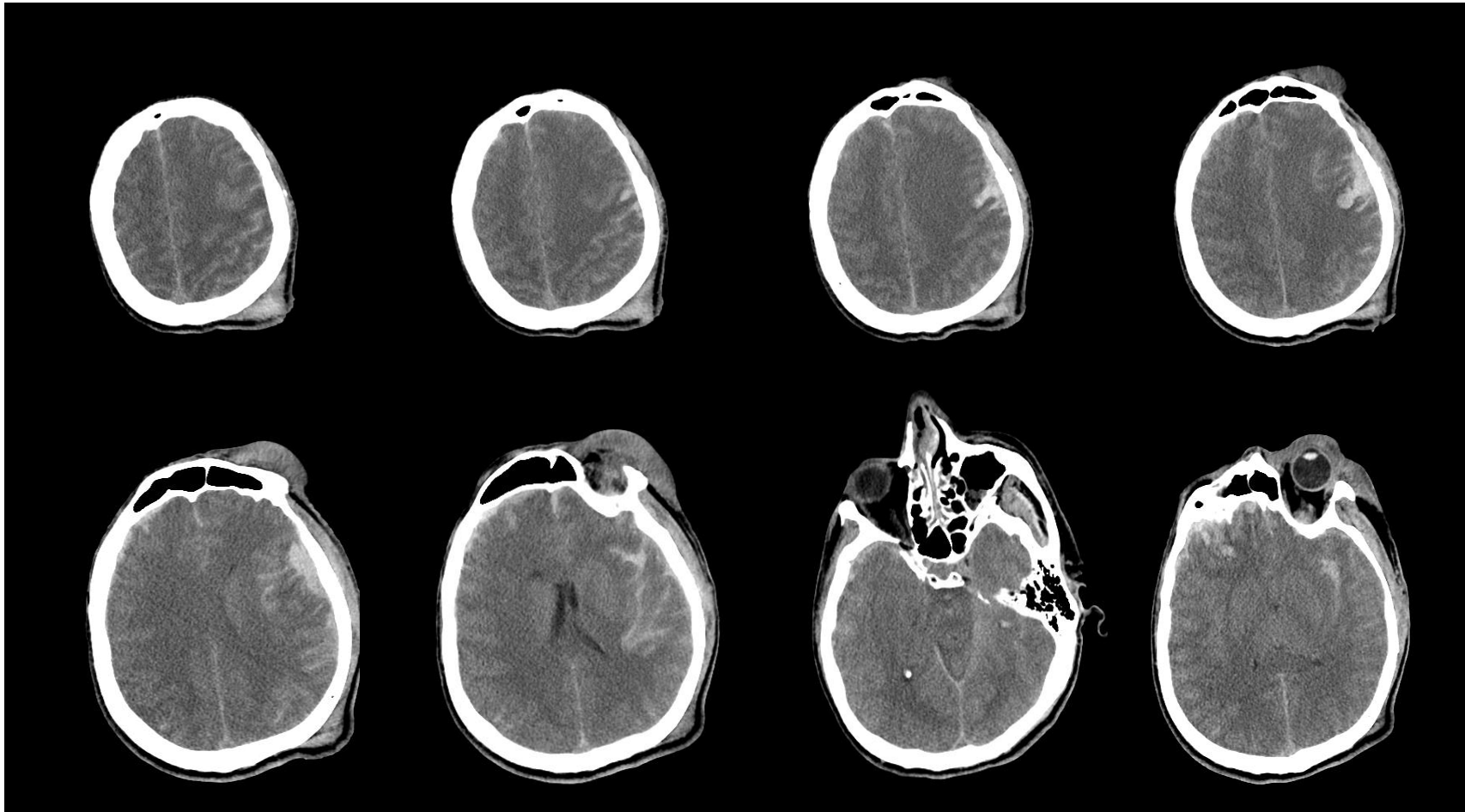


6 months Follow up

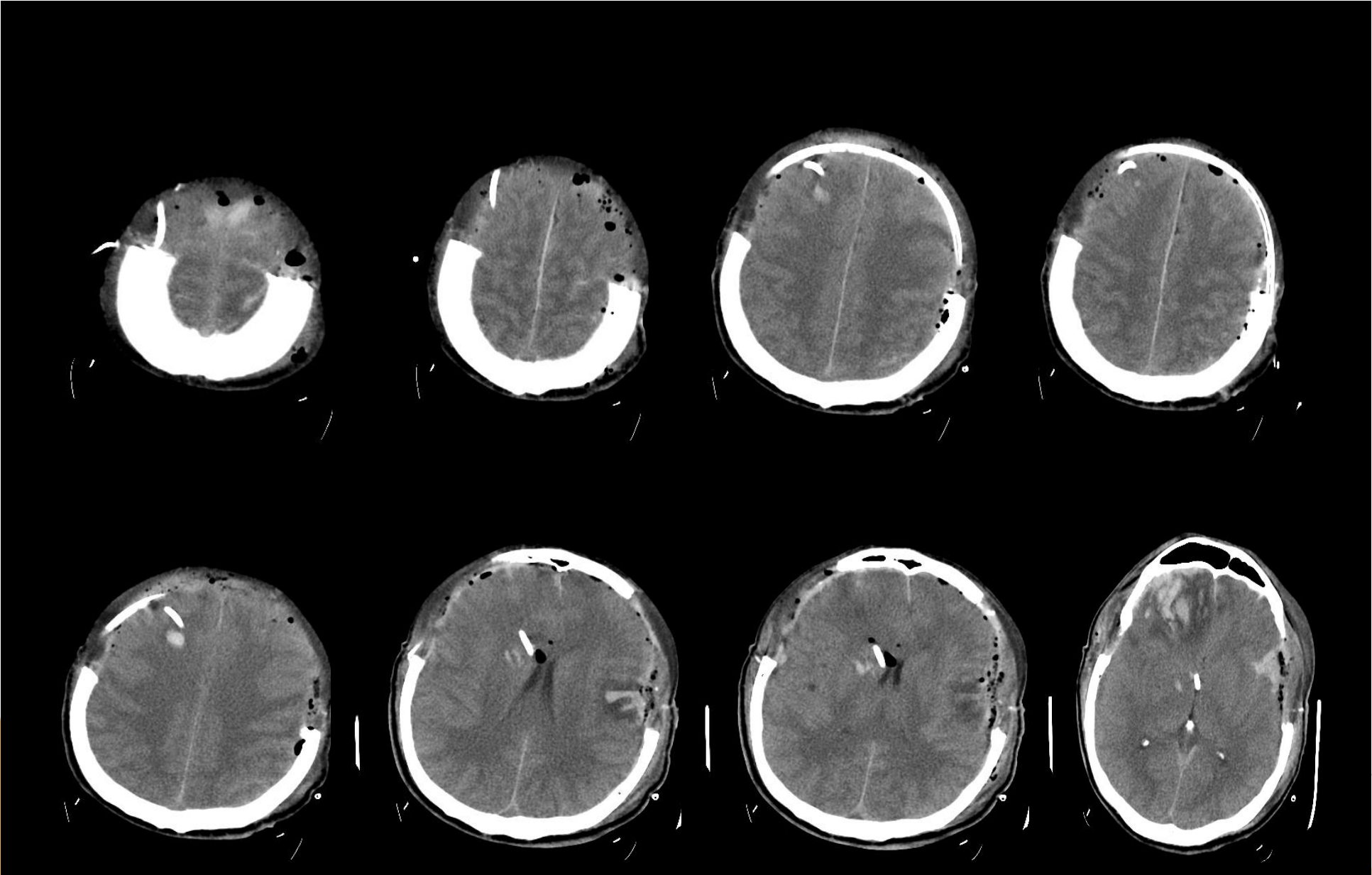
Video



Case 3







VR

SP



R

L



WL: 287 WW: 332

IA

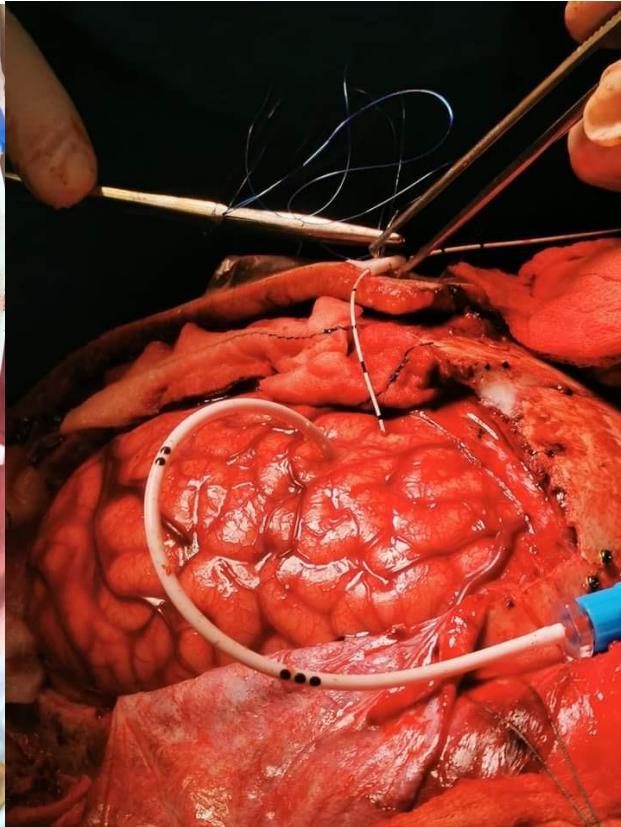
L-R: 5.1° S-I: 29.1° Roll: -12.9°

6 Months Follow up

Video



Case 4



Take home message

- ▶ Studies and protocols **SHOULD NOT** be used as the only source for decision making
- ▶ DECRA and RESCUEicp can simply be **misinterpreted**
- ▶ Do not have a tunnel vision and do not see cases **in black & white**
- ▶ These studies, protocols and personal experience should be used to make the best decision **in the benefit of the patient**
- ▶ Personal treatment plan !
- ▶ Involve the **patient's family** and inform them of outcomes !!

Disclaimer

- ▶ All cases are courtesy of Dr. Tahaei Arad and University of Szeged, Department Of Neurosurgery

Resources

- ▶ Trial of Decompressive Craniectomy for Traumatic Intracranial Hypertension
Peter J. Hutchinson, Ph.D., F.R.C.S et al. New England Journal of Medicine
- ▶ Decompressive Craniectomy in Diffuse Traumatic Brain Injury
Cooper, D. James and Rosenfeld et al. New England Journal of Medicine
- ▶ Solon Schur, Philippe Martel, Judith Marcoux, Optimal Bone Flap Size for Decompressive Craniectomy for Refractory Increased Intracranial Pressure in Traumatic Brain Injury: Taking the Patient's Head Size into Account, World Neurosurgery, Volume 137, 2020,