Decompressive Craniecomy

What is its role in 2015?

Yeah, nah, yeah

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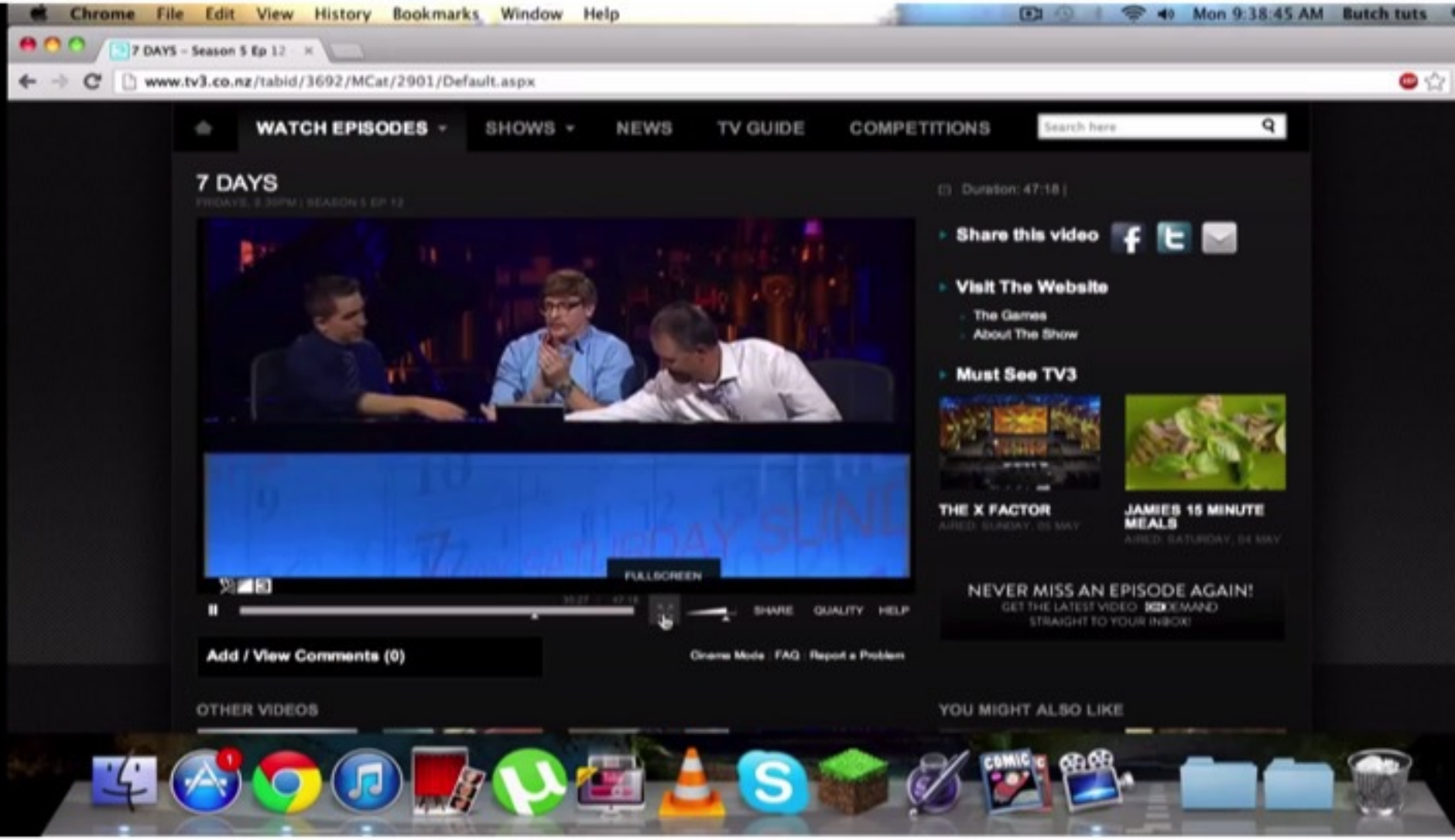
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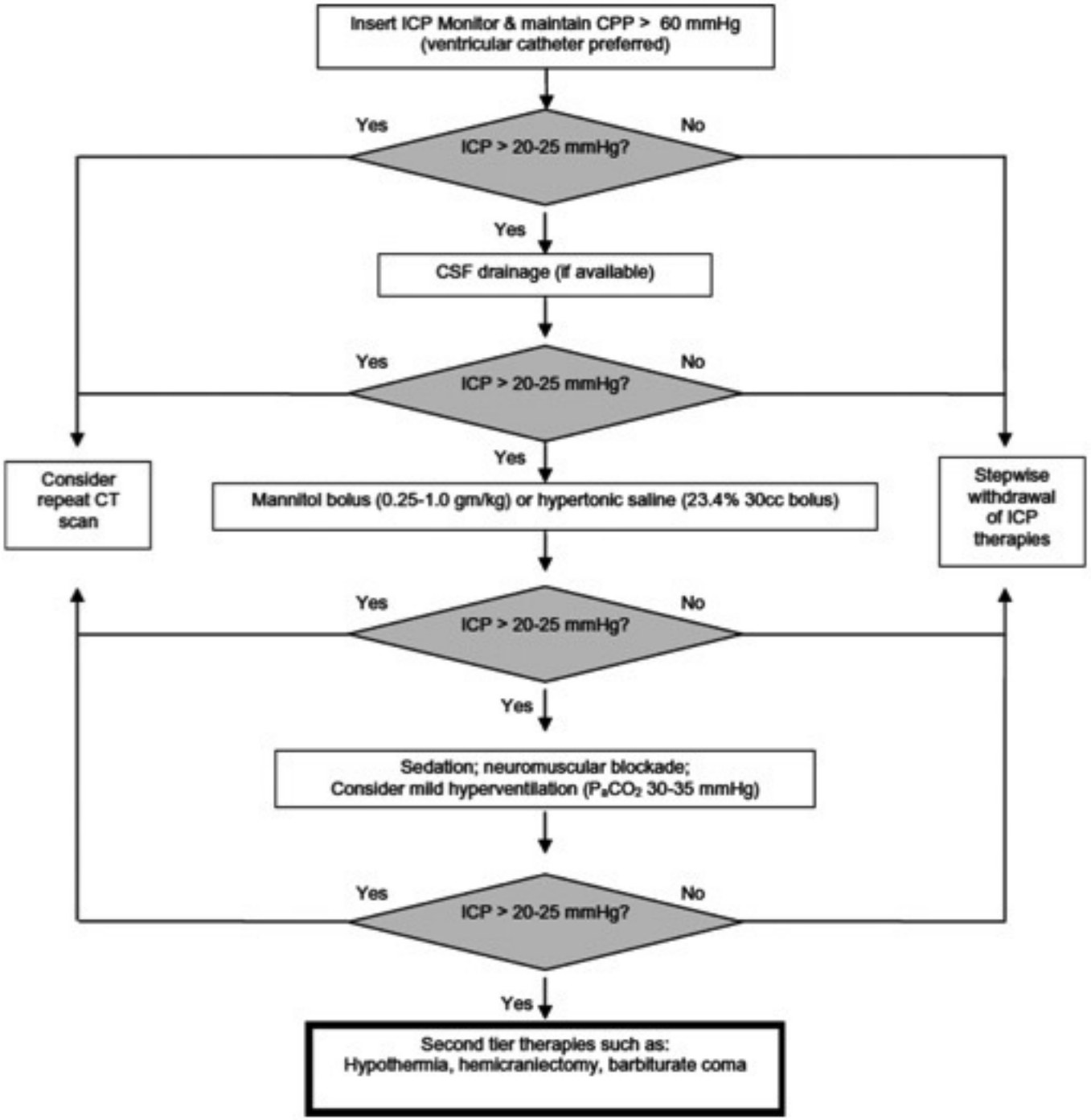
Secondary injury

- Aim of modern neurocritical care is to minimise secondary injury
- In part related to raised ICP
  - Reduces CBF
  - Directly injures brain by herniation


Insert ICP Monitor & maintain CPP > 60 mmHg
(ventricular catheter preferred)
Yes
ICP > 20-25 mmHg?
No
Yes
CSF drainage (if available)
Yes
ICP > 20-25 mmHg?
No
Consider repeat CT scan
Yes
Mannitol bolus (0.25-1.0 gm/kg) or hypertonic saline (23.4% 30cc bolus)
Stepwise withdrawal of ICP therapies
Yes
ICP > 20-25 mmHg?
No
Yes
Sedation; neuromuscular blockade;
Consider mild hyperventilation (P_aCO_2 30-35 mmHg)
Yes
ICP > 20-25 mmHg?
No
Yes
Second tier therapies such as:
Hypothermia, hemicraniectomy, barbiturate coma

Yeah

Role of Decompressive craniectomy prior to 2011

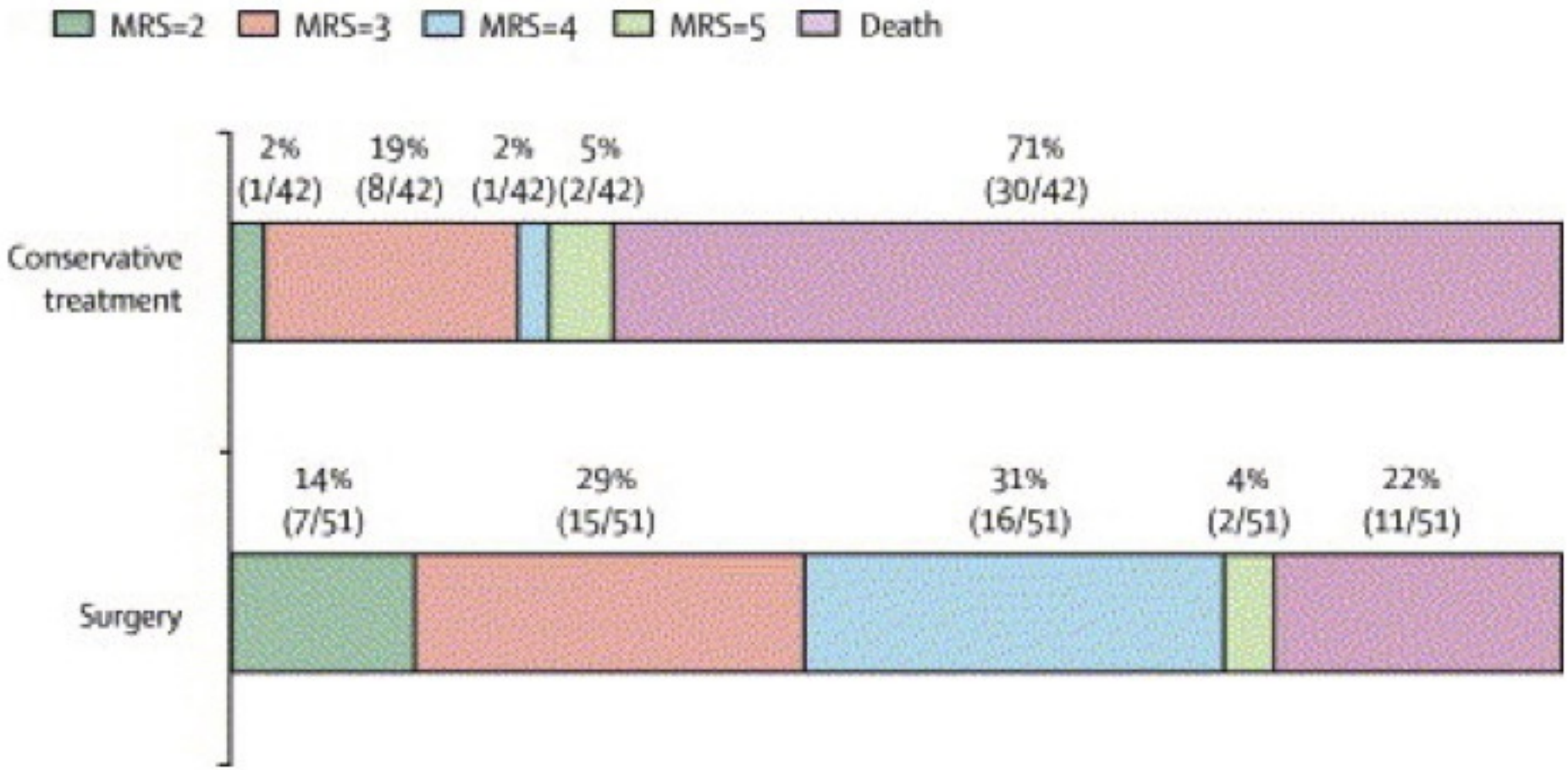
- A number of Class II studies (but not all) suggested improved outcome with decompression
- Polin (Neurosurg 97)
- N= 35 over 9 yrs
- Control cases from TCDB
- Favourable outcome
  - Craniecotomy 37%
  - Medical 16%
  - P <0.01

  - Suggest early surgery

- **A randomized trial of very early decompressive craniectomy in children with traumatic brain injury and sustained intracranial hypertension.** **Taylor CNS 2001**

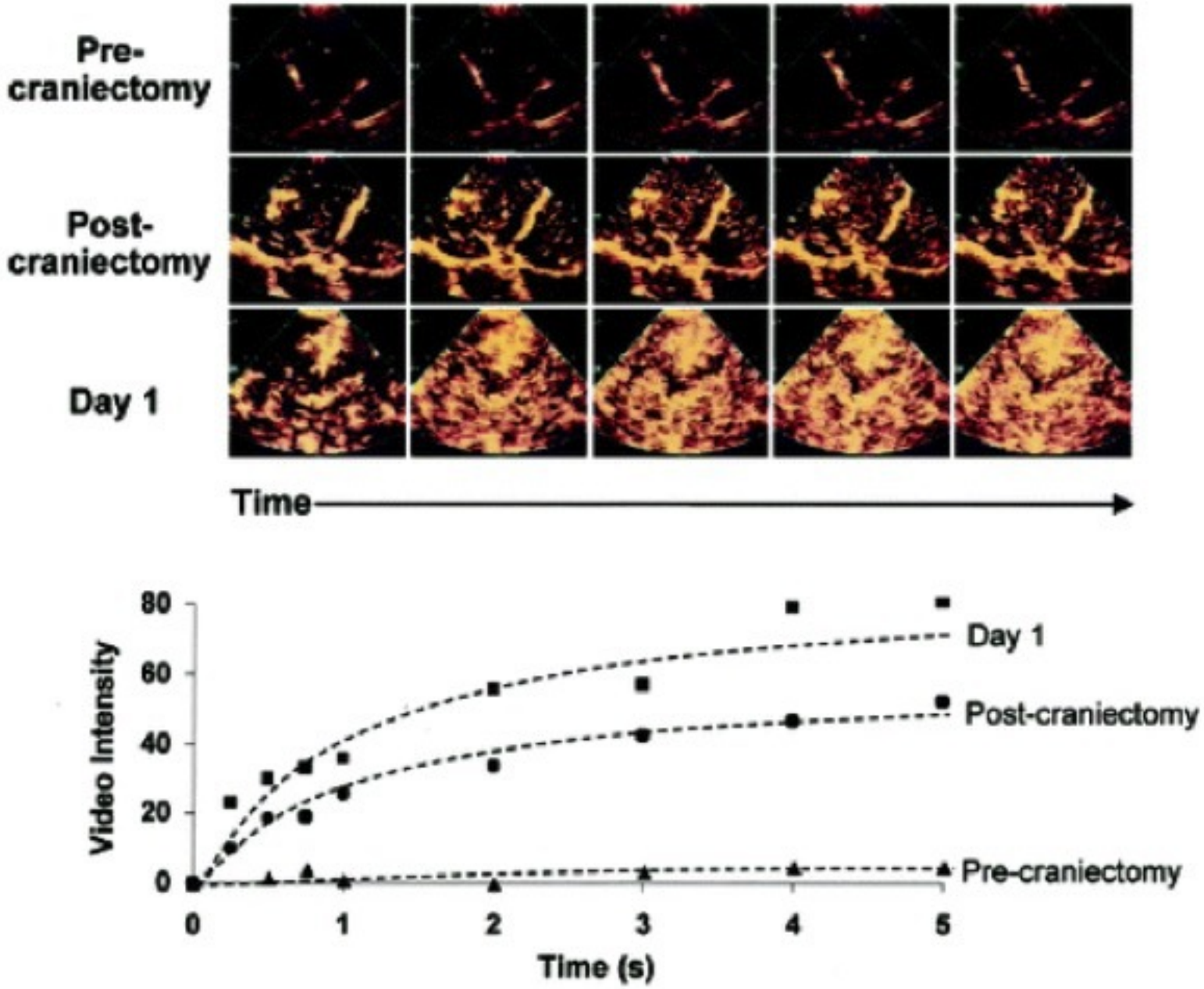
- Randomised study of 27 children at Royal Childrens Hospital
- Favourable outcome in 55% with early decompression vs 15% treated medically
- Reduction in morbidity an mortality

Evidence in other conditions
MCA stroke



Lowers ICP

- We know craniectomy lowers ICP
- However so do barbiturates and hypothermia which do not improve outcome


Pre-craniectomy
Post-craniectomy
Day 1
Time
Video Intensity
80
60
40
20
0
0
1
2
3
4
5
Time (s)
Day 1
Post-craniectomy
Pre-craniectomy

Decompressive Craniectomy

- For
  - Lowers ICP (if that indeed is important)
  - Improves CBF
  - Shortens ICU stay
  - ?Improves outcome
  - Lets us sleep at night
- Against
  - Transfer and operate on critically ill patient
  - Manipulation of brain (frontal lobes)
  - Complications of surgery (bleed, infection, syndrome of the trephined, hydrocephalus)
  - Need for subsequent cranioplasty and complications
  - Stretching of axons?
  - ? Facilitating survival of bad neurological outcome patients

Nah

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Decompressive Craniectomy in Diffuse Traumatic Brain Injury

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ABSTRACT

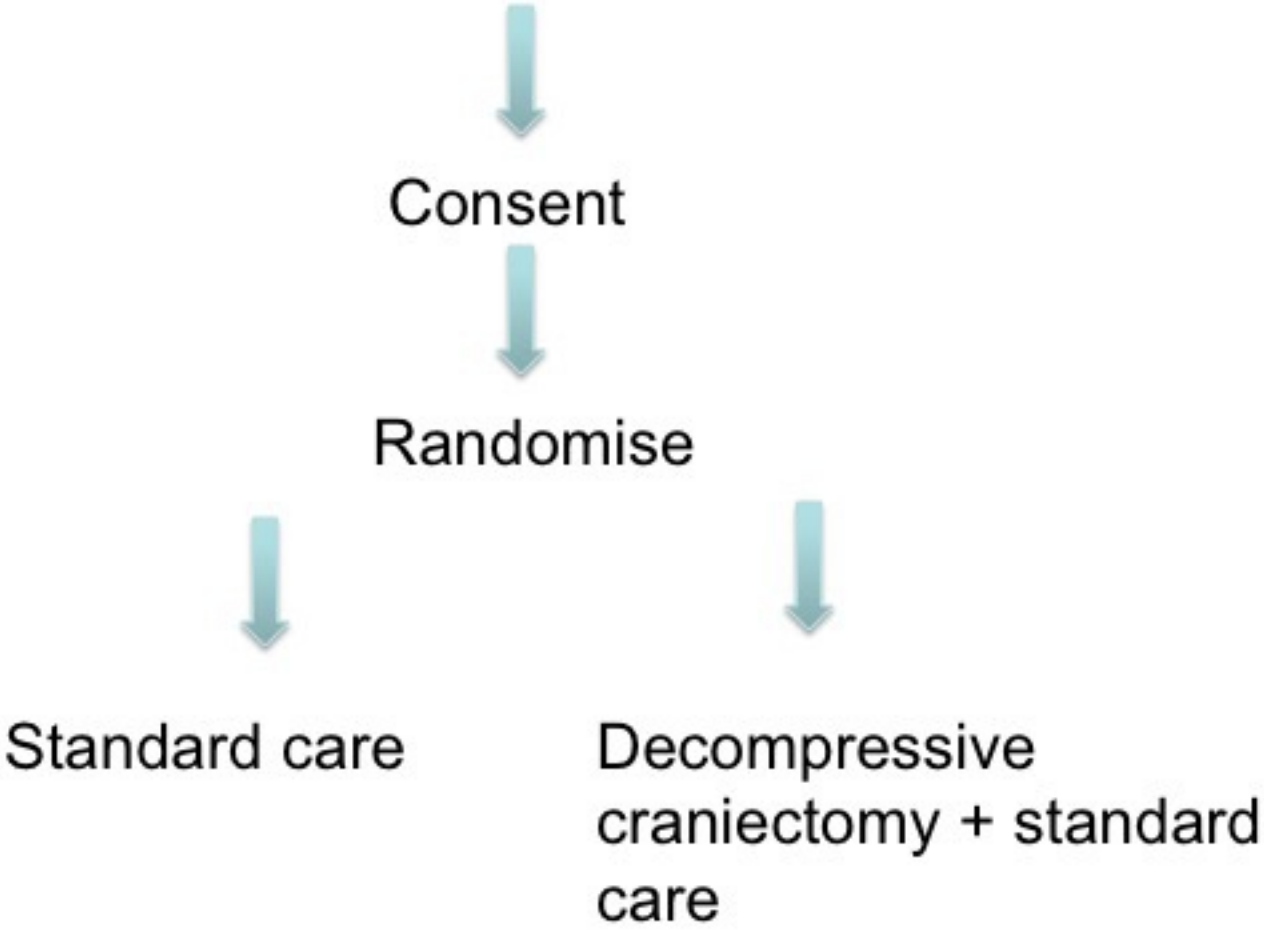
CONCLUSIONS

In adults with severe diffuse traumatic brain injury and refractory intracranial hypertension, early bifrontotemporoparietal decompressive craniectomy decreased intracranial pressure and the length of stay in the ICU but was associated with more unfavorable outcomes. (Funded by the National Health and Medical Research Council of Australia and others; DECRA Australian Clinical Trials Registry number, ACTRN012605000009617.)

- **Inclusions**:
- diffuse TBI:
  - GCS < 9 and CT scan swelling OR
  - GCS>9 pre intubation + severe CT swelling (Grade III or IV)
- < 72 hrs since accident
- ICP in situ (EVD encouraged, Codman acceptable)

- **Exclusions**:
- arrest at scene
- GCS 3 + F&D pupils
- Age: <15 or > 60
- mass lesion + craniectomy
- spinal cord injury
- neurosurgery contraindicated, no chance of survival

- If in first 72 hours post injury, and despite optimising medical management, ICP >20mmhg for 15mins/hr



Salvage options

- **LAST OPTION: If ICP > 20mmHg for 4 hours or > 30mmHg for 1 hour – both arms of study**
- **Thiopentone:** up to burst suppression
- **Uncommonly**, a patient with uncontrollable ICP despite thiopentone infusion yet who is considered salvageable, may receive a late decompressive craniectomy surgery(> 72 hours). Analysed on intention to treat.

Results

Table 2. Primary and Secondary Outcomes.*

Outcome	Decompressive Craniectomy (N=73)	Standard Care (N=82)	P Value†
Intracranial pressure and cerebral perfusion pressure			
Intracranial pressure after randomization — mm Hg	14.4±6.8	19.1±8.9	<0.001
No. of hr of intracranial pressure >20 mm Hg — median (IQR)	9.2 (4.4–27.0)	30.0 (14.9–60.0)	<0.001
Intracranial hypertension index — median (IQR)‡	11.5 (5.9–20.3)	19.9 (12.5–37.8)	<0.001
Cerebral hypoperfusion index — median (IQR)§	5.7 (2.5–10.2)	8.6 (4.0–13.8)	0.03
Duration of hospital intervention			
Days of mechanical ventilation — median (IQR)	11 (8–15)	15 (12–20)	<0.001
Days of ICU stay — median (IQR)	13 (10–18)	18 (13–24)	<0.001
Days of hospitalization — median (IQR)	28 (21–62)	37 (24–44)	0.82
Extended Glasgow Outcome Scale			
Score — no. (%)			
1 (dead)	14 (19)	15 (18)	
2 (vegetative state)	9 (12)	2 (2)	
3 (lower severe disability)	18 (25)	17 (21)	
4 (upper severe disability)	10 (14)	8 (10)	
5 (lower moderate disability)	13 (18)	20 (24)	
6 (upper moderate disability)	6 (8)	13 (16)	
7 (lower good recovery)	2 (3)	4 (5)	
8 (upper good recovery)	1 (1)	3 (4)	
Median score (IQR)	3 (2–5)	4 (3–5)	0.03
Unfavorable score of 1 to 4 — no. (%)	51 (70)	42 (51)	0.02

Appeared to convert good survivors to poor

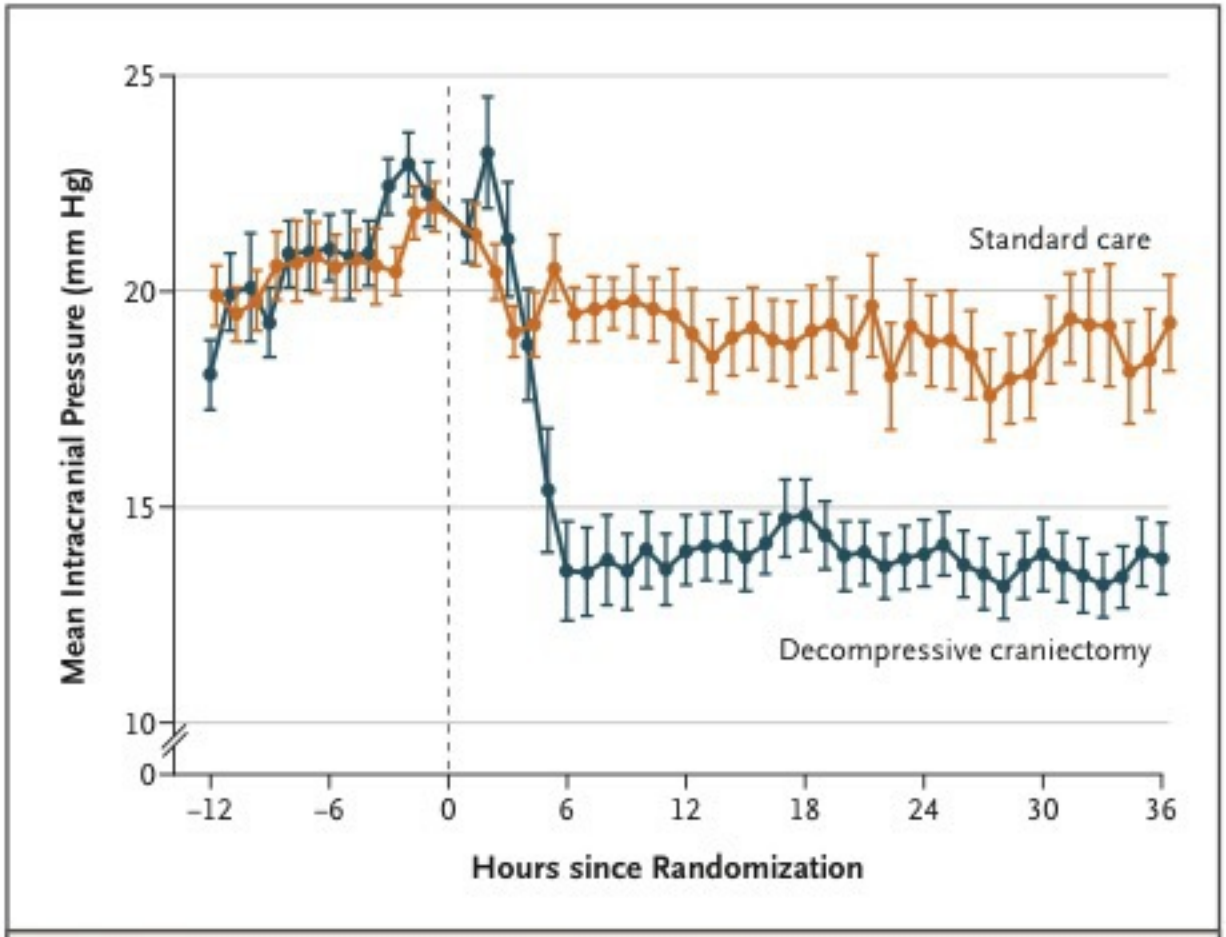
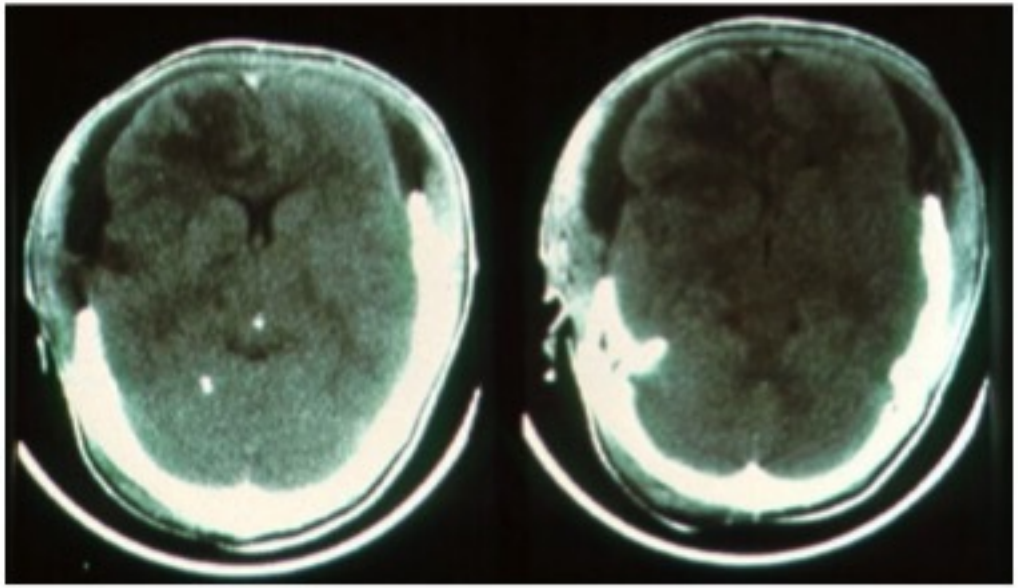


Figure 1. Intracranial Pressure before and after Randomization.

Shown are the mean measurements of intracranial pressure in the two study groups during the 12 hours before and the 36 hours after randomization. The I bars indicate standard errors.

Type of surgery

- Unilateral hemicraniectomy often used (on the worse effected side)
- Bifrontal typically reserved for bifrontal contusions



Baseline characteristics

	Decompressive Craniectomy (N=73)	Standard Care (N=82)	
Reactivity of pupils — no./total no. (%)			0.04
Neither pupil	19/71 (27)	10/80 (12)	
One or both pupils	52/71 (73)	70/80 (88)	
Marshall class — no. (%)††			0.39
Diffuse injury II	17 (23)	27 (33)	
Diffuse injury III or IV	53 (73)	53 (65)	
Nonevacuated mass lesion (VI)	3 (4)	2 (2)	

When statistical adjustment for pupils was performed, the worse outcome for decompression lost significance

Authors stress that pupils were small but not reactive (bilaterally fixed and dilated were excluded) so may be opiate effect

Low enrolment rate

- 3478 assessed, 155 enrolled
  - main exclusions due to mass lesion or ICP controlled with 1st tier therapy
- 8 yrs to recruit
- Population of the trial does not represent that of severe TBI encountered in clinical practice

Low ICP cut off for randomisation

- Many surgeons would not consider ICP>20mmHg for 15 mins an indication for surgery
- “the results of the DECRA study showed that a relatively transient and mild increase in ICP does not imply that there is significant ongoing secondary brain injury, and any potential improvement obtained by surgical decompression may well be off set by surgical morbidity”
  - Honeybul S
- Authors argue that 20 is the cut off for intervention in BTF guidelines and was after first tier therapy

Cross over

- 23% (19pts) in standard care group underwent decompression
  - with 4 being before 72hrs in violation of study protocol

Yeah

Conclusion

- Early (ICP >20mmHg for 15mins) bifrontal decompressive craniectomy may not improve outcome
- Anecdotally has not lead to widespread change in practice;
  - Craniectomy still performed for recalcitrant raised ICP
- Note this does not apply to
  - Primary decompressive craniectomy
  - Children (more prone to cerebral swelling)

Randomised Evaluation of Surgery with Craniectomy for Uncontrollable Elevation of Intra-Cranial Pressure

- Patients aged 10-65 years
- An abnormal CT
- Requring ICP monitoring with raised ICP (>25mmHg >1-12 hours), refractory to initial medical measures.
- Patient's may have an immediate operation for a mass lesion but not a decompressive craniectomy.

- Bilateral fixed and dilated pupils
- Bleeding diathesis
- A devastating injury not expected to survive for 24 hours
- Follow up not possible
- Unable to monitor ICP
- Patients treated on the Lund protocol are not eligible
- Primary decompression
- Have received barbiturates pre-randomisation
- Brainstem involvement

- **The surgical treatment will comprise:**

  (a) for unilateral hemisphere swelling / a large unilateral fronto-temporo-parietal craniectomy
  or
  (b) for bilateral diffuse hemisphere swelling a large bilateral fronto-temporo-parietal craniectomy from the frontal sinus anteriorly to the coronal suture posteriorly and pterion laterally with a wide dural opening (pedicles based on the superior sagittal sinus medially and division of the falx anteriorly).

  If continued medical treatment is drawn no decompressive surgery will be performed at the time of randomisation, but decompressive surgery may be performed later at the clinician's discretion if the patient subsequently deteriorates (for example prolonged and unacceptably high ICP >40mm Hg with compromised CPP).

- Completed recruitment May 14

Summary

- Decompressive craniectomy still has a place in severe TBI
- However
- Watch this space!