
WWJMRD 2020; 6(10): 35-40
www.wwjmrd.com
*International Journal*
*Peer Reviewed Journal*
*Refereed Journal*
*Indexed Journal*
*Impact Factor MJIF: 4.25*
E-ISSN: 2454-6615

**Dr. Nikunj Mendiratta**
Junior Resident, Department of Surgery, LLRM Medical College, Meerut, UP, India.

**Dr. Sanjay Sharma**
Associate Professor, Department of Neurosurgery, LLRM Medical College, Meerut, UP, India.

**Dr. Mayank Mishra**
Senior Resident, Department of Neurosurgery, LLRM Medical College, Meerut, U.P., India.

**Correspondence**:
**Dr. Sanjay Sharma**
Associate Professor, Department of Neurosurgery, LLRM Medical College, Meerut, UP, India.

# TBI at Tertiary Care Hospital in Western UP-Outcome and Review of Literature

**Dr. Nikunj Mendiratta, Dr. Sanjay Sharma, Dr. Mayank Mishra**

**Abstract**
Head injury cases are increasing nowadays due to rapidly moving vehicle increasing on roads day by day. Road side accident is most common cause for head injury. Severe TBI is a challenge, not only for the public but also for the Neurosurgeon in India. In severe TBI an elevated intracranial pressure is main cause for mortality. The conservative management for reducing the ICP, various modalities like hyperosmolar agent, analgesia, deep sedation and ventriculostomy and ventilator support are commonly used. The surgical management of raised ICP, Decompressive craniectomy has been frequently used for last two -three decades. The aim of study is to analyse the outcome in head injury clinical characteristics, complications and factors associated with the management of Traumatic Brain Injury with emphasis on outcome as measured by Glasgow Outcome Scale in patients who underwent only medical management and among patients who underwent a decompressive craniectomy.
**Materials and Methods:**
A study was conducted among patients with head injuries presenting to Trauma emergency of SVBP Hospital, Meerut. The Prospective data of 1138 patients admitted from Jan 2019 till Jun 2020 was taken and then analysed categorically with standard analytical software. Comparison was made between various outcomes of two groups of management of severe TBI: Medical Conservative and Surgical Decompressive Craniectomy (DC).
**Results:** 51 subjects (23.61%) passed away in immediate post-op period. Mean hospital stay duration was 11 days (7-23). 20 subjects could not be followed up as they did not turn up in OPD/Emergency. 3-month mortality rate for subjects who underwent DC was 41.20% (89 subjects). 302 patients expired without undergoing surgical management, due to severity of their injury. Overall mortality rate was 77.73% for all patients with Severe Traumatic Brain Injury. Only 53 participants (24.53%) out of 216 who were treated by surgical modality had Glasgow Outcome Scale Score of 5 at 3 months.
**Conclusion:** Decompressive craniectomy is an efficient technique to reduce intracranial hypertension. The use of proper surgical technique can be the key to a good surgical outcome. In the future, conduct of clinical trials to standardize the correct technique, surgical timing and better guidelines may make this modality a better choice for patients.

**Keywords:** Decompressive craniectomy; Traumatic Brain injury; Intracranial hypertension, Glasgow Outcome Scale; Severe TBI, DECRA, RESCUE, RESCUEicp, RESCUE-ASDH

## Introduction
In India, more than 100,000 lives are lost every year with over 1 million suffering from serious head injuries. Mostly road side accident patients suffering severe TBI do not receive optimal care in golden hours. Some patients are deteriorated before reaching the level III hospital.

The outcome of TBI is drastically correlated to the response of pre-hospital care and rehabilitation. Thirty percent of those who currently die from head injuries could be saved if quality care were available to them sooner. Most road traffic accident victims are in the 20- to 40-year age group, the main bread-earners of the family, putting the whole family below the poverty line in many cases while depriving society of vital drivers of economy as in many cases these are entrepreneurs or professionals.

It is now known that only a portion of neurological damage occurs in accidents (primary injury); damage progresses during the ensuing minutes, hours and days i.e. secondary brain injury, can result in increased mortality and disability.

An elevated intracranial pressure (ICP) is the primary cause contributing to mortality in more than 50% of patients with TBI. The conservative treatment for reducing ICP includes the general principles of physiologic homeostasis, cerebrospinal fluid (CSF) drainage, head of bed elevation, analgesia and sedation, neuromuscular blockade, usage of diuretics, and controlled hyperventilation with use of ventilators. Rapid fall in intracranial pressure that occurs after the application of either of the medical therapies occurs as a result of cerebral vasoconstriction. Given the well-known deleterious effects of ischaemia, it perhaps not unsurprising that numerous studies have failed to demonstrate that any of these therapies provide clinical benefit in terms of improvement in long term outcome.

Decompressive craniectomy (DC) is a surgical procedure in which a large section of the skull is removed, and the underlying dura mater is opened. The rationale for surgical decompression is based on the strong association between elevated intracranial pressures and poor outcome and mortality following TBI. And decompressive craniotomy will decrease intracerebral pressure by the principal of Kellie-Monroe Doctrine. Unfortunately, this assumption has been seriously questioned by the results of DECRA and RESCUEicp trials comparing early decompressive surgery with standard medical therapy in which the authors concluded that decompressive craniectomy was associated with more unfavourable outcomes albeit lesser mortality.

**Materials and Methods**

This single-centre study was conducted at Department of Neurosurgery, SVBP Hospital and LLRM Medical College, Meerut. The patients were admitted in emergency of SVBP Hospital with history of trauma and resulting Head Injury. Initial examination and management as per ATLS guidelines were done and patients transferred to neurosurgery department for management of TBI, after getting CXR and FAST done. 1138 patients were identified to be suffering from Clinically or Radiologically proven TBI during the period from January 2019 to June 2020.

Assessment of patients done in respect to demographic profile, mode of injury, clinical status by Glasgow Coma Scale [GCS], pupillary reaction, and investigate the patients with CT SCAN and radiological findings like intracranial pathology and midline shift as assessed on a head computed tomography (CT)), hemodynamic instability (preoperative blood pressure), postoperative complications, length of hospital stay and GOS at death/discharge were noted and analysed. Exclusion criteria included patients not giving consent to be a part of study, patients who were immediately referred to higher centre (for any reason), & patients who were brought dead. The Glasgow coma scale (GCS) was measured and tabulated as a summation of eye, verbal and motor component post resuscitation, and further categorized into three groups:

- GCS 13-15 was regarded as mild head injury
- GCS 9-12 as moderate head injury
- GCS<8 as severe head injury

State of pupil was defined as Equal and Reactive, Unequal and Dilated Bilaterally. Vitals including SpO2 levels, Systolic Blood Pressure and Pulse Rate being quantitative data was tabulated.

Non-Contrast CT Head was used as Investigation of Choice. The radiological evidence of extradural haemorrhage subdural haemorrhage, intraparenchymal haemorrhagic contusions, subarachnoid haemorrhage, intraventricular haemorrhage, oedema and midline shifts was noted, Diffuse axonal injuries were also noted in severe head injury and classified according to Marshall Classification.

**Table. 1:** Marshall Classification of diffuse axonal based on CT Scan findings:

| Marshall Class | | Description |
|---|---|---|
| Class I | Diffuse injury I (no visible pathology) | No visible pathology seen on CT scan |
| Class II | Diffuse injury II | Cisterns are present with midline shift 0-5 mm and/or: lesion densities present no high- or mixed-density lesion > 25 cc may include bone fragments and foreign bodies |
| Class III | Diffuse injury III (swelling) | Cisterns compressed or absent with midline shift 0-5 mm, no high- or mixed-density lesion > 25 cc |
| Class IV | Diffuse injury IV (shift) | Midline shift > 5 mm, no high- or mixed-density lesion > 25 cc |
| Class V | Evacuated mass lesion | Any lesion surgical evacuated |
| Class VI | Non-evacuated mass lesion | High- or mixed-density lesion > 25 cc, not surgical evacuated |

**Decompressive craniectomy:**

The patient's selection for decompressive craniectomy were done on the basis of mass effect (increasing midline shift >5MM), and deterioration of level of consciousness (deteriorating GCS), the presence of a refractory ICH despite adequate medical management and a large intraparenchymal or subdural hematoma (SDH) causing midline shift and a deteriorating GCS. A proper informed consent was taken from the patient's attendants before each surgical procedure Bone flap is preserved in mostly patients in abdominal wall.

The patients with minor and moderate head injury selected for DC only when the GCS deteriorated to ≤8, along with radiological evidence of increasing midline shift on CT scan and/or increasing ICP nonresponsive to the medical management for more than 20 min. Delayed surgical decompression in the form of a DC was performed in the cases having a refractory ICP despite adequate medical management owing to progressive diffuse cerebral edema. The absence of brain stem reflexes in a comatose patient was a contraindication for DC. Laterality of DC was decided by the clinical and radiological cues.

Standard bi-coronal incision was used for Kjellberg (Bifrontal) type of DC; Reverse question mark-shaped incision was used for FTP hemicraniectomy, of anteroposterior length approximately 15 cm, medially extending until 2-3 cm lateral to the superior sagittal sinus, and inferiorly reaching till the floor of the middle cranial fossa at the origin of the zygomatic arch. The evacuation of the hematoma was done, along with removal of contusion if required, and followed by a lax duraplasty using a synthetic dura patch graft. The bone flap, after its removal, was placed either in a subcutaneous pocket in the abdomen or replaced back in the calvarial defect if brain edema is not significant (Floating Bone Flap).

**Images of DC**:
Right FTP craniectomy(a)incision, (b) Anterior-posterior flap must be @15 cm long, (c) Top to base. i.e. up to zygomatic arch must be @ 12 cm.

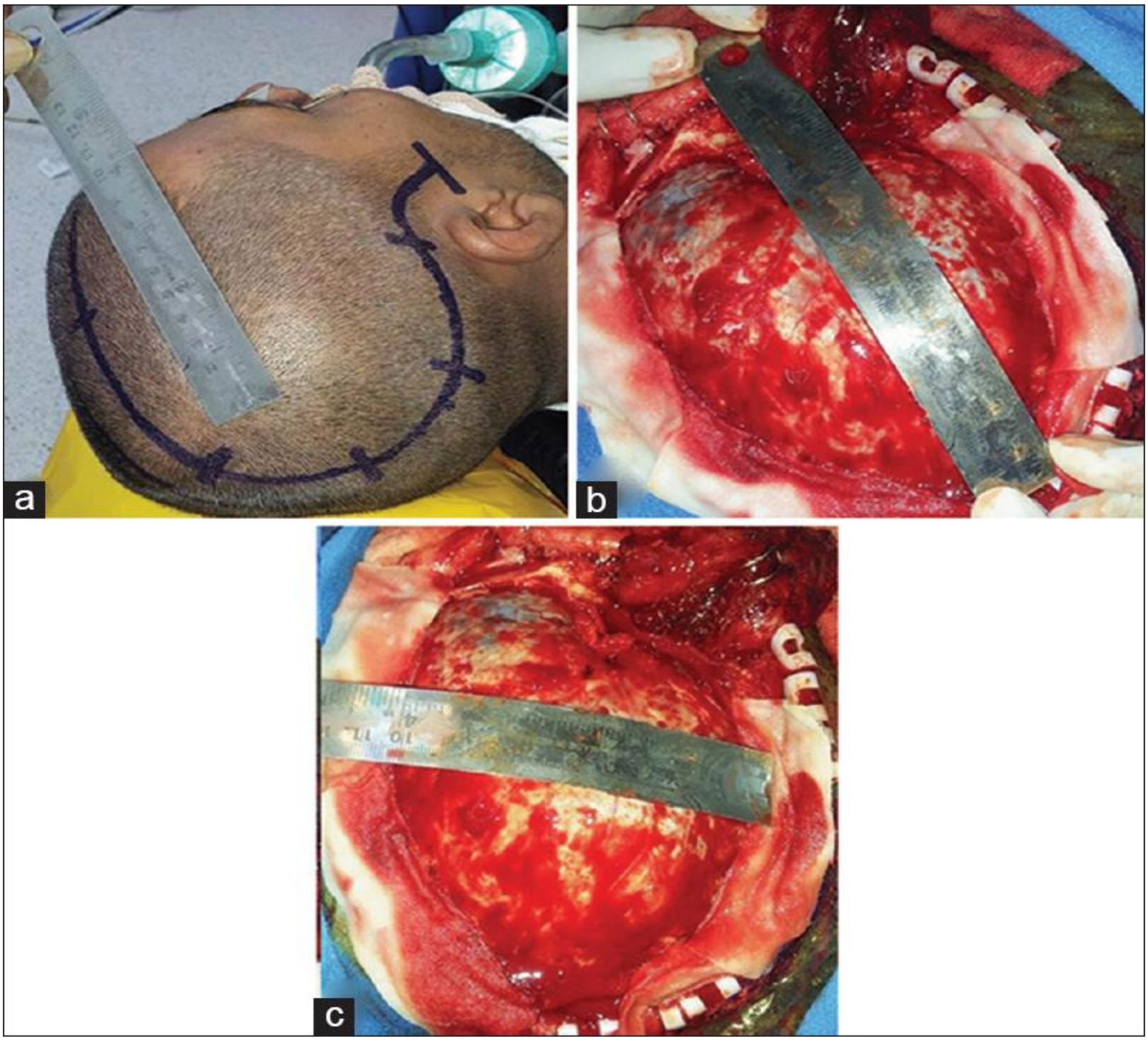



**Table. 2:** Post-operative complications of Decompressive Craniectomy can be divided into:

| Early | | Late |
|---|---|---|
| Expansion of haemorrhage/contusion | Appearance of new subdural hematoma on contralateral side | Herniation through the craniectomy defect |
| Seizures | Leakage of CSF | Subdural effusion |
| Brain herniation | Intracranial infection | Post-traumatic hydrocephalus |
| Ventilator Associated Pneumonia | Dysnatremia | Syndrome of the trephined |
| Shock | Sepsis | |

**Glasgow Outcome Scale**:
Outcome of management was measured by Glasgow Outcome Scale scores at the time of discharge, at 1 month and at 3 months. The GOSE (Glasgow Outcome Scale Expanded) splits each of Severe Disability, Moderate Disability, and Good Recovery into lower and upper categories to allow for greater differentiation between the levels of recovery that can be achieved.

| | |
|---|---|
| 1. Death | Severe injury or death without recovery of consciousness |
| 2. Persistent vegetative state | Severe damage with prolonged state of unresponsiveness and a lack of higher mental functions |
| 3. Severe disability | Severe injury with permanent need for help with daily living |
| 4. Moderate disability | No need for assistance in everyday life, employment is possible but may require special equipment. |
| 5. Low disability | Light damage with minor neurological and psychological deficits. |

Hypothesis was that Decompressive Craniectomy results in an improvement in mortality rates and Glasgow Outcome Scale as compared to optimal medical treatment.

**Observation and Results**

During the period of study from 1st January 2019 to 30th June 2020, 1138 admission were made to the emergency department of SVBP Hospital associated with LLRM Medical college, Meerut. 808 of them were males (71%) and 330 identified themselves as females (29%). Median age was 29 years (32 in males vs 25 in females). There were about 10.54% patients admitted to our hospital in less than 2 hours from onset on injury, 26.01% of patients reached our Hospital within 2 to 6 hours while 29% reached between 6 hrs to 24 hrs late. These patients first went to PHC, CHC or Level I or II hospital. 20.12% patients were shifted between 1 day to 3 days period from private hospitals either due to financial issues or no visible improvement to the attendants. Around 9.49% of patients were shifted to our hospital between 3 day to 7 days due to the same reasons. About 4.83% of patients were shifted for terminal care or from autonomous institutes.

64.61% patients (735) were transported by a private vehicle lacking basic BLS equipment. 561 (49.30%) patients got injured in a road traffic accident, while 314 (27.59%) injured themselves due to fall from a height. 19.86% came with a history of physical assault (226), 0.79% due to firearm injury (9) and 2.46% due to domestic trauma or sports injury (28).

334 (29.35%) subjects had Mild TBI (GCS > 12), 301 (26.45%) subjects had Moderate TBI (GCS between 9 and 12), and 503 (44.20%) subjects had Severe TBI (GCS < 9). The pupillary response was equal in 716 (62.91%), Anisocoric in 339 (29.79%) and dilated bilaterally in 83 (7.3%) subjects.

Most common Symptoms included Loss of consciousness(>30min), Vomiting, Bleeding from Ears, Nose or Throat, Headache, Vertigo and Amnesia. 401 patients (35.23%) of the patients had other associated injuries, cranio-facial fractures (10.72%) and orthopaedic limb injuries (13.36%) were the most common ones.

| Symptoms and sign | No. of patients (out of 1138) | Percentage (%) |
|---|---|---|
| Loss of consciousness (for more than 30 min) | 643 | 56.50% |
| Vomiting | 612 | 53.77% |
| Convulsions | 157 | 13.79% |
| Bleed from eyes, nose, throat | 346 | 30.40% |
| Aphasia | 84 | 7.38% |
| Hearing Loss | 98 | 8.61% |
| Vision loss | 154 | 13.51% |
| Hemiparesis | 226 | 19.86% |
| Focal Neurological Deficit | 168 | 14.76% |
| Post Traumatic Amnesia (for more than 2 hours) | 368 | 32.34% |
| Headache | 823 | 72.31% |
| Vertigo | 346 | 30.40% |
| Black eye (Raccoon Eyes) | 227 | 19.95% |
| Battle Sign | 109 | 9.58% |
| Agitated, abnormal or confused cognitive state | 315 | 27.68% |

Many a times, mainly in patients who came already investigated and with a NCCT Head report, the associated injuries were missed and noticed directly in ICU/HDU, this can be attributed to laxity in Primary and Secondary examination of the patient when the admitting doctor already knows a diagnosis. 16.26% of patients(n=185) came to us with Endotracheal tube/Tracheostomy in-situ, and 19.95% of patients (n=227) were intubated or airway access was gained within 4 hours of presentation for maintaining SpO2, prevention of aspiration and due to low GCS. 324 (28.47%) of intubated patients were kept on ventilator and 88 (7.7%) were kept on T-Piece with $O_2$ connected.

| Concomitant injury | No. of patients |
|---|---|
| Chest Injury | 91 |
| Blunt Trauma abdomen | 58 |
| Orthopaedic Limb Injury | 152 |
| Spinal Injury | 36 |
| Maxillo-Facial Trauma | 122 |
| Ophthalmic Injury | 63 |
| Brachial Plexus Injury | 13 |

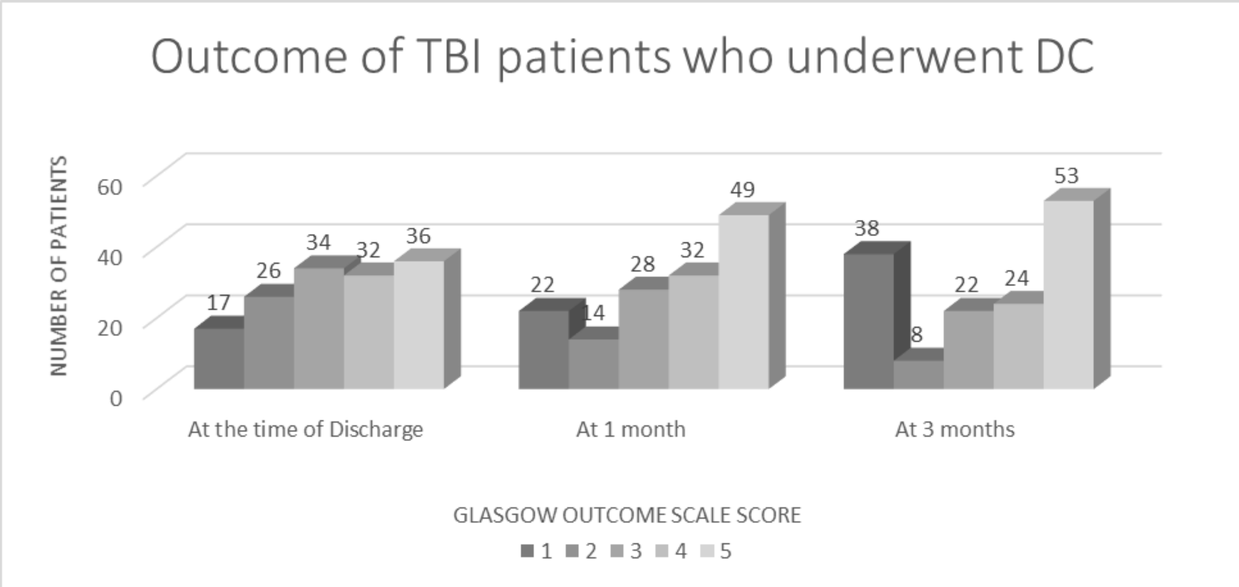
Subdural Haemorrhage (24.68%, n=281) and Haemorrhagic Contusions [Left (8.08%, n=92) > Right (5.09%, n=58) > Bilateral (3.08%, n=35)] were the most common findings along with Cerebral Edema (67.49%, n=768). Marshall scoring was then used and 46 patients (4%) were seen with a Marshall score of 2, 398 patients (35%) with a Marshall score of 3, and 649 (57%) patients with a Marshall score of 4.

| Pathology | No. of Patients | % of TBI patients |
|---|---|---|
| Extra Dural Haemorrhage | 172 | 15.11% |
| Sub Dural Haemorrhage | 281 | 24.68% |
| Sub Arachnoid Haemorrhage | 147 | 12.91% |
| Haemorrhagic Contusions | 135 | 11.86% |
| Intraventricular Bleed | 94 | 8.26% |
| Depressed Fracture | 198 | 17.39% |
| Pneumocephalus | 96 | 8.43% |
| Diffuse Axonal Injury | 153 | 13.44% |
| Cerebral Edema | 768 | 67.49% |
| Linear Fracture | 278 | 24.42% |

The decision for DC as an immediate way of reducing raised intracranial pressure was made in 216 patients (18.98%). About the timing of surgery, 16 patients (7.41%) were operated within 6 hours of presentation, 30 patients (13.89%) in the timing of 6-12 hours and in 59 patients (27.32%) before the end of first 24 hours. Rest remaining 111 were managed with Late DC. In intensive care unit (ICU), the few parameters were noted namely, blood pressure measurement, pulse rates and oxygen saturation. Breaking down the parameters the blood pressures were noted stable in 122 patients (56.49%) only. The pulse rates were noted stable in a larger sample size, in 172 patients (79.63%). The Oxygen saturation was noted stable in these 200 (93.05%) ventilated patients.

Post op plain CT Head was done at 48 hrs in 145 patients that is 67.13% of the patients who underwent DC. 51

subjects (23.61%) passed away in immediate post-op period. Mean hospital stay duration was 11 days (7-23). 20 subjects could not be followed up as they did not turn up in OPD/Emergency. 3 month mortality rate for subjects who underwent DC was 41.20% (89 subjects). 302 patients expired without undergoing surgical management, due to severity of their injury. Overall mortality rate was 77.73% for all patients with Severe Traumatic Brain Injury. Only 53 participants (24.53%) out of 216 who were treated by surgical modality had Glasgow Outcome Scale Score of 5 at 3 months.




## Discussion

A favourable outcome (GOS 4 and 5) at discharge was observed in a significant proportion of patients undergoing a DC (31.48% overall – 68 subjects), which is comparable to the previously reported series where the outcome ranged from 16 to 61%. Hemicraniectomy, also known as unilateral DC or fronto-temporo-parietal craniectomy, refers to the removal of a large fronto-temporo-parietal bone flap, whereas bifrontal DC refers to the removal of a bone flap extending from the floor of the anterior cranial fossa to the coronal suture, and to the middle cranial fossa floor bilaterally. Wide opening of the dura is a necessary part of the procedure.

DECRA trial has clearly demonstrated is that an ICP > 20mmHg for 15 minutes provides insufficient evidence that there are significant ongoing secondary insults and therefore any benefit conferred by decompression is offset by surgical morbidity. This finding would appear to be unequivocal. Whilst there may be some confounding of the results introduced by some problems with randomisation of patients and crossover between the surgical and standard care arms, it has to be accepted that the current scientific evidence is that early surgical decompression in these particular circumstances does not improve outcome.

In RESCUE-ICP trial, Decompressive Craniectomy resulted in substantially lower mortality but higher rates of vegetative state, lower severe disability, and upper severe disability than medical care. The rates of moderate disability and good recovery were similar in the two groups. Nevertheless, surgical patients continued improving beyond the 6 months, and at 12 months, 45.4% of surgical patients had a favourable outcome (upper severe disability or better) compared to 32.4% in the medical group. These results suggest that secondary DC can be helpful as a last-tier intervention to reduce mortality in the subset of TBI patients with severe and refractory post-traumatic intracranial hypertension. However, caution is needed because approximately 40% of extra survivors generated by DC will be dependent on others at 12 months.

In these circumstances attempting to scientifically establish that a decompressive craniectomy provides clinical benefit may be extremely difficult. Once a patient is adjudged to have failed medical therapy can they realistically be randomised to continue that therapy?

The best time to decompress a patient is still under discussion, but early DC (within 24 h after injury) is recommended for severely head injured patients without brain stem dysfunction requiring neurosurgery for removing intracranial collections. Also, data suggested that complications of TBI may be reduced following early DC. This decision can be made intraoperatively based on the patient’s mechanism of injury; age; degree of underlying cerebral swelling, atrophy, or both; and the surgeon’s estimation of the likelihood that the patient will develop severe ICH. Should be noted that in places where multimodal monitoring, DC can be the choice treatment to prevent brain herniation. Otherwise, the outcome of the patients who undergo late DC (after 24 h) is more encouraging

Another area of debate is the use of floating or hinged bone-flaps as a potential decompressive method for TBI. Floating or hinged bone flaps have the potential to control at least moderate swelling while at the same time obviating the need for a subsequent cranioplasty

## Conclusion

Decompressive craniectomy is an efficient technique to reduce intracranial hypertension. The use of proper surgical technique can be the key to a good surgical outcome. In the future will be the conduct of clinical trials to standardize the correct technique, surgical timing and makes a better choice of patients suitable for this technique. The current role of decompressive craniectomy in the management of severe traumatic brain injury has yet to be established. It is here that decompressive craniectomy may have at least a theoretical advantage. By challenging the Monroe Kellie Doctrine and expanding the "rigid box" the intracranial pressure can be reduced but not at the expense of cerebral blood volume and cerebral perfusion appears to be improved. What remains to be scientifically established is whether this improvement in cerebral perfusion and oxygenation is converted into clinical benefit.

The results of the recent DECRA have provided important clinical information and demonstrated some of the difficulties encountered when planning and executing trials of this nature. Whilst the results may not significantly alter the current neurosurgical practice the trial has in some ways suggested that more surgical judgement may be required prior to considering surgical decompression because in certain situations it may provide no benefit and may in fact do more harm. Prior to the findings of the study it was almost assumed that lowering the intracranial pressure by surgical decompression would be beneficial.

Whilst a significant number of patients survive following surgery and go on to make a good functional recovery, a significant number remain severely disabled, the ethical problem has been the high number of seriously disabled survivors following decompressive craniectomy. To what degree that outcome is acceptable to those individuals is difficult to determine, there has to come a point where the primary brain injury is so severe that if a patient survives the most likely long-term outcome is one of severe neurological disability. Some authors consider that long-term results justify DC after severe TBI.

A limitation of the present study was related to the fact that it was a single-centre, nonrandomized, and retrospective study design. This was an institutional study and many surgeons have operated on these patients. Post or Pre-Operative ICP monitoring was unavailable. The higher proportion of patients lost to follow-up in the current study was because the study included patients living in remote areas of the country with financial constraints and having limited access to means of communication. Considering the possibility that patients who were lost to follow-up were either dead or in a PVS, we may be underestimating the burden of PVS in the present cohort.

**References**

1. Decompressive Craniectomy in Diffuse Traumatic Brain Injury - DECRA Trial Investigators: https://www.nejm.org/doi/pdf/10.1056/NEJMoa1102077?articleTools=true
2. Trial of Decompressive Craniectomy for Traumatic Intracranial Hypertension - RESCUEicp Trial Collaborators: https://www.nejm.org/doi/pdf/10.1056/NEJMoa1605215?articleTools=true
3. Randomised Evaluation of Surgery with Craniectomy for patients
4. Undergoing Evacuation of Acute Subdural Haematoma - RESCUE-ASDH: https://drive.google.com/file/d/1IYqzUcJuyTCGqRp_5orvGBA1jYg6KWyR/view
5. Decompressive craniectomy in severe traumatic brain injury: prognostic factors and complications – Grille et al: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4489778/pdf/rbti-27-02-0113.pdf
6. The current role of decompressive craniectomy in the management of neurological emergencies -
7. Honeybul S: https://www.tandfonline.com/doi/full/10.3109/02699052.2013.794974
8. The Current Status of Decompressive Craniectomy in Traumatic Brain Injury - Angelos G. Kolias: https://doi.org/10.1007/s40719-018-0147-x
9. Peng R, Chang C, Gilmore D, Bongard F. Epidemiology of immediate and early trauma deaths at an urban Level I trauma center. Am Surg 1998; 64:950-4.
10. Brain Trauma Foundation, American Association of Neurological Surgeons, Congress of Neurological Surgeons. Guidelines for the management of severe traumatic brain injury. J Neurotrauma 2007; 24:S1-106.
11. 6 Guidelines for the Management of Severe Traumatic Brain Injury: 2020 Update of the Decompressive Craniectomy Recommendations Neurosurgery, Volume 87, Issue 3, September 2020, Pages 427–434, https://doi.org/10.1093/neuros/nyaa278,