*Original Article*

# Decompressive craniectomy in severe traumatic brain injury - a study of 20 cases

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***Abstract***

*Severe traumatic brain injury is common in all developing countries like Bangladesh. These patients are commonly managed conservatively in the most of the hospitals of our country where immediate surgical intervention and perioperative ICU facilities are not available. This cross sectional interventional study was aimed at evaluating and comparing the post operative surgical outcome of decompressive craniectomy in patients with severe traumatic brain injury (TBI) with conservatively treated patients. This study was done in Dhaka Medical College Hospital from January 2010 to December 2012. Twenty clinically suspected patients who sustained severe head injury with a GCS of 3-8 with neurological deterioration and evidence of brain contusion, laceration or evidence of brain swelling on CT Scan were included. Patient with primary fatal brain stem injury, an initial and persisting GCS score of 3, or bilaterally dilated and fixed pupil are not candidate for operative management. Outcome was assessed by Glasgow outcome scale (GOS). Follow up was given for a period of six to twelve months.*

**Key words:** Traumatic Brain Injury, decompressive craniectomy, intracranial hypertension

## Introduction

Severe traumatic brain injury (TBI) where GCS is 3-8 is usually associated with high motality (50%) and morbidity.[1] Some of these patients die due to the primary insult to brain. Diffuse brain Oedema and multiple cerebral contusions are the most common cause of death after severe head injury patients. There is renewed interest for decompressive craniectomy in the management of raised intracranial pressure (ICP) from severe traumatic brain injury. Decompressive craniectomy initially considered as a second line treatment procedure where conservative treatment failed but recently decompressive craniectomy is being considered more and more as an early procedure whenever it is indicated in clinical setting. This last proposal is very attractive for developing countries where resourcees are limited.[2] Decompressive craniectomy has series of complications like bone infection (7%), meningitis/encephalitis (6%), hydrocephalus (20%) requiring shunt, blossoming of contusion, contralateral mass lesion, external cerebral herniation, paradoxical herniation, motor trephine syndrome (syndrome of the trephined) etc.[1,2]

Common and accepted pathophysiological procedure of traumatic brain injury is due to excitotoxic surges, which facilitate an influx of calcium into cell causing mitochondrial metabolic disturbance resulting cell death. All these events cause sub-optimal cerebral blood flow and inadequate oxygen delivery activate cascade of vicious cycle causing more and more brain swelling and increased intracranial pressure (ICP). Primary rise in intracranial pressure can be managed and adjusted by CSF shift from ventricle and cistern and blood from sinuses. A secondary increased ICP is often observed 3 to 5 days after trauma due to delayed haematoma, haemorrhagic contusions with surrounding edema, which requires decompression.[3]

Common objectives of surgery are reduction of ICP and thereby prevention of midline shift and herniation. Planning of decompressive craniectomy depends upon the location of lesion (contusion, laceration and brain swelling). Timing of decompressive craniectomy is crucial regarding the surgical outcome. In traumatic brain injury cerebral contusion induces life threatening brain swelling within 2-3 hours. Second peak of brain swelling occurs within 2-5 days due to blood cell break down products and activated inflammatory cascades1. So surgery should be done as early as possible, not after 5 days of occurrence.[4]

## Methods

Twenty adult patients of severe traumatic brain injury in whom decompressive craniectomies were performed between the period of January 2010 to December 2012 were included in this study. Among them, early-primary decompressive craniectomy in 6 cases (immediate

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following trauma within 24 hours) and late within 2-5 days as secondary decompressive craniectomy in 14 cases where intractable intracranial hypertension and cerebral oedema resistant to medical management. The indication for surgery were selected on the basis of clinical evaluation, CT Scan findings and GCS score.

The parameters evaluated included the patient's demographic profile, causes of head injury, GCS on admission, clinical and neurologic deficit, CT findings, indication for surgery, specific surgical procedure and finally surgical outcome. Follow up was done by Glasgow outcome scale (GOS) for six months.

**Results**

Among the 20 patients 15 were male and 5 were female. Male : Female ratio was 3:1. Among the 20 patients, causes of severe traumatic brain injury were - motor vehicle accident (including motorcycle) 14 (70%), physical assault 4 (20%) and fall from height 2 (10%) cases.

Eight patients got admitted immediately within 24 hours but rest after 24 hours of occurrence. Clinical presentation and GCS scale were variable in all patients in this study. All patients were unconscious. GCS was 3-5 in very severe traumatic brain injury in 6 patients and 6-8 in severe traumatic brain injury in 14 patients. All these patients needed immediate resuscitation but all very severe traumatic brain injury patients required ICU support in perioperative period.CT findings were acute subdural haematoma with huge underlying oedema of brain with gross midline shift in 14 patients, hemorrhagic contusion ± laceration with acute subdural haematoma with huge brain swelling in 6 patients. CT findings of midline shift were up to 10 mm in 08 patients and more than 10 mm in 12 patients

Time of surgical intervention was variable. 8 (40%) patients got admitted in to the hospital within 24 hours of occurrence and among them 6 (30%) patients undergone early surgical decompression (decompressive craniectomy) within 2 days. 12 (60%) patient got admitted in to the hospital after 2 days of occurance, so operations were done after 2 days. 14 patients undergone surgery between 2-5 days.

Among 20 patients who undergone surgery, decompressive craniectomy + radial durotomy were done in 15 & decompressive craniectomy + duroplasty done in 5 patients. Immediate post operative follow up was done using GCS. Post operative GSC was improved more in severe traumatic brain injury than in very severe traumatic brain injury.

Longtime outcome following decompressive craniectomy was done by modified GOS score . (Table-I)

**Table-I:** Longtime outcome following decompressive craniectomy

| year of study | No. of pt | Indication | Follow up time | Pre operative GCS | *Favourable no (%) | **Unfavourable no (%) | Dead (mortality) |
|---|---|---|---|---|---|---|---|
| 2010 | 5 | Primary DC-1<br>Secondary DC-4 | 2 years | 3-5:(n=1)<br>6-8:(n=4) | 2 (10) | 2 (10) | 1 (5) |
| 2011 | 7 | Primary DC-2<br>Secondary DC-5 | 1 year | 3-5:(n=1)<br>6-8:(n=6) | 3 (15) | 2 (10) | 2(10) |
| 2012 | 8 | Primary DC-2<br>Secondary DC-6 | 6 months | 3-5:(n=3)<br>6-8:(n=5) | 4 (20) | 2(10) | 2(10) |

* Favourable GOS-5 and 4. ** Unfavourable GOS-3 and 2.

**Discussion**

Decompressive craniectomy has been attracting interest as a treatment option for refractory cerebral edema since at least 1970. A recent systematic review of decompressive craniectomies following severe traumatic brain injury showed paediatric age group has better surgical outcome in term of mortality and morbidity in the early decompressive craniectomy group than the adult age group.[5] Our study also revealed that earlier age group has better GOS than the later age group.

On reviewing available outcome reports, it is noticeable that the mortality in patients undergoing craniectomy has decreased to 20-30% in the last two decades. This change may reflect generalized improvement in ICU management and introduction of intracranial pressure monitoring devices and decompressive creniectomy.[6] Cooper et al presented a group of 50 patients with acute subdural haematoma treated with craniectomy as well as haematoma evacuation got benefited from surgical decompression.[7] Pereira et al presented a series of patients

in whom bi frontal outcome (42% of all patients or 84% of survival patients).[8] But in our study 45% of all patients or 60% of surviving patients had favourable outcome. Gower et al attempted to assess whether decompressive creniectomy provide any additional benefits compared to maximum medical therapy alone. With all the limitations of the small, interventional prospective study they were able to demonstrate improved survival rates in patients who had decompressive creniectomy as well as barbiturates versus patients who had received barbiturates alone (mortality 40% versus 82% respectively).[9] Several other centers have also reported favourable experience with craniectomy in trauma patients concluding that it may lead to improved survival and functional outcome.[10] Polin, De Luca, Schneither Ziai-all reported improved survival, but also high rates of unfavourable outcome (severe disability, persisting vegetative state GOS-3 & GOS-2).[9,10] In our study 6 (30%) patients had unfavourable outcome and 9 (45%) had favourable outcome.

Gaab et al conducted a prospective single centre study with strict exclusion criteria (based on patient's age, radiological degree of injury, presence of brain stem injury etc. ) and found that ''recovery was surprisingly good'', with only 8% of patients having unfavourable outcome.[9] In our study exclusion criteria were not strictly maintained, so 30% patients had unfavourable outcome.The indication of surgery was intracranial hypertension refractory to medical measures, correlated with clinical and electrophysiological deterioration. Guerra et al reported low rates of unfavourable outcomes in a large series of patients (n=57) using the same strict inclusion and exclusion criteria.[10] Some authors also suggested the importance of age, severity of injury, presence of extra cranial injuries as significant factors for patients' selection and outcome. Performing decompressive creniectomy before irreversible changes in the injured brain had happen may be equally important and optimum time intervel of performing decompressive creniectomy before irreversible changes within first 2 days have better surgical outcome than later. The size of craniectomy may also play role in intracranial pressure control and have an effect on outcome. In many centre, decompressive creniectomy is used part of a protocol driven management of patient with severe head injury together with or as an alternative to medical management of control intracranial pressure. In 2006, observation by Timofeev et al supported this by a series of 49 patients treated with DC of whom 30 (61%) had favorable outcome at least 6 months after injury.[4] In our series 9 patients (45%) whom favourable outcome and 6 patients (30%) have unfavourable outcome and 5 patients (25%) died.

So finally decompressive creniectomy may have a definite role to play in the developing countries in the preemptive treatment of post traumatic raised ICP. Outcome was observed by GOS scale in the cases of severe head injury in this study. It appears to hold great potentials salvaging certain cases of head injuries with clinically benign but radiologically severe status that might have had adverse outcome. These observations offer base line information for more scientifically rigorous future studies on this subject in our practice setting.

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