

# Evaluation of the Efficacy of the Non-Decompressive Single Stage Bilateral Craniotomy in Treatment of Traumatic Brain Injury

AKRAMUJALLAH<sup>1</sup>, SAJID KHAN<sup>2</sup>, MUHAMMAD ZUBAIR<sup>3</sup>, SAHIBZADA HASEEB AHMAD<sup>4</sup>, TARIQ JAMAL<sup>5</sup>

<sup>1,2</sup>Assistant Professor, Prime Teaching Hospital/ Peshawar Medical College

<sup>3</sup>Senior Registrar, Prime Teaching Hospital / Peshawar Medical College

<sup>4</sup>Medical Officer, Police Services Hospital Peshawar

<sup>5</sup>Medical Officer, Prime Teaching Hospital/ Peshawar Medical College

Corresponding author: Sajid Khan, Email: [utmanxai@gmail.com](mailto:utmanxai@gmail.com)

## ABSTRACT

**Background:** Traumatic brain injury is one of the major health care problem around the globe. It is heterogeneous entity. Traumatic lesions including fracture and hematomas typically require surgery.

**Objective:** The study aimed to analyze the Non-Decompressive Single Stage Bilateral Craniotomy in the patients suffering from traumatic brain injury.

**Study design:** This prospective and single center based study was conducted at the neuroscience department of Prime Teaching Hospital/ Peshawar Medical College for the duration of the six months from January 2022 to June 2022.

**Material and Methods:** Out of all the patients visited the neuroscience department of our institute teaching hospital, only 40 were selected for the study after analysis of the computed tomography images. These 40 fulfilled the inclusion criteria. The ethical and review board committee of our hospital approved the study. The patients willingly signed the consent. The bilateral frontal contusectomy was most commonly used surgical procedure. While other used surgical procedures were contralateral contusion and unilateral epidural hematoma.

**Results:** Out of all the patients admitted in the hospital there were 40 that met all the requirements of the study. There were 30 men and 10 women. Most of the cases were reported in the range of 40-59 age. Middle aged men were mostly effected by the disease. The cases were almost in equal number as far as severity of the Traumatic brain injury is concerned. There were some patients that developed ventilator acquired pneumonia and some of the participants suffered from urinary tract infection along with a case of wound infection. There were some death cases reported as well. There were some of the patients who quit medical advice because of their poor financial state.

**Conclusion:** To deal with traumatic brain injury in an effective way, SSBC can prove to be a safe and cost effective procedure, as it has multiple advantages like single incision, single anesthesia and reduced surgical charges, the management of the patient after operation is similar to that of unilateral procedure. Stay in hospital is also reduced and opposite lesion condition can also be avoided this way.

**Keywords:** Traumatic brain, injury, surgical treatment and unilateral procedures.

## INTRODUCTION

Traumatic brain injury is one of the major health care problem around the globe. It is heterogeneous entity. The number of morbidity and mortality cases are associated with the different types of head injuries. According to a recent study the incidence of traumatic brain injury is observed to be 260 in every 100,000 people<sup>1-3</sup>. For reducing the intracranial pressure different protocols are being used by the surgeons. Traumatic lesions including fracture and hematomas typically require surgery. The decompressive craniectomy procedure is not new<sup>4</sup>.

Since the invention of trephination by the ancient Greeks and Kocher about a century ago, the phenomena of brain decompression has been around for hundreds of years. The procedure was most recently carried out in the setting of cutting-edge, sophisticated neuro-intensive care<sup>5-7</sup>. Since Kocher and Cushing first described the decompressive craniectomy (DC) in modern neurosurgery at the beginning of the 20th century, it has been the subject of discussion till now. Even-though these are life-saving in extreme circumstances but, the poor long-term prognosis are observed in such patients. Bilateral surgery is typically only indicated in cases of significant cerebral edema or bilateral hematoma, and most surgical cases are unilateral. The injury site that was most commonly found among the patients was bifrontal contusion, then it was followed by unilateral epidural hematoma along with contralateral contusion<sup>8-9</sup>. The major type of pathological injury found was epidural hematomas. One of the most fundamental pathophysiological mechanisms associated with traumatic brain damage is brain swelling escalating cycle, intracranial pressure (ICP) elevation, decrease oxygen and blood supply, energy production failure and apoptosis. Therefore, managing these patients should focus on preventing secondary insults, lowering ICP, and maintaining blood flow, oxygen delivery, and the brain's energy status. The trauma scene required such management when the patients just admitted to the intensive care units of the hospitals. SBC is an excellent TBI treatment option,

especially in resource-constrained developing nations. It is cost-effective and safe method. The duration of hospital stay reduced after this surgical treatment. This prospective and single center based study was conducted at the neuroscience department of the hospital to analyze the Non-Decompressive Single Stage Bilateral Craniotomy in the patients suffering from traumatic brain injury<sup>9-11</sup>.

## MATERIAL AND METHODS

Out of all the patients visited the neuroscience department of our institute, Prime Teaching Hospital/ Peshawar Medical College, only 40 were selected for the study after analysis of the computed tomography images. These 40 fulfilled the inclusion criteria. The ethical and review board committee of our hospital approved the study. The patients willingly signed the consent. The bilateral frontal contusectomy was most commonly used surgical procedure. While other used surgical procedures were contralateral contusion and unilateral epidural hematoma. Chronic subdural hematoma was excluded from our analysis because it had no craniotomy and aneurysm clipping was also not included in the study because it was not a condition of TBI. The data of every patient was recorded. The SPSS software was used for the statistical evaluation of the data.

Table 1: Inclusion criteria set for surgery

Inclusion criteria	
A	Hematoma > 25ml
B	Midline shift in case of >5mm
C	Localizing characteristics of elevated intracranial pressure
D	Hematoma 15-20ml with B or C condition

## RESULTS

Study was carried out to analyze the Non-Decompressive Single Stage Bilateral Craniotomy in the patients suffering from traumatic brain injury.

Chronic subdural hematoma was excluded from our analysis because it had no craniotomy and aneurysm clipping was also not included in the study because it was not a condition of TBI. Out of all the patients admitted in the hospital there were 40 that met all the requirements of the study. There were 30 men and 10 women. Most of the cases were reported in the range of 40-59 age. Middle aged men were mostly effected by the disease. The cases were almost in equal number as far as severity of the Traumatic brain injury is concerned.

Table 2: Age wise distribution of cases

Age groups	Men	Women	Total no. of patients
Less than 20 years	0	2	2
20-39	8	1	9
40-59	12	3	15
60-79	8	2	10
More than 80 years	2	2	4
Total	30	10	40

The injury site that was most commonly found among the patients was bifrontal contusion, then it was followed by unilateral epidural hematoma along with contralateral contusion. The major type of pathological injury found was epidural hematomas

Table 3: GCS at the time of admission and discharge

Glasgow comma scale	At the time of admitting patient	At the time of discharge	Expiries/LAMA
<8	13	5	3/2
10-14	13	3	0/2
15-16	14	21	-
Total	40	29	4/4

Another major pathological injury found in our study was contusion and temporal and frontal sites were the commonly found sites of injury. To cause continuous ventilation, tracheostomy was carried out in six patients.

Table 4: Diagnosis of patients and their total number

Diagnosis of patients	No. of patients
Bifrontal contusion	8
Bifrontal Edh	5
Bilateral temporal contusion	3
Unilateral Asdh With Contralateral Edh	2
Bilateral Csdh	15
Bifrontal Edh with contralateral contusion	7
Bilateral Fronto-parietal Edh	1

There were some patients that developed ventilator acquired pneumonia and some of the participants suffered from urinary tract infection along with a case of wound infection.

Table 5: Outcomes of surgery in both genders

Consequences of surgery	Men	Women	Total
LAMA	4	0	4
Expired	3	2	5
Discharged	26	1	27
Chest infection and tracheostomy	4	2	6

There were some death cases reported as well. There were some of the patients who quit medical advice because of their poor financial state.

Table 6: Outcomes of surgery as per Glasgow outcome scale

Glasgow outcome scale	No. of patients
Expired	5
Continuous vegetative condition	3
Moderate and severe sort of disability	4,2
Fine recovery	14

## DISCUSSION

This study was carried out to find on decompressive single stage bilateral craniotomy in case of patients suffering from traumatic

brain injury. Irrespective of the fact that there is a lot of research going to find the pharmacological treatments related to traumatic brain injury but still it is a major health dilemma for people worldwide<sup>12-13</sup>. In order to standardize the surgical techniques and indications, there is a lot of study going on. In case of depressed fracture, chronic hematomas or other acute brain injuries, surgeries are carried out. As per previous reports it was found that there is no data yet that suggest SSBC for patients suffering from traumatic brain injury, however there are other techniques and procedures that are used to treat traumatic brain tumor. There are a lot of article that link SSBC with the decompressive craniectomy. Most of the literature related to SSBC is related to EDH alone, therefore its link with the decompressive craniectomy is not easy to find. As majority of the cases of traumatic brain injury are treated by making use of single side craniotomy therefore, the occurrence of bilateral is difficult to find<sup>14</sup>.

In our studies it was found that the occurrence of SSBC was found to be low. As per reports traumatic brain injury is commonly found in younger patients but in our study the SSBC cases were more frequently found among middle aged men. Some of the signs and symptoms for the SSBC were quite alike neurotrauma. The indications included contusion, fracture and hematoma. It was found that the most common area of injury was temporal ad frontal lobe. Majority of the patients were found to be present in the fine recovery group, while the rest of the groups contained almost equal patients as per GOS<sup>15</sup>. As previous studies have shown that Glasgow coma scale was a reliable prognosticating technique that is long used for the management of traumatic brain injury. But in our study GCS was not independently used factor that will decide the fate of bilateral procedures. All cases of traumatic brain injuries can be operated by a single incision in the bicoronal site because most of the time injury occur in either parietal, temporal or frontal site. But if the case is related to isolated bilateral temporal contusion single incision can't be made as it requires two bilateral incisions<sup>16-17</sup>.

There are many ways by which surgery can be made easier like strapping of the body on table, use of metallic endotracheal pipe and the rotation of the table when required. If patients are suffering like conditions e.g. stiffing of neck or short neck, then it becomes difficult for surgeons to operate on such patients. In our study the pressure on the craniotomy area present on the opposite area was avoided as the next procedure contra lateral burr hole can be carried out. There are some studies that suggest two surgeons working on a patient simultaneously so that there is ease to operate the surgery<sup>18-19</sup>. After the operation the management depends on the initial GCS and the medical state of the patient. As far as cost is concerned SSBC is far more cost effective as compared to other procedures as it reduces the intraoperative procedure cost by 50%. The stay in the hospital is also reduced to 2-5 days after SSBC, moreover the multiple CT scans, and pathology lab charges are also reduced. In some cases, the issue of sudden deterioration of the procedure is also controlled, mostly in cases where the lesion becomes worse. If there is a center where there is no monitoring for the intracranial pressure, then this approach can prove to be useful there<sup>20-21</sup>.

The advantages of SSBC include single anesthesia and reduction in charges, the management of the patient is same as done after unilateral procedure. There is single incision required for this procedure and the chance of deleterious consequences of opposite lesion can also be reduced by using this procedure<sup>22-23</sup>. However, there are some disadvantages as well. The operation time is longer for elderly as well as younger patients, there are some cases of infection reported after SSBC which makes the morbidity increased in case of SSBC. The study also has some limitations e.g. there is no monitoring of intracranial pressure, as this could reduce the number of cases of SSBC<sup>24</sup>.

## CONCLUSION

To deal with traumatic brain injury in an effective way, SSBC can prove to be a safe and cost effective procedure, as it has multiple

advantages like single incision, single anesthesia and reduced surgical charges, the management of the patient after operation is similar to that of unilateral procedure. Stay in hospital is also reduced and opposite lesion condition can also be avoided this way.

## REFERENCES

1. Roka YB, Thapa AJ. Non Decompressive Single Stage Bilateral Craniotomy in Traumatic Brain Injury. *Nepal journal of Neuroscience*. 2013 Jul 1;10(2).
2. Im SH, Jang DK, Han YM, Kim JT, Chung DS, Park YS. Long-term incidence and predicting factors of cranioplasty infection after decompressive craniectomy. *Journal of Korean Neurosurgical Society*. 2012 Oct 22;52(4):396-403.
3. Wettervik TS, Lenell S, Nyholm L, Howells T, Lewén A, Enblad P. Decompressive craniectomy in traumatic brain injury: usage and clinical outcome in a single centre. *Acta neurochirurgica*. 2018 Feb;160(2):229-37.
4. Olivecrona M, Rodling-Wahlström M, Naredi S, Koskinen LO. Effective ICP reduction by decompressive craniectomy in patients with severe traumatic brain injury treated by an ICP-targeted therapy. *Journal of neurotrauma*. 2007 Jun 1;24(6):927-35.
5. Kunze E, Meixensberger J, Janka M, Sörensen N, Roosen K. Decompressive craniectomy in patients with uncontrollable intracranial hypertension. *Intracranial Pressure and Neuromonitoring in Brain Injury 1998* (pp. 16-18). Springer, Vienna.
6. Yang XF, Wen L, Shen F, Li G, Lou R, Liu WG, Zhan RY. Surgical complications secondary to decompressive craniectomy in patients with a head injury: a series of 108 consecutive cases. *Acta neurochirurgica*. 2008 Dec;150(12):1241-8.
7. Kung WM, Lin FH, Hsiao SH, Chiu WT, Chyau CC, Lu SH, Hwang B, Lee JH, Lin MS. New reconstructive technologies after decompressive craniectomy in traumatic brain injury: the role of three-dimensional titanium mesh. *Journal of Neurotrauma*. 2012 Jul 20;29(11):2030-7.
8. Liang W, Xiaofeng Y, Weiguo L, Gang S, Xuesheng Z, Fei C, Gu L. Cranioplasty of large cranial defect at an early stage after decompressive craniectomy performed for severe head trauma. *Journal of Craniofacial Surgery*. 2007 May 1;18(3):526-32.
9. Thapa A, Adhikari RB, Bidur KC, Shakya B. Role of cisternal drainage in patients with traumatic brain injury undergoing decompressive craniectomy. *Nepal Journal of Neuroscience*. 2018;15(3):14-20.
10. Roka YB. Subspecialties in Neurosurgery: Are We Ready?. *Nepal Journal of Neuroscience*. 2018 May 28;15(1):1-2.
11. Sakowitz OW, Sharma MR, Kiening KL. Current Concepts in Diagnosis and Treatment of Traumatic Brain Injury: Implications for Healthcare in Nepal. *Nepal Journal of Neuroscience*. 2005 Jan 31;2(1):29-51.
12. Shah DB, Paudel P, Joshi S, Karki P, Sharma GR. Outcome of decompressive craniectomy for traumatic brain injury: An institutional-based analysis from Nepal. *Asian Journal of Neurosurgery*. 2021 Apr;16(2):288.
13. Pant B, Shrestha P, Shrestha P, Arita K, Hori T. Initial experience of different surgical techniques in temporal lobe epilepsy in Nepal. *Nepal Journal of Neuroscience*. 2004;1(2):98-103.
14. Pandey S, Sharma V, Singh K, Pandey D, Sharma M, Patil DB, Shende N, Chauhan RS. Bilateral traumatic intracranial hematomas and its outcome: a retrospective study. *Indian journal of surgery*. 2017 Feb;79(1):19-23.
15. Thapa A. Sub-specialty in neurosurgery: Time has come for Nepal. *Nepal Journal of Neuroscience*. 2021 Sep 1;18(3):1-2.
16. Karmacharya BG, Sathian B. Study of traumatic brain injury due to recent earthquake in manipal teaching hospital. *Nepal Journal of Neuroscience*. 2015;12(2):63-6.
17. KHAN FF, NAWAZ M, KHAN T. Primary Decompressive Craniectomy—Salvation in Closed TBI. *Pakistan Journal Of Neurological Surgery*. 2015;19(2):121-8.
18. Khadka NK, Karmacharya BG, Jha R, Adhikary DR, Sharma GR, Bista P, Sultania PK. An Audit of Head Injury at Bir Hospital. *Nepal journal of Neuroscience*. 2013 Jul 1;10(2).
19. Niaz A, Nasir MH, Niraula K, Majeed S, Neupane J, Ghimire M, Vohra AH. Factors affecting the surgical outcome in extradural hematoma in Punjab Institute of Neurosciences, Lahore, Pakistan. *Nepal Journal of Neuroscience*. 2017 Dec 1;14(3):13-8.
20. Alves Bersot CD, Linhares RM, Barbosa CA, Guimarães Pereira JE. Peri-operative fluid management during neurosurgical procedures. *Nepal Journal of Neuroscience*. 2021 May 1;18(2).
21. Cherian I. Basal cisternostomy—Is it a panacea for traumatic brain swelling?. *Journal of College of Medical Sciences-Nepal*. 2012 Sep 11;8(1):1-6.
22. Karmacharya B. Role of CT scan in modern Neurosurgery. *Journal of Brain and Spine Foundation Nepal*. 2021 Aug 10;2(1):1-.
23. Ali M, Usman M. TRAUMATIC BRAIN INJURY: A COMMON NEUROSURGICAL ENTITY. *JPMI: Journal of Postgraduate Medical Institute*. 2013 Oct 1;27(4).
24. Joshi S, Paudel P, Shah DB, Karki P, Sharma GR. Ex-vivo Preservation Technique of Autologous Bone Flap in Resource Limited Settings: Retrospective Analysis of Outcome Based on Single Institute of Nepal. *Nepal Journal of Neuroscience*. 2022 Jan 1;19(1).