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The Impact of Cranioplasty on Functional and Cognitive Outcomes in Patients with Cranial Defects

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Abstract: ***Background**: Decompressive craniectomy (DC) is a life-saving neurosurgical procedure used to manage refractory intracranial hypertension following traumatic brain injury, stroke, or other conditions. Patients with cranial defects often experience physical, cognitive, and psychosocial impairments that reduce quality of life (QoL). Cranioplasty (CR) restores cranial integrity and is thought to enhance neurological recovery and social reintegration. **Objective**: This retrospective study evaluates the impact of cranioplasty on functional and cognitive outcomes in patients with cranial defects following traumatic brain injury or elective craniotomy. **Material & Methodology**: The study was conducted at a tertiary care hospital between January 2019 and January 2025 and included 30 patients (26 males, 4 females) aged 21–70 years who underwent cranioplasty after decompressive craniectomy. Etiopathogenesis comprised 20 cases due to road traffic accidents (RTA) and 10 cases secondary to cerebrovascular accidents (CVA). Functional and cognitive outcomes were assessed using validated tools, including the Modified Rankin Scale (mRS), Barthel Index (BI), and Glasgow Outcome Scale–Extended (GOSE), at different time points following decompressive craniectomy (DC) and subsequent cranioplasty (CR). The findings demonstrate patients with persistently low Glasgow Coma Scale (GCS) scores at three months post-decompressive craniectomy showed limited or no benefit from the procedure. **Conclusion**: Cranioplasty significantly improves quality of life in patients following decompressive craniectomy, with benefits extending beyond cosmetic restoration.*

Abbreviations: Craniectomy (DC), Cranioplasty (CR). Glasgow Coma Scale (GCS) Modified Rankin Scale (mRS), Barthel Index (BI), Glasgow Outcome Scale–Extended (GOSE).

Keywords: Modified Rankin Scale (mRS), Barthel Index (BI), Glasgow Coma Scale Glasgow Outcome Scale–Extended (GOSE), decompressive craniotomy, cranioplasty, Quality of life

1. Introduction

The brain is naturally protected by a robust and resilient membranous structure known as the skull. However, defects or loss of these protective bones increase the vulnerability of the brain to trauma and damage. Acquired cranial defects arise from various factors such as trauma, tumors, infections and other causes. A significant number of these are observed following decompressive craniectomy (DC), a surgical procedure commonly performed to manage subdural hematoma (SDH) caused by traumatic brain injury (TBI) or cerebrovascular accidents (CVAs)[1]. Most patients who experience cranial defects also face functional, behavioral, and cognitive disabilities, making their rehabilitation a complex and challenging process[2, 3]. As described by Grant and Norcross (1935) the main indications for cranioplasty are both cerebral protection and cosmetic rehabilitation[4]. Cranioplasty, although classified as an elective procedure, is considered crucial for offering brain protection and improving the patient's quality of life. Therefore, it is recommended that the procedure be performed as early as possible to optimize the outcomes. These patients present with a wide array of signs and symptoms, mild to severe headache, epilepsy, risk of further trauma, cosmetic concerns, abnormal pulsation, dizziness, fatigue, and psychological distress. These symptoms are collectively referred to as the "Syndrome of Trephine" (ST)[4,5]. The neurological manifestations of ST are often triggered by external atmospheric pressure gradients. These symptoms may worsen due to factors such as cerebrospinal fluid (CSF) diversion, CSF hypovolemia, dehydration, and positional changes. One specific complication associated with large craniectomies is Sinking Skin Flap Syndrome (SSFS), first described by Yamura and Makino in 1977. This rare condition can progress to "paradoxical herniation," where the atmospheric pressure exceeds the intracranial pressure (ICP), potentially leading to neurological deterioration, coma, or even death[6].

Despite the improved clinical condition of these patients following cranioplasty, the exact mechanism by which this surgical intervention improves neurological outcomes remains unclear. Recent studies, however, have demonstrated significant improvement in neuromotor activities, cerebral hemodynamics, motor, and cognitive functions following cranioplasty which are thought to stem from the alleviation of atmospheric pressure effects, increased blood perfusion, and cerebral expansion[2, 7-13]. Although encouraging, these findings have mostly been reported in case studies and remain underexplored in large cohorts, making it challenging to draw definitive conclusions. Additionally, although these studies suggest improvement, comprehensive documentation of how these interventions affect the overall quality of life of patients is still lacking.

The objective of this study was to evaluate the functional outcomes and quality of life in patients with cranial defects who underwent cranioplasty by comparing the parameters before and after intervention. The parameters assessed include the Modified Rankin Scale (mRS)[14], the Barthel Index (BI)[15], and the Glasgow Outcome Scale Extended (GOSE)[16].

2. Material and Methods

This retrospective study was conducted at a tertiary care hospital over a period of six years, from January 2019 to January 2025. The study included thirty patients who underwent decompressive craniectomy (DC) followed by definitive reconstruction with cranioplasty. The patients age ranged from 23 years to 64 years. Only patients with no known past comorbidities were included in the study, while those suffering from other general body conditions were excluded to minimize potential bias.

The parameters assessed in the study were selected based on their relevance to patients with head or brain injury, and they allowed for an objective evaluation of the patient's recovery. The Glasgow Coma Scale (GCS) was also assessed along with the mRS, BI and GOSE.

Modified Rankin Scale (mRS): The mRS is a 6-point disability scale, with possible scores ranging from 0 to 5, with an additional category (6) for patients who pass away. It is a commonly used tool to assess the functional outcome and degree of disability or dependence in patients who have experienced a stroke or other neurological conditions. It measures the level of disability, ranging from no symptoms to severe disability (Table1).

Table 1: Modified Rankin Scale

Modified Rankin Scale	
0	No symptoms
1	No significant disability. Able to carry out all usual activities, despite some symptoms.
2	Slight disability. Able to look after own affairs without assistance, but unable to carry out all previous activities.
3	Moderate disability. Requires some help, but able to walk unassisted.
4	Moderate severe disability. Unable to attend to own bodily needs without assistance, and unable to walk unassisted.
5	Severe disability. Requires constant nursing care and attention, bedridden, incontinent.
6	Dead

Barthel Index (BI): The BI is an ordinal scale used to assess performance in activities of daily living (ADLs). It includes ten variables that describe mobility and other ADLs, assigning scores based on the degree of assistance required. A higher score indicates greater independence, and the scale is often used to predict the likelihood of a patient being able to live at home independently following discharge from the hospital (Table 2).

Table 2: Barthel Index Scoring Form

Barthel Index Scoring Form

Patient Name: ____________________ Rater Name:____________________ Date:___________

FEEDING
0 = unable
5 = needs help cutting, spreading butter, etc., or requires modified diet
10 = independent

BATHING
0 = dependent
5 = independent (or in shower)

GROOMING
0 = needs to help with personal care
5 = independent face/hair/teeth/shaving (implements provided)

DRESSING
0 = dependent
5 = needs help but can do about half unaided
10 = independent (including buttons, zips, laces, etc.)

BOWELS
0 = incontinent (or needs to be given enemas)
5 = occasional accident
10 = continent

BLADDER
0 = incontinent, or catheterized and unable to manage alone
5 = occasional accident
10 = continent

TOILET USE
0 = dependent
5 = needs some help, but can do something alone
10 = independent (on and off, dressing, wiping)

TRANSFERS (BED TO CHAIR AND BACK)
0 = unable, no sitting balance
5 = major help (one or two people, physical), can sit
10 = minor help (verbal or physical)
15 = independent

MOBILITY (ON LEVEL SURFACES)
0 = immobile or < 50 yards
5 = wheelchair independent, including corners, > 50 yards
10 = walks with help of one person (verbal or physical) > 50 yards
15 = independent (but may use any aid; for example, stick) > 50 yards

STAIRS
0 = unable
5 = needs help (verbal, physical, carrying aid)
10 = independent

TOTAL SCORE= ___________

Glasgow Outcome Scale (GOS) and Glasgow Outcome Scale Extended (GOSE): The GOS, first described by Jennett and Bond in 1975, is a scale used to predict long-term rehabilitation outcomes for patients with brain injuries, including their potential to return to work and daily life. The extended version of this scale (GOSE) subdivides the upper three categories, providing more detailed outcomes (Table 3&4).

Table 3: Glassgow outcome score

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.

Table 4: Glassgow outcome score extended

1. Death
2. Vegetative state
3. Lower severe disability
4. Upper severe disability
5. Lower moderate disability
6. Upper moderate disability – some disability but can potentially return to some form of employment
7. Lower good recovery- minor physical or mental defect
8. Upper good recovery- full recovery

These parameters were assessed at four key time points by an independent nurse researcher through telephonic interviews with the patients.

- One week following decompressive craniectomy (DC1)
- Twelve weeks following decompressive craniectomy (DC12)
- One week following cranioplasty (CR1)
- Twelve weeks following cranioplasty (CR12)

3. Results

The present study was a retrospective observational analysis aimed at evaluating the functional outcomes and QoL in patients who underwent DC followed by CR. It was conducted at a tertiary care hospital between January 2019 and January 2025, including 30 patients who met the inclusion and exclusion criteria. The average age of participants was 41.1 years (±14.27 years), with ages ranging from 23 to 64 years. The male to female ratio in the study group was 6.5:1.

Table 5: Master table

patient age	underlying etiology	GCS-DC1	GCS-DC12	GCS-CR1	GCS-CR12	mRSA DC1	mRSA DC12	mRSA CR1	mRSA CR12	BI DC1	BI DC12	BI CR1	BI CR12	GOSE DC1	GOSE DC12	GOSE CR1	GOSE CR12
32/M	RTA	15	15	15	15	4	3	2	1	35	90	90	100	4	6	7	8
54/M	RTA	15	15	15	15	4	3	3	2	0	60	65	100	3	4	4	5
62/M	CVA	8	12	15	15	5	4	4	3	0	0	0	40	3	4	4	5
26/M	RTA	8	8	8	8	5	5	5	5	0	0	0	0	2	2	2	2
25/M	RTA	8	8	8	8	5	5	5	5	0	0	0	0	2	2	2	2
32/F	RTA	8	10	12	15	5	5	4	3	0	0	30	90	3	4	4	8
34/M	RTA	12	14	15	15	4	3	3	2	35	45	45	90	4	5	5	7
56/M	CVA	12	15	15	15	4	3	2	1	35	90	90	100	4	6	7	8
27/F	CVA	9	12	12	15	5	4	4	3	0	0	0	30	3	4	4	5
52/F	CVA	10	12	15	15	5	4	4	3	0	0	0	30	3	4	4	5
33/M	RTA	15	15	15	15	4	3	2	1	40	90	90	100	4	6	7	8
55/M	CVA	15	15	15	15	4	3	3	2	0	60	65	100	3	4	4	5
63/M	RTA	12	15	15	15	5	4	4	3	0	0	0	40	3	4	4	5
27/M	RTA	8	8	8	8	5	5	5	5	0	0	0	0	2	2	2	2
28/M	RTA	15	15	15	15	4	3	3	2	35	45	45	90	4	5	5	7
26/M	RTA	8	8	8	8	5	5	5	5	0	0	0	0	2	2	2	2
57/M	CVA	15	15	15	15	4	3	2	1	35	90	90	100	4	6	7	8
23/M	RTA	10	12	12	15	5	4	4	3	0	0	0	30	3	4	4	5
54/M	CVA	12	14	14	15	5	4	4	4	0	0	0	35	3	4	4	5
64/M	CVA	10	14	14	15	5	4	4	3	0	0	0	40	3	4	4	5
29/M	RTA	9	15	15	15	5	4	4	3	0	0	0	30	3	3	3	4
34/M	RTA	15	15	15	15	4	3	2	1	35	90	90	100	4	6	7	8
53/M	RTA	15	15	15	15	4	3	3	2	0	0	0	40	3	4	4	5
25/M	RTA	15	15	15	15	4	3	3	2	35	45	45	90	4	5	5	7
42/M	RTA	8	8	8	8	5	5	5	5	0	0	0	0	2	2	2	2
48/M	CVA	9	14	14	15	5	4	4	3	0	0	0	40	2	3	3	4
35/F	RTA	9	12	12	15	5	4	4	3	0	0	0	40	3	4	4	5
58/M	CVA	15	15	15	15	4	3	2	1	35	90	90	100	4	6	7	8
24/M	RTA	10	12	14	15	5	4	4	3	0	0	0	30	3	4	4	5
55/M	RTA	8	12	14	15	5	4	4	4	0	0	0	40	3	4	4	5

Statistical Data Analysis

The data on categorical variables is shown as n (% of cases) and the data on normally distributed continuous variables is presented as mean and standard deviation (SD). The paired statistical comparison of distribution of categorical variables is tested using Wilcoxon's signed rank test. All results are shown in tabular as well as graphical format to visualize the statistically significant difference more clearly. In the entire study, the p-values less than 0.05 are considered to be statistically significant. The entire data is statistically analyzed using Statistical Package for Social Sciences (SPSS ver 24.0, IBM Corporation, USA) for MS Windows.

Age distribution

Of 30 cases studied, 10 (33.3%) had age below 30 years, 9 cases (30.0%) had age between 51 – 60 years. The mean ± SD of age of cases studied was 41.10 ± 14.27 years and the minimum – maximum age range was 23 – 64 years.

Gender distribution

Of 30 cases studied, 26 cases (86.7%) were male and 4 cases (13.3%) were female. The male to female sex ratio was 6.5: 1.0 in the study group.

Distribution of underlying etiology

Of 30 cases studied, 20 cases (66.7%) had RTA – head injury and 10 (33.3%) had CVA.

Distribution of GCS score after DC and CR (Table 6 & figure1).

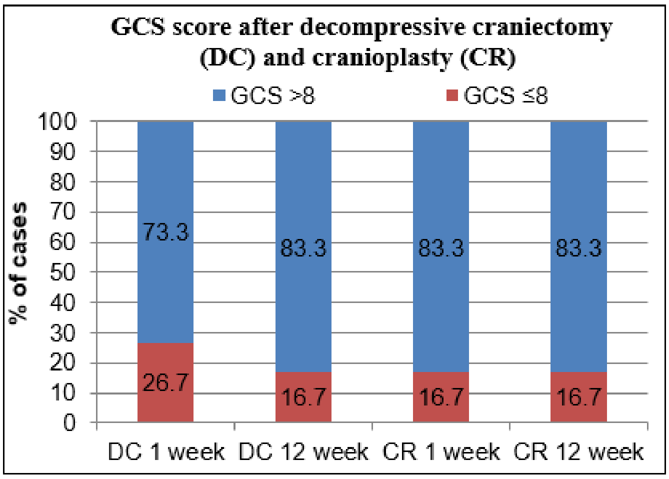
GCS DC1: 8 cases (26.7%) had GCS ≤ 8, 22 cases (73.3%) had GCS ≥ 8. GCS DC12: 5 cases (16.7%) had GCS ≤ 8, 25 cases (83.3%) had GCS ≥ 8. GCS CR1 & GCS CR12: 5 cases (16.7%) had GCS ≤ 8, 25 cases (83.3%) had GCS ≥ 8 at 01 week and 12 weeks post CR.

Distribution of GCS DC12 did not differ significantly compared to GCS CR12 (P value>0.05).

Table 6 & Figure 1: Distribution of GCS score after DC and CR

	Follow-up	GCS score	No. of cases	% of cases
DC	1-week	≤8	8	26.7
		>8	22	73.3
	12-week	≤8	5	16.7
		>8	25	83.3
P-value	1 week vs 12 week		**0.083**^{NS}	
CR	1-week	**≤8**	5	16.7
		>8	25	83.3
	12-week	**≤8**	5	16.7
		>8	25	83.3
P-value	1 week vs 12 week		**0.999**^{NS}	
P-value	DC vs CR (12 week)		**0.999**^{NS}	

P-value by Wilcoxon's signed rank test. P-value<0.05 is considered to be statistically significant. NS – Statistically non-significant.



Distribution of mRS score (Table 1& 7) – mRS DC1: All cases (100.0%) had mRS score ≥ 3. mRS DC12: 12 cases (40.0%) had mRS score ≤ 3, 18 cases (60.0%) had mRS score ≥3. Distribution of **mRS** score significantly improved from DC1 to DC12 (P value<0.05). **mRS CR1** – 12 cases (40.0%) had mRS score ≤ 3, 18 cases (60.0%) had mRS score ≥ 3. **mRS CR12** – 23 cases (76.7) had mRS score ≤ 3, 7 cases (23.3%) had mRS score ≥ 3.

Table 7: Distribution of mRS score after DC and CR

	Follow-up	mRS score	No. of cases	% of cases
DC	1-week	≤3	0	0.0
		>3	30	100.0
	12-week	≤3	12	40.0
		>3	18	60.0
P-value	1 week vs 12 week		**0.001*****	
CR	1-week	≤3	12	40.0
		>3	18	60.0
	12-week	≤3	23	76.7
		>3	7	23.3
P-value	1 week vs 12 week		**0.001*****	
P-value	DC vs CR (12 week)		**0.001*****	

P-value by Wilcoxon's signed rank test. P-value<0.05 is considered to be statistically significant. ***P-value<0.001.

Distribution of mRS score at 12 weeks post CR improved significantly compared to mRS score at 1 week post CR(P-value<0.05).

Distribution of Barthel index (BI) score after DC and CR (Table 2 & 8)
BI DC1 – All cases (100.0%) had BI score ≤ 90. **BI DC12**- 6 cases (20.0%) had BI score ≥ 90, 24 cases (80.0%) had BI score ≤ 90.

Distribution of BI DC 12 improved significantly compared to BI DC1 (P-value<0.05).

BI CR1 – 6 cases (20.0%) had BI score ≥ 90, 24 cases (80.0%) had BI score ≤ 90. **BI CR12** – 12 cases (40.0%) had BI score ≥ 90, 18 cases (60.0%) had BI score ≤ 90.

Distribution of BI score at CR 12 improved significantly compared to BI CR1(P-value<0.05).

Table 8: Distribution of Barthel Index score after DC and CR

	Follow-up	BI score	No. of cases	% of cases
DC	1-week	≥90	0	0.0
		<90	30	100.0
	12-week	≥90	6	20.0
		<90	24	80.0
P-value	1 week vs 12 week		**0.014***	
CR	1-week	≥90	6	20.0
		<90	24	80.0
	12-week	≥90	12	40.0
		<90	18	60.0
P-value	1 week vs 12 week		**0.014***	
P-value	DC vs CR (12 week)		**0.014***	

P-value by Wilcoxon's signed rank test. P-value<0.05 is considered to be statistically significant. *P-value<0.05.

Distribution of GOSE score after DC and CR (Table 4 & 9)

GOSE DC1 All cases (100.0%) had GOSE score ≤6. **GOSE DC12 –** 6 cases (20.0%) had GOSE score ≥ 6, 24 cases (80.0%) had GOSE score ≤ 6.

Table 9: Distribution of (GOSE) score after DC and CR

	Follow-up	GOSE score	No. of cases	% of cases
DC	1-week	≥6	0	0.0
		<6	30	100.0
	12-week	≥6	6	20.0
		<6	24	80.0
P-value	1 week vs 12 week		**0.014***	
CR	1-week	≥6	6	20.0
		<6	24	80.0
	12-week	≥6	10	33.3
		<6	20	66.7
P-value	1 week vs 12 week		**0.046***	
P-value	DC vs CR (12 week)		**0.046***	

P-value by Wilcoxon's signed rank test. P-value<0.05 is considered to be statistically significant. *P-value<0.05.

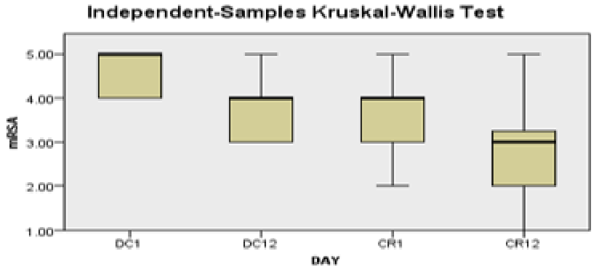
Distribution of GOSE score at DC 12 improved significantly compared to GOSE score DC 1 (P-value<0.05).

GOSE CR1 – 6 cases (20.0%) had GOSE score ≥ 6, 24 cases (80.0%) had GOSE score ≤6. **GOSE CR12** – 10 cases (33.3%) had GOSE score ≥ 6, 20 cases (66.7%) had GOSE score ≤ 6.

Distribution of GOSE score at CR 12 improved significantly compared to GOSE score at CR 1 (P-value<0.05).

The study parameters- mRS and GOSE provided discrete data and determine the clinical outcome of the patient. Kruskal Wallis test was done and "H" statistics analyzed for the discrete parameters- mRS and GOSE. Barthel Index provides continuous data and was hence analyzed by ANOVA test and "F" statistics was analyzed. The data analysis revealed significant improvement in clinical parameters after CR. However, it was seen that patients with a low GCS at DC 12 i.e. 03 months post decompressive craniectomy may show limited or no improvement by CR. The patients with lower GCS at 03 months post CR (i.e. CR12) also show limited improvement in the other three parameters – mRS, BI and GOSE.

Independent-Samples Kruskal-Wallis Test

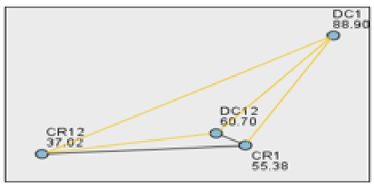


Total N	120
Test Statistic	36.993
Degrees of Freedom	3
Asymptotic Sig. (2-sided test)	.000

1. The test statistic is adjusted for ties.

Figure 2: Kruskal Wallis Test

Pairwise Comparisons of DAY



Each node shows the sample average rank of DAY.

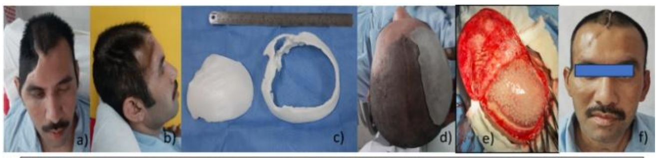
Sample1-Sample2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj.Sig.
CR12-CR1	18.367	8.651	2.123	.034	.202
CR12-DC12	23.683	8.651	2.738	.006	.037
CR12-DC1	51.883	8.651	5.997	.000	.000
CR1-DC12	5.317	8.651	.615	.539	1.000
CR1-DC1	33.517	8.651	3.874	.000	.001
DC12-DC1	28.200	8.651	3.260	.001	.007

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .05.

Figure 3: GOSE data analysis

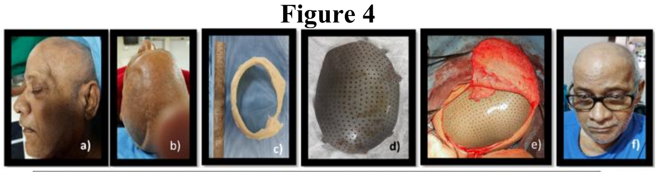
4. Discussion

Cranioplasty (CR) post decompressive craniectomy (DC) improves the overall functional and cognitive activity of such individuals. There are very limited studies assessing the functional outcome and quality of life in patients managed with CR post DC. CR using various materials – autograft, allografts, to treat the "syndrome of trephined" results in considerable improvements in neuropsychological deficits, control of convulsions and partial prevention of cerebral atrophy (Figure 4,5,6).



a)Rt fronto-temporo-parieto-frontal cranial defect b) sinking flap syndrome c)Polyglycolic acid template d) PMMA cranial plate e) PMMA flap placed in the defect f) postoperative frontal view

Figure 4



a) Lt fronto-temporo-parietal residual defect b) bird's view c) Polyglycolic acid template d) customised 3D printed Titanium cranial plate e) Customised Ti plate in situ f) postoperative frontal view

Figure 5

a) Rt fronto-temporo-parietal residual defect b) bone flap preserved in anterior abdominal wall c) autogenous calvarial bone graft d) raised cranial flap e) autogenous calvarial bone graft in situ f) postoperative radiograph g) postoperative frontal view

Figure 6

The beneficial effects of CR have been brought out by various studies[2,7-13]. The results show that there are positive synergistic effects of CR on post-TBI rehabilitation progress in functional activity level and cognitive recovery. A neuropsychological assessment is the best approach for understanding the nature and the severity of cognitive complaints for addressing diagnostic issues as well as treatment and rehabilitation planning (Mokri, 2010). The process typically begins with a clinical interview, and then continues with tests that assess the function in various cognitive and emotional domains. Because the effects of brain injury can have wide-ranging neurological, psychological and psychosocial consequences, both patients and care-givers can benefit from an assessment that identifies and quantifies deficits.

The possible mechanisms of CR on ameliorating the advancement have been deciphered in respective modes like pressure balancing[14,15], intracranial compliance restoring[25], increase in cerebral blood flow[12,16-18,19,20-24] and metabolic or cerebrospinal fluid hydrodynamic changes[26]. In order to reconstruct the structural defects caused by DC, CR seems to be the most direct way to equilibrate the atmospheric pressure on skull defects, thereby harmonizing the neurological deficit[19,27]. Increase in global intracranial compliance, cerebrospinal fluid velocities, and flow in the craniospinal junction all promote better blood flow circulation of the cerebral cortex whereby this amends the metabolic utility[25-26]. Therefore, increasing cerebral blood flow might be the key component to raise the development on motor and cognitive functioning[12,16,18,20]. Functional improvement in craniectomy patients after intensive rehabilitation has been established in many studies[12,16-24].

The present study is a retrospective observational analysis aimed at evaluating the functional outcomes and quality of life in patients who underwent DC followed by CR including 30 patients who met the inclusion and exclusion criteria. The mean age of participants was 41.1 years (±14.27 years), with

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ages ranging from 23 to 64 years. The parameters assessed GCS, mRS, BI and GOSE in the study were selected based on their relevance to patients with head or brain injury, and they allowed for an objective evaluation of the patients' recovery.

Distribution of mRS score at 12-week post CR improved significantly compared to mRS score at 12-week post DC (P-value<0.05) as evident from Table 2. Thus, it can be concluded that the CR resulted in the significant improvement in mRS score (a measure of functional disability).

Also, BI score at 12-week post CR improved significantly compared to BI score at 12-week post CR (P-value<0.05) appreciated in Table 3. Thus, it can be concluded that the CR resulted in the significant improvement in BI score (a measure of functional disability).

Similarly, GOSE score at 12-week post CR improved significantly compared to GOSE score at 12-week post DC (P-value<0.05) seen clearly in Table 4. Thus, it can be concluded that the CR resulted in the significant improvement in GOSE score (a measure of global disability and recovery post brain injury).

The current study revealed novel observations i.e. there is a close correlation between the GCS and neuropsychological status at 03 months post craniectomy and post cranioplasty as shown in Table 1. Patients with a low GCS at 03 months post DC may show limited or no improvement in the parameters – mRS, BI and GOSE by CR.

However, CR results in remarkable improvement in the overall functional and cognitive activity of the larger population affected with the syndrome of trephined. Several aspects undermine the contention of the study which includes the sample size being too small; it was difficult to exclude all confounding factors in the observational study such as the time effects on post-TBI spontaneous recovery. Also, more comprehensive tools in evaluating functional and cognitive domains need to be explored.

5. Conclusion

The current study showed the synergistic beneficial effect of cranioplasty on craniectomy patients. Daily activity improvement and cognitive function are much better refined with cranioplasty intervention during in-patient rehabilitation. The results should help in designing rehabilitation approaches in severe TBI patients, which might lead to further functional gain and cognitive enhancement after cranioplasty. However, it was seen that patients with lower GCS at 03 months post craniectomy (i.e. DC12) show limited improvement in the other three parameters – mRSA, BI and GOSE. Nevertheless, larger sample size, longer follow-up and more suitable comprehensive psychological tools are required to confirm the promising denouement.

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Conflict of Interest

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Informed Consent Statement

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