

# Home based cognitive retraining in traumatic brain injury

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**Abstract:** Traumatic brain injury is a complex injury with a broad spectrum of symptoms and disabilities. The impact on a person and his or her family can be devastating. Cognitive difficulties are very common in people with traumatic brain injury. Studies have shown neuropsychological rehabilitation to be usefulness in improving the cognitive functions and day-to-day functioning. The purpose of the study was to examine the efficacy of home based cognitive retraining in traumatic brain injury. Single case-study was adopted. The neuropsychological profile of the patient was compared pre and post home based cognitive retraining. A 32-year-old male was referred for post head-injury neuropsychological assessment and rehabilitation. He was given 6 months package of home based cognitive retraining. The training was given by patient's wife. The preassessment showed impairment in frontal and temporal functions. Results indicated improvement in cognitive functions, occupational functions and social functioning.

**Keywords:** brain injury, cognitive impairment

## INTRODUCTION

Traumatic brain injuries are a common cause of disability in the productive age group of persons upto the age of 40 years<sup>1</sup>. Traumatic brain injury (TBI) is a complex injury with a broad spectrum of symptoms and disabilities. The impact on a person and his or her family can be devastating. It is estimated that India would occupy third position for TBI by 2020. Psychological sequelae of cognitive deficits and emotional problems contribute significantly to the disability in the patient<sup>2</sup>. The natural recovery curve for moderate to severe head injury is 18–24 months, with further restitution of function occurring at a slow rate for years after. Cognitive difficulties are very common in people with TBI. Cognition includes an awareness of one's surroundings, attention to tasks, memory, reasoning, problem solving, and executive functioning (e.g., goal setting, planning, initiating, self-awareness, self-monitoring and evaluation). Problems vary depending on the location and severity of the injury to the brain. Neuropsychological rehabilitation is based on the neuronal plasticity. The principle involved is re-establishment and re-organization of the lost functions of the brain. The training focuses on the improvement of attention tasks, memory, reasoning,

problem solving, and executive functioning. Studies have shown Neuropsychological rehabilitation to be usefulness in improving the cognitive functions and day to day functioning<sup>3</sup>.

Home based cognitive retraining (HCR)<sup>4</sup> is a four week package incorporating tasks which addresses the functions of attention, working memory, response inhibition and learning and memory. The method of saturating cueing is followed; the tasks are in increasing difficulty order and provision for scoring for error and time is provided. This package is to be administered either by the literate family members, friends or any well wisher of the patient. The first session of every week package is taught to the significant others by the Neuropsychologist in the hospital setting and subsequently the sessions are to be carried out in the home setting. The patient is asked to report to the Neuropsychologist every week, based on the progress made by the patient the same week package or the next week package will be advised. This program will go on till the patient has made significant improvement on the tasks as well as day to day functioning. It is cost effective and the applicability is wide spread. Single case study was adopted. The neuropsychological profile of the patient was compared pre- and post-HCR.

## CASE REPORT

Patient S was a 32 year-old married male farmer from lower socio economic status, studied uptill 5<sup>th</sup> standard, with no significant personal, past and family history. He met with road traffic accident in Dec 2006 and was

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unconscious for four hours. He was admitted to a local hospital was diagnosed to have moderate head-injury (GCS 10/15), and treated conservatively. Patient reported to NIMHANS with chief complaints of headache, forgetfulness, irritability, inability to tolerate noise, inability to work in March 2007. He was referred for neuropsychological evaluation and rehabilitation in view of his cognitive deficits.

**NIMHANS Neuropsychology Battery administered<sup>4</sup> :** This is a comprehensive neuropsychological assessment which is carried out by trained neuropsychologists to assess cognitive functioning. The following cognitive domains were assessed: motor speed, fluency (category and phonemic fluency), working memory (verbal and visual), planning, set-shifting, verbal learning, and verbal memory. Some of tests are paper-pencil tests. The tests used for the present study have been standardized for use in the Indian population

**PROCEDURE**

With informed consent the patient was assessed with adequate rest pause during the testing. The patient’s pre-training assessment revealed impairment in attention, executive functions and verbal and visual learning and memory indicating the involvement of dorsolateral prefrontal and bilateral lobe involvement. Following the assessment the home based cognitive retraining (HCR) was started. Patient’s wife who was educated up till 10<sup>th</sup>

standard was asked to carry out the retraining. HCR was given for one week, and patient was asked to report after two weeks. Since patient performance on the tasks was poor he was asked to continue the I week HCR and was asked to report after two weeks. Patient showed minimum improvement and hence was asked to continue I week tasks for a month more and report for follow up. Patients performance had improved and had reached a saturation point and hence II week tasks was given for two months. He showed improvement on the tasks and in his day to day functioning, corroborated by his wife. Subsequently III week and IV week tasks was carried out for a month each. HCR was carried out for 6 months, after which neuropsychological assessment revealed significant improvement.

**Data Analysis:** Cognitive functioning of the patient was compared with normative data derived from a group of 540 normal healthy volunteers<sup>5</sup>. Healthy volunteers were recruited from relatives of patients admitted at the hospital, students, and from the community at large. Healthy volunteers who obtained a score of >2 on the General Health Questionnaire (GHQ-12) were excluded, as these persons met criteria for psychological distress,

Table 1 : Pre- & Post-HCR Neuropsychological Assessment:

S. No.	TESTS	Function	Percentile Scores	
			Post	Pre
1.	Finger Tapping (FT)	Motor Speed	5	45
2.	Digit Symbol Substitution (DSSST)	Mental Speed	12	50
3.	Digit Vigilance Test (DVT) Sustained Attention	5	45	
4.	Controlled oral word association test (COWA)	Fluency	10	33
5.	Catogory Fluency Test (CT)	Fluency	5	25
6.	Verbal N-Back (VNB)	Working Memory	5	60
7.	Tower of London Test (TOL)	Planning	3	40
8.	Wisconsin Card Sorting Test (WCST)	Set- shifting	25	45
9.	Token Test (TT)	Comprehension	5	85
10.	Auditory Verbal Learning Test (AVLT)	Verbal learning and memory	5	15
11.	Complex Figure Test (CFT)	Visual learning and memory	10	25

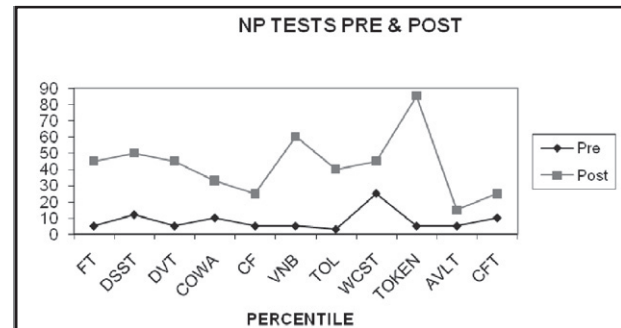


Fig 1: Graph showing the percentage of improvement in various cognitive functions in 6 months

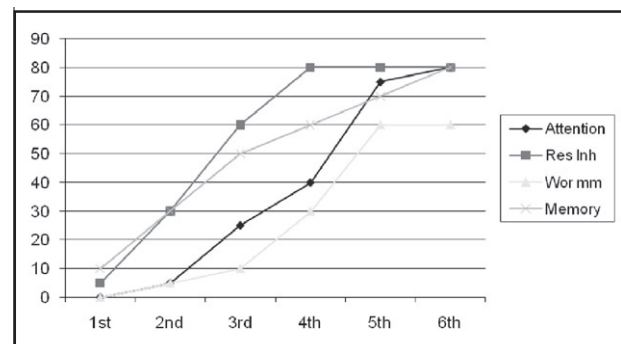


Fig 2: Shows improvement in the various cognitive domains i.e., attention, response inhibition, working memory and verbal memory in 6 weeks

which could influence cognitive functioning. Healthy volunteers were also excluded if they had a previous history of neurological, neurosurgical, or psychiatric illness or substance dependence and family history of alcohol dependence, schizophrenia or bipolar disorder. For each test variable, percentile scores were calculated. The 15th percentile score (1 SD below the mean) was taken as the cut-off score. Cut-off scores were calculated for each group based on age, education, and gender. A deficit was defined as a test score falling below the 15th percentile. Validation for each of the tests has been carried out on patient groups with focal lesions, refractory epilepsy, head injury, and Parkinson disease<sup>5</sup>. In order to examine the prevalence of cognitive deficits, a cognitive profile of the patient was compared with the normative data described above. Based on the number of test variables falling below the 15th percentile, the severity of cognitive impairment was established.

Table 1 shows pre, post Home based cognitive retraining Neuropsychological assessment test scores. The post test scores indicate improvement on all the tests.

### DISCUSSION

Neural plasticity is evident via the ability of the brain to habituate and learn and is mediated by the re-organization and re-establishment of the lost functions. HCR has utilized the capacity of the brain to change and adapt to help restore the challenged functions. Initially attention function was targeted, since attention is a basic component of brain function on which many neural processes depend upon. Attention has various neurological underpinnings as was first proposed by Michael Posner more than 35 years ago. Neuroimaging studies have shown activity in the frontal and parietal regions, particularly of the right hemisphere, when people are required to achieve and maintain the alert state for even a brief period<sup>6</sup>. Recent evidence suggests that the right dorsolateral prefrontal cortex could act in a more executive capacity, monitoring performance or arousal levels and regulating them accordingly, in conjunction with the anterior cingulate cortex (ACC) or other midline frontal structures<sup>7</sup> activity in the left hemisphere has been associated with linking temporal and spatial information<sup>8</sup>. Brain imaging studies have identified the ACC as an important node in the executive network. They have consistently demonstrated activation of the dorsal ACC (dACC) in cognitive tasks especially attention and executive functions<sup>9,10</sup>. Patient was given attention tasks

with increasing difficulty level for both sustained and focused attention, as the patient began to show improvement on the attention task, there was improvement in the other domains too. It was in the third month that patient showed improvement in memory functions. Thereafter the improvement was significant in all the functions that were addressed - attention, response inhibition, working memory and learning and memory. This improvement is corroborated with the post-HCR neuropsychological assessment. Patient's wife also reported significant improvement in his day to day functioning. Patient himself resumed his occupation.

### CONCLUSION

HCR is useful in brain damage as it integrates patient back into the society at the highest level of functioning possible. There is improvement in day to day functioning, and the patient can resume his occupation.

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