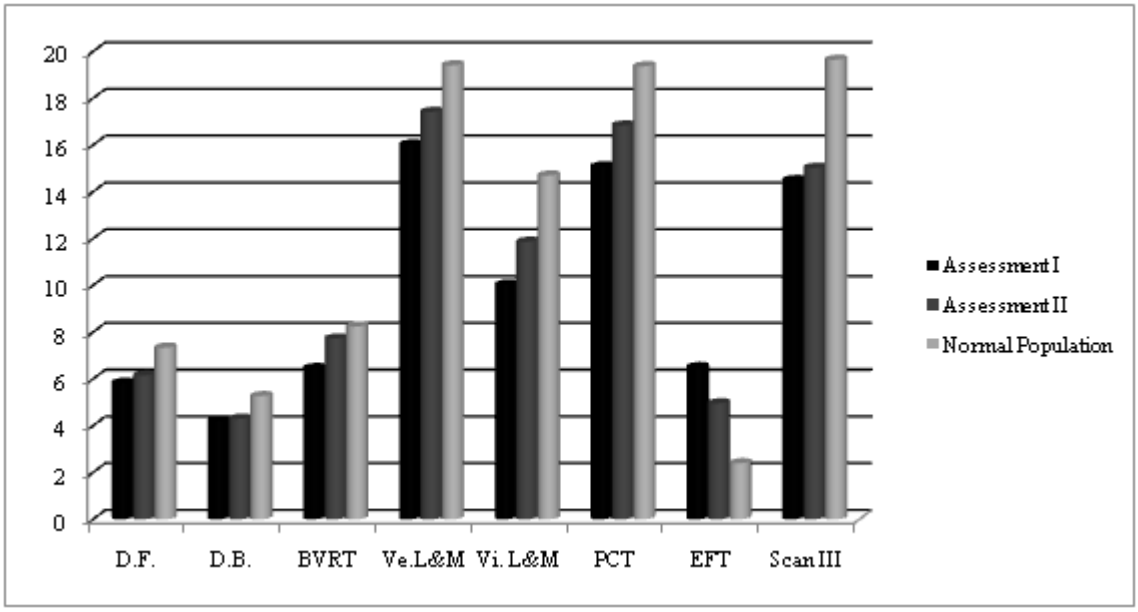

Graphical representation of the performance of the head injured in both assessments and the normal group on some of the tasks

D. F.- Digit Forward D. B. Digit Backward BVRT- Benton Visual Retention Test Ve. L & M- Verbal learning & Memory Vi. L & M- Visual Learning & Memory PCT- Picture Completion Test EFT- Embedded Figures Test Scan III- Scanning

At the second assessment, 3 months later, the mean scores of the patient group on various tests indicated improvement in neuropsychological functioning in general. Minimal to moderate improvement was visible on all the tests, though the deficit did not normalize on all the tests. (Parallel forms were used on certain tasks to avoid practice effects). Significant improvement was seen on tests of visual memory and verbal learning and memory; however the scores did not normalize completely. Improvement was also evident on tasks requiring general ability and flexibility of control and reasoning (left hemispheric). There was no significant change between the two assessments on tests measuring attention, information processing speed, visuo-perceptual processing and visual learning and memory, indicating persistent deficits in these areas. Delayed recall was impaired in both the verbal and visual domain.

In the qualitative analysis, on tests of visuo-spatial integration and organization, and on tests of concept formation, the initial deficits at the first assessment were at a mild to moderate level, which improved considerably on the second assessment and were minimal.

Discriminant function analysis, using tests sensitive to CHI, significantly discriminated the HI group at the first assessment from the normal group. The coefficient indicated that digit symbol, trail making and visual numerical scanning tasks were most important in discriminating the two groups. The correct classification of subjects into their respective groups was 91.78% for each group.

Table 3: Showing discriminant function analysis

Actual Group	No. of cases	Predicted	Group membership
Group I (normal)	29	27 (93.1%)	2 (6.9%)
Group II (HI I asst.)	44	4 (9.1%)	40 (90.3%)
Percentage of "grouped cases " correctly classified: 91.78%			

6. Discussion

The head injured sample selected for the study was a fairly close representative of the closed head injured population in general. The average age of the patient group and the male-female ratio was similar to that reported in many incidence studies. The major cause of the head injury was also motor vehicle accidents, a fact similar to most studies. These patients were taken up for assessment, only after they were clinically recovered and free from any focal neurological deficits (examined by a neurosurgeon), which would have hampered their test performance.

The neurobehavioral profile emerging from the neurobehavioral rating scale is that of disturbances in attention, memory, somatic complaints, slowness and reduced efficiency. Most of these symptoms were of mild to moderate degree and there was evidence of improvement longitudinally. However, a persistent symptom reported by many patients was that of slowness and reduced efficiency in work and minimal attention and memory disturbances.

The present study provided convincing evidence of persistent cognitive deficits in patients with Head injury over a 6 month period. Though marked cognitive recovery was manifest over the 2 assessments, an evidence of better recovery in certain functions compared to others was also evident.

The 1st assessment revealed evidence of gross brain dysfunction in our sample, a finding corroborated by many other studies in the past (Levin et al, 1987, 1992 and 2010),. Cognitive deficits are common in head injured (Dikmen et

al 1990 & Dacey etal 1991), especially immediately after the trauma. Disturbances in learning and memory (Levin et al 2009), rate of information processing(Shum et al 1990) and adaptive functioning are often seen in closed head injury (Tate et al , 1991). A slowness in information uptake has also been implicated in head injured (Capruso & Levin, 1991), a finding seen in the present study too. In addition, the qualitative analysis revealed that these patients had problems in alternating, a deficit in sequential analysis, poor mental flexibility and an inability to benefit from cues. These patients also had a tendency to give up easily if the complexity of the task increased: an evidence of poor planning, deficit in executive functioning and motivation.

At the second assessment, the deficits persisted in some of the neuropsychological tests, with significant improvement evident on some others. These tests measured sustained attention, visual scanning, immediate visual memory, ability to sustain a flexible and complex mental set and ability to maintain rapid Visuo-motor activity. Patients' Performance on these tests was also highly correlated with each other in assessing the effects of head injury.

Many studies (Paniak et al, 1989 and Kreutzer et al, 1991) have reported some of the tests (digit symbol and trail making) to be extremely sensitive to brain damage (Levin et al , 1990 and others) and an extremely slow recovery rate of the functions sub-served by these tests. (Mandleberg and Brooks, 1976). Similar findings were reported in the present study. The Trail making test has also shown poor recovery at the second assessment. Extreme slowness and poor visuo-motor tracking and a disturbance in sequential analysis in the patient group was also noted in our study at both the assessments. Similar findings have been reported in the literature as well (Clifton, et al 1993).

Deficits in visual search and visual neglect were also noted to be persistent in the second assessment, also an indicator of impairment in sustained directed attention, mental tracking and parallel processing. All these deficits point towards evidence of slowed information processing, i.e. poor recovery of right hemispheric functions, especially the right fronto-parietal cortex.

Similarly, continued deficits in visual learning and memory tasks and improved performance in verbal learning and memory functions at the second assessment, indicates better recovery of left hemispheric functions(verbal) and persistently poor visual learning capacity, essentially demanding right hemispheric resources of simultaneous processing. Similar findings have been reported by Mukundan et al (1987).

7. Summary & Conclusions

1. Closed Head Injury resulted in significant neuropsychological deficits at 3 months post trauma. Performance on tasks of attention and memory was relatively poorer.
2. Significant improvement on certain tasks (especially verbal) was evident at the second assessment, whereas, insignificant improvement was seen in other tasks : viz: visual learning & memory, attentional tasks and complex information processing tasks. Some of these deficits are subtle in nature and can be detected only by very sensitive complex tasks, though with far reaching implications.
3. Improvement in certain functions and no change in other functions across the two assessments is indicative of a predominant left hemisphere functional recovery (verbal functions) and a retarded and slow rate of recovery in the right hemispheric functions(sustained attention and speed of information processing and mental tracking).
4. The above mentioned subtle deficits may lead to poor social, psychological and recreational adjustment, leading to problem at work and at home. These patients can be helped by cognitive retraining and specific counseling to handle the emotional and behavioral changes, thus aiding in their adjustment with family and at work.

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