LANGUAGE IMPAIRMENTS IN CHILDREN SUBSEQUENT TO TRAUMATIC BRAIN INJURY

REG. No.M9512
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DEDICATION

"WE GROW IN THE IMAGE OF THOSE WHOM WE LOVE"

This piece of work is dedicated to my ma-papa

Until the end of my existence

U R my so very strong pillars of strength

and

my never ending source of inspiration

U R love means the world to me.

CERTIFICATE

This is to certify that this dissertation entitled LANGUAGE IMPAIRMENTS IN CHILDREN SUBSEQUENT TO TRAUMATIC BRAIN INJURY is the bonafide work in part fulfilment for the degree of Master of science (Speech and Hearing) of the student with Register No.M9512.

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This is to certify that this dissertation entitled LANGUAGE IMPAIRMENTS IN CHILDREN SUBSEQUENT TO TRAUMATIC BRAIN INJURY has been prepared under my supervision and guidance.

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DECLARATION

This dissertation entitled LANGUAGE IMPAIRMENTS IN CHILDREN SUBSEQUENT TO TRAUMATIC BRAIN INJURY is the result of my own study under the guidance of Dr. SHYAMALA CHENGAPPA, Reader and HOD, Department of Speech Pathology, All India Institute of Speech and Hearing, Mysore and has not been submitted earlier at any University for any other diploma or degree.

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CHAPTER I

INTRODUCTION

The acquired aphasias of childhood are those language disorders that appear after a period of normal language development and are secondary to cerebral dysfunction (Robinson, 1937). Acquired aphasias account for 4% - 7% of cases of language impairment in children. Traditionally childhood aphasia has been classified into traumatic and convulsive subgroups and most clinicians view the results of severe brain injury particularly after closed head injury as being typical cases of Acquired Childhood aphasia (ACA). According to Murdoch (1990), the most common cause of ACA is traumatic brain injury (TBI).

Incidence of TBI is approximately 200 per 100,000 population and trauma in US is identified as the third leading cause of death (Turnkey, 1983; Gualtieri, 1985). Also, it has been found that more than twice as many males as females suffer from TBI. Head injury (HI) has been reported as the leading cause of death in children before the age of 15 (Ewing, 1985), and the age group having the highest incidence of TBI in children is identified as 4-5 years.

Head injury could be open or closed. In open head injury (OHI), the brain/meninges are exposed and the damage produced could be focal, while in closed head injury (CHI), meninges remain intact even though the skull may be fractured. In CHI, there are 2 categories of brain injuries - primary and secondary. Primary injuries occur immediately following impact. Secondary brain injuries include epidural hematoma, acute subdermal hematoma, intra cerebral hematoma hypoxia, brain stem compression and cerebral edema (Pang, 1985).

CHI are also called diffuse axonal injuries (DAI) because they result in diffuse shearing of axons with their myelinsheaths in the brain. Axonal shearing is a major cause of unconsciousness in these patients.

The consequences of TBI :

Severe TBI changes the way all of us live and the change is sudden and profound. Immediately following the trauma, once healthy and active children find themselves fighting for their lives and experiencing years of medical care, rehabilitation and an atypical life style. The mosaic of cognitive, physical, communication and social disabilities

occur following TBI and make the journey of language recovery difficult.

At least 10% of the individuals who survive a significant HI are likely to have residual deficits that result in total and permanent incapacity (Kingston, 1985). The majority of the remaining HI victims are likely to suffer at least some transient cognitive, motor/sensory aberration and 40-80% of these patients will have residual physical, intellectual or behavioral deficits (Fisher, 1985; Levin, Benton and Grossman, 1982; National Head Injury Foundation, 1982).

The disabilities after HI are complex and varied and are seldom fully recognized, even when they are, their management is often difficult. The main reason for this is that the mental deficits dominate and these interfere both with the patient's ability to cope and with the capacity for cooperation with those trying to help the patient (Jennet, 1983).

Coming to the spontaneous recovery (SR) in these cases. This clinical group is known for its rapid and complete recovery, however the traditional 6 months cut off for SR of

function has recently been scrutinized by many researchers, particularly in relation to linguistic skills.

Jordan and Murdoch (1993) indicated that although mildly CHI children typically demonstrate most recovery during the first 6 months post injury, severely CHI children appear to demonstrate more gradual improvement in speech and language skills with recovery continuing well after 6 months post injury.

The language functioning of children with CHI has been evaluated by various researchers. The performance of these children on battery of language assessments has been compared to that of normals. Results indicated that various areas of language competence (syntax, semantics, pragmatics) appear to be compromised after childhood CHI.

At times, the language disorder found among those with TBI are more than simply a reflection of underlying cognitive deficits. At other times, specific language processing deficits occur in conjunction with cognition related communication disorders.

Various terms are used to describe language deficits in this clinical group. These include terms like aphasia, subclinical aphasia, language of confusion, cognition language disorder, cognition communication disorders. The last 2 terms are the most recent ones. These so called "cognition communication deficits" are result of diffuse damage to the brain that result in deficits which span a broad range and type.

Various studies in this area suggest that following severe CHI, children may exhibit a multitude of language impairments, which include difficulties in syntactic comprehension, lexical comprehension, impaired naming and lexical retrieval, syntactically simplified expressive language etc.

Since research in this area is very limited, specially in Indian context, the only investigation being by Bhavna (1995) on Language impairments in adults after TBI, the present study was undertaken to delineate the various language impairments in children subsequent to CHI.

This study is the first of its kind to explore language deficits in children subsequent to CHI.

CHAPTER II

REVIEW OF LITERATURE

Childhood aphasia, in general, refers to language disorganization from focal cerebral lesions that occur during childhood. Acquired childhood aphasia (ACA) refers to disturbances of language due to cerebral lesions which have occurred after language acquisition. Lees (1993) has defined ACA as "those language disorders that appear after a period of normal language development and are secondary to cerebral dysfunction".

Differentiating developmental aphasia from acquired aphasia, McCarthy (1968) commented that developmental dysphasia is a condition in which either poor endowment/brain injury occurring before, during or after birth prevents the child from acquiring language. The disorder of developmental aphasia (developmental language disorder/specific language disorder) is manifested when a child fails to learn to talk normally, but a frank neurological basis is not apparent. Acquired aphasia sustained in childhood, however, interferes with the developmental process of language learning and disrupts those aspects of language already mastered.

As pointed out by Lees (1990), there are many problems in looking at natural history and clinico pathological correlations of ACA. (1) The pathological classification is insecure, particuarly over localizing the lesion. (2) Many previous studies lack adequate language tests to document the severity of the aphasia or the course of recovery. (3) The number of children in any of the aetiological subgroups are small. (4) A decision must be taken about the inclusion of children with epilepsy. (5) The shifting baseline of cognitive development in childhood demands age dependent normative data and an awareness of possible critical periods for language acquisition. (6) The influence of both medical treatment and therapy is often ignored in publications. (7) Also, it is not possible to state definitively where childhood aphasia ends and adult aphasia begins.

Fascination of ACA is due to the mystery that surrounds it. One of the commonly held beliefs which has now been challenged is that ACA is transitory and that its sequelae are very few/absent. This has contributed to the rarity of studies in this area. Although a few studies in this clinical group are available from 1940s, ACA has become a subject of significant research and clinical interest since 1978.

According to Guttman (1942), ACA occurs in same regularity as it does in adults. However, Robinson (1987, 1991) who has researched extensively in this area has found no large scale studies on epidemiology of ACA, though small scale studies are present in literature which suggest that they are considerably rarer than developmental language impairment. They also highlighted that ACA accounted for between 4% and 7% of cases of language impairment in children.

Traditionally, childhood aphasia has been classified into traumatic and convulsive subgroups. Most clinicians view the results of severe Brain Injury, particularly after Closed Head Injury, as being typical cases of ACA.

Estimates suggest that in the United States each year there are more than 1 million cases of Head Injury requiring hospitalization (Berrol and Rosenthal, 1986). At least 10% of the individuals who survive a significant HI are likely to have residual deficits that result in total and permanent incapacity (Kingston, 1985). The majority of the remaining HI victims are likely to suffer at least some transient cognitive, motor or sensory aberration and somewhere between 40% to 80% of these patients will have residual physical,

intellectual/behavioural deficits (Fisher, 1985; National Head Injury Foundation, 1982).

Since "The brain is the sum total of all we are", as Nobel Prize Laureate Sir John Eccles (1983) states, injury to this structure, which constitutes our very being, is inherently going to have a multifaceted impact upon all aspects of behaviour. Accordingly, it is necessary to have an understanding of many levels of the mechanisms of BI and its effects upon our behaviour.

Prior to the recent advances in emergency medicine, many patients with cerebral injury died (Lillehei and Haff, 1985). However, since the 1960s, the advent of emergency programs, the development of regional trauma centers, and availability of neurosurgeons, along with the development of critical and acute care management of the BI patient, the individual with a BI now stands a better chance of survival (Miller and Jones, 1985) which has required the development of programs to meet the long term needs of these individuals.

What is a Traumatic Brain Injury (TBI)?

TBI means an acquired injury to the brain caused by an external physical force, resulting in total/partial functional disability/psychosocial impairment, or both that adversely affects a child's educational performance. The term applies to open/closed head injuries resulting in impairments in one/more areas, such as cognition, language, memory, attention, reasoning, abstract thinking, judgement, problem solving, sensory, perceptual and motor abilities, psychosocial behaviour, physical functions, information processing and speech. The term does not apply to brain injuries that are congenital/degenerative, or brain injuries induced by birth trauma. (Individuals with Disabilities Education Act Federal Register, 1992).

BI is considered significant in the context of one/any combination of the following :

(a) alteration in the level of consciousness sufficient to produce a Glasgow Coma Scale rating of 14 or lower Table-I).
(b) post traumatic amnesia of 5 min/greater.
(c) physiologic evidence (eg.EEG), radiologic evidence (eg.CT, MRI), or objective physical findings (eg. paralysis, aphasia, sensory deficit).

Eye opening	Best verbal response	Best Motor response
4. Spontaneous	5. Oriented	6. Responds to verbal commands
3. Nonspecific reaction to speech.	4. Confusion disoriented	5. Localized movement to terminate painful stimulus.
2. Response to painful stimulus	3. No sustained/ coherent conversation	4. Withdrawl from painful stimulus.
1. No response.	2. No recognizable words.	3. Decorticate posture
	1. No response	2. Decerebrate posture
		1. No response

Table-1 : Items and categories on the Glsscow Coma Scale

Source :Teasdale and Jennett (1974)

What are the causes of HI ?

The majority of the HI occur as a consequence of motor vehicle accidents, followed by motor cycle and bicycle accidents (Rivara and Mueler, 1986). Head injuries resulting from falls from heights, pedestrian injuries, and assaults also contribute a frequent source (Kaufman, Makela, 1986). In pediatric HI, child abuse - particularly that caused by violent shaking - is a significant source of cerebral injury (Alexander, Schor and Smith, 1986).

The primary goal for those with residual effects on brain injury is to improve their quality of life. It is anticipated that through a better understanding of the nature of BI, the neuropathologic processes that occur, and its effects on cognitive and behavioural outcome, as well as the diagnostic evaluation and treatment methods available, we would appreciate this multifactorial problem of BI in a much better way and work for providing them with a better long-term treatment and outcome.

The Neuropathology of TBI

TBI is an insult to the brain not of a degenerative/ congenital nature but caused by an external force that produces diminished consciousness/coma. It is most commonly defined as neural damage resulting from closed or open head injuries following an accident involving the head. Where the skull is penetrated, as from a gun shot wound, the damage to the brain is referred to as open-head injury (OHI) (Lishman, 1987). OHI tend to be more localized than those sustained in CHI (closed Head Injury), where in tissue damage is usually concentrated in the path of the intruding object (Strub, 1988) (TAble II).

TYPES OF TBI

Penetrating B.I.	Non-penetrating B.I (CHI)
1. The skull is fractured/ perforated.	1. Brain suffers indirect damage skull may/may not be fractured.
2. The meninges are torn/ lacerated.	2. Meninges remain intact.
3. Causes - High velocity missiles (bullets, other projectiles) - Low velocity impacts (automobile and other accidents, blow to the head).	3. Damage may be of several types. - abrasions (scrapes) - lacerations (cuts) - contusions (bruises) - Shearing (tearing) - impression trauma (skull deformation at the point of impact). coup injuries (trauma at point of impact). - counter coup (trauma on opposite side of impact) (due to the result of inertia of brain tissue that lags behind the head that is moving forward/ backward).
4. Immediate effects - death, fracture of the skull - respiratory and cardiac failure (due to severe injury to brain stem) - destruction of brain tissue on the projectile tract (the path of a bullet) - further destruction of brain tissue and infection because of penetrating bone fragments, hair skin particles. - bleeding, infection swelling of brain tissue, hydrocephalus. - long term, physical, cognitive, language, deficits.	In NPI, the brain structure move around within the cranial structure. The moving brain structures may rub against sharp bony projections of the glass, metal and other skull, causing further damage.

Table-II : TYPES OF TBI (Craniocerebral trauma)
SOURCE : Hegde,M.N. (1949) "Unit II - TBI. A Course book on aphasia and other neurogenic language disorders, P.241-258.

CHI are far more common than OHI (Jennett, 1990). In CHI, the predominant damaging force is that of impact, such as resulting from vehicular accidents. The blow at the point of impact is referred to as the coup, where there tends to be contusion and laceration. However, the damage is not always confined to the site of the impact but also occurs at an area called the countercoup. Countercoup damage is commonly found in the case of motor vehicular accidents, where there has been acceleration followed by a sudden deceleration and the head is forced into motion before impacting against a surface (Grubb, 1978).

It is more likely that in CHI, there would be diffuse damage due to widespread interruption and damage to nerve fibers from shearing effects when the movement of the brain within the skull puts strain on nerve fibers and blood vessels. In addition, secondary effects are often present in the form of haematoma and oedema (Grubb, 1978). These conditions compound the damage by causing swelling and pressure within the brain so that a wide range of neural structures might be affected. There may also be damaging effects from complications such as ischaemia, infection or hydrocephalus and oxygen deficits (Jennett, 1990).

It is quite common for contusions (bruising) to occur in areas where there is the greatest brain-bone interface. Accordingly, the frontal and temporal lobes are the regions most likely to be damaged because of the peculiarities of the skull/brain interface. This occurs regardless of the site/direction of the initial impact.

Effects of TBI :

- Immediate loss of consciousness lasting seconds to months.
- Slow and gradual recovery of consciousness or rapid and full recovery.
- The death rate is highest in the first three days.

Symptoms of TBI :

I Traumatic Hematoma

Hematoma - accumulation of blood due to hemorrhage.

Types of hematoma -

1. Epidural Hematoma

- Accumulation of blood between the dura mater and the skull. (Due to damaged middle cerebral artery blood vessels. Frequently caused by automobile accidents).
- Massive bleeding due to damaged artery. (as against damaged vein). A frequent cause of death within a few hours).
- Epidural hematoma is surgically cleared.

2. Subdural hematoma

- Lacerated cortical blood vessels causing hematoma. It is the accumulation of blood between the dura and the arachnoid.

- More common and deadlier than epidural hematoma. There is a 60% or more mortality rate. Auto accidents are the most frequent causes.

- Subdural hematoma may be acute/chronic. Acute subdural hematoma has a high mortality rate. Chronic subdural hematoma is common in older patients and in alcoholic patients.

II Increased Intracranial pressure (ICP)

TBI can cause increased ICP. Accumulation of blood, water or CSF causes increased pressure. Accumulation of fluid :

- between the skull and brain is hematoma
- with in ventricles is hydrocephalus.
- with in brain cells is edema.

Increased pressure is the frequent cause of death in TBI. pressure is greatest at the site of injury.

Brain tissues may be displaced from high pressure areas to low pressure areas.

Brain tissue may be compressed, distorted, stretched, forced against the skull.

Ischemic Brain Damage is due to lack of oxygen to tissues because of reduced/blocked blood supply caused by

- breathing difficulties
- slowered down heart rate
- constricted cerebral blood vessels.

III Alteration in consciousness, memory and physical function

Most consistent features of TBI (OHI and CHI) is impaired consciousness, followed by post traumatic amnesia (PTA). Even brief concussion could result in destruction of brainstem cells and longer periods of coma are indicative of disruption of brain reticular activity and damage of a more serious nature (Jennett, 1990).

PTA refers to the loss of memory often observed in survivors of TBI and is considered an effective predictor of the extent of damage and of long-term psychosocial adjustment. Impaired consciousness producing PTA of less than 1 hour is considered mild, whereas that lasting several hours is moderate and any period of amnesia over 1 day is considered severe (Strub, 1988; Russell, 1961).

The physical deficits comprise those related to cerebral hemisphere function (e.g.language expression and reception, epilepsy, hemiplegia) and those caused by damage to the brain stem and cranial nerves (eg. visual, olfactory and auditory impairments).

Prognosis of TBI

Prognosis of TBI is not well understood and the outcome can vary from death/prolonged coma to only mild deficits. Recovery rates are dependent on variables such as age, severity of injury, location of injury, preinjury intellectual physical and mental status and the nature of post injury social and medical support system. Guttmann (1942) finds that children with traumatic etiology improve more than those with vascular disease; however this is not true in TBI, specially for patients with severe comas (> 7 days), where the recovery is minimal (Lange-Cosak and Tepfer, 1973).

In a recent article on communication outcome following TBI, Ylvisaker, 1992 commented that children with TBI improve neurologically for months/years after the injury and may recover much of the information and skill acquired before their injury despite substantial new learning and behavioural self-regulation problems.

Cognition and emotion :

The neural pathways which connect the cortex (implicated in cognitive function) with subcortical regions such as the

limbic lobe (implicated in the mediation of affective responses) are commonly damaged in TBI. Thus, changes in emotional functioning can result from direct damage to the cerebral hemispheres, as well as from complications of the injury such as swelling and bleeding (Stratton, 1993).

CONSEQUENCES OF TBI

Some level of cognitive impairment after TBI is inevitable. Impairments are varied and include deficits in attention, concentration, memory, perception, judgement, orientation, comprehension; language and self awareness (Ben Yishay, 1983) severely injured children have significant cognitive and neuropsychological deficits at 1 year after CHI. Maladaptive behaviour may be a direct manifestation of these cognitive difficulties on the child's ability to function in areas involving social skills and judgement.

Behaviour outcomes after pediatric CHI have also been investigated. In a report from the US National Pediatric Trauma Registry, 30% of children with mild-severe CHI had behaviour difficulties. Greater behaviour problems are reported in mild TBI children when compared to severe TBI children.

These affective changes after TBI depend on factors like actual location of damage within the brain, severity of injury, and time since injury.

Even the social interaction is known to be affected after TBI. Even when a head injury is relatively mild, it can have a considerable impact on interpersonal functioning.

Lezak (1978) emphasized that various personality changes after TBI cause problems in social interaction. These are -

(1) impaired capacity for social perceptiveness resulting in self centered behaviour. Both empathy and self-reflective attitudes are greatly diminished.

(2) impaired capacity for self regulation leading to impulsivity and impatience.

(3) social dependency, resulting in difficulty in planning and organizing.

(4) emotional lability and depression.

The episodic symptoms in dysfunctioning children and adolescents following TBI include temper tantrums, staring spells and memory lapses and episodic dysphoria (Roberts, 1996). It is important to be aware of these because they may go unnoticed in the wake of catastrophic deficits in cognition, motor function executive function and self

awareness, which commonly occur in the first 6 months following severe TBI (Table-Ill).

I. Cognitive sequelae

- attention deficits, memory disorders, language impairments, impaired abstraction and judgement capabilities (inflexibility), decreased speed, accuracy and consistency, susceptibility to internal and external stresses

II. Perceptual sequelae

- decreased acuity/increased sensitivity in vision, hearing/touch, vestibular deficits, spatial disorientation, disorders of smell and taste

III. Physical sequelae

- disorders such as ataxia, spasticity and tremors musculoskeletal disorders.

IV. Emotional sequelae

- irritability, impatience, poor frustration tolerance, dependence, denial of disability (Hamlin, 1987).

V. Behavioral sequelae (Hagen, 1979)

- Poor concentration, Poor mental shifting/perservation, Disorienttion, Reduced initiation, Confusion, Confabulation, Disorganized activity, Disorganized communication, Stimulus bound responses, Impaired learning, Incompleteness of thought and activity, Poor reasoning, Impaired comprehension of humor, Impaired problem solving, Socially inappropriate behaviour, Impaired planning and execution, Limited insight.

Table III : Consequences of TBI (in brief).

Assessment of patients with TBI

Due to importance given to assessment of TBI patients, now there is greater appreciation of the long term consequences of head trauma (Levin, 1982). Surviving patients recover language and motor functions to varying degrees.

TBI patients have periods of rapid recovery alternated with periods of no/little recovery. When the patient gains consciousness, he/she may be inconsistent, disorganized, disoriented to time and place (confused), restless, irritated. Short attention span and high distractibility accompany recovery. While daily routines may be recovered, memory and abstract reasoning problems may persist.

One must check for Amnesia ("How old are you?"), Orientation ("where are you now?") and short term memory (memory for words, etc.) more in depth assessment is possible in case of patients with mild-to-moderate injury.

The effects of TBI in most cases are diffuse. The patients' responses are slowed down. Non-verbal skills (drawing constructions) tend to be impaired more than the

verbal skills (naming, repetition). Memory for post traumatic events is poorer. (Post-traumatic amnesia) than that for pretraumatic events (pretraumatic amnesia).

The following skills are typically assessed verbal and non-verbal intelligence, memory. alertness and vigilance selective attention, sustained attention, communication deficits.

- Pure linguistic problems are not severe.
- Grammar is usually intact.

There are a number of tests applicable to the traumatic brain injured population, as shown in Table IV.

LANGUAGE IMPAIRMENTS FOLLOWING CHI

Although HI has been reported as the leading cause of death in children before the age of 15, there continues to be an increasing number of childhood HI survivors. (Ewing, 1985), due to greater emergency and intensive care facilities. It has been estimated that a child's chance of having a significant CHI, before reaching the age of 16, is one in 30 (Kolb, 1990). The increasing population of pediatric survivors of such injuries has been found to

Neuropsychological Batteries -

1. Halstead-Reitan neuropsychological Test Battery (Reitan and Davison, 1974).
2. Luria Nebraska Neuropsychological battery (Golden, Hammeke and Purisch, 1980).

Communication Assessment Batteries -

1. Assessment of intelligibility of dysarthric speech (Yorkston, et al., 1984).
2. Boston Diagnostic Aphasia Examination (BDAE) (Goodglass and Kaplan, 1983).
3. Boston Naming Test (Goodglass and Kaplan, 1983).
4. Clinical Evaluation of Language Functions (Semel and Wiig, 1980).
5. Detroit Tests of Learning Aptitude (Baker and Leland, '67)
6. Expressive one-word Picture Vocabulary Test (Gardener,'79)
7. Fullerton Language Test for Adolescenets (Thorum, 1979).
8. Galveston Orientation and Amnesia Test (Levin, et al.,'82)
9. Goldman-Fristoe-Woodcock Auditory Skills Test Battery (Goldman, et al., 1974).
10. Illinois Test of Psycholinguistic Abilities (ITPA) (Kirk, et al., 1968).
11. Logical Memory Subtest of Wechsler Memory Scale-Revised (Wechsler, 1987).
12. Minnesota Test for Differential Diagnosis of Aphasia (Schuell, 1972).
13. Peabody Picture Vocabulary Test (PPVT) (Dunn & Dunn, '81)
14. Raven Coloured Progressive (1965).
15. Reading Comprehension Battery for Aphasia (LaPointe and Horner, 1979).
16. Reporter's Test (DeRenzi and Ferrar's, 1978).
17. Revised Visual Retention Test (Benton, 1974).
18. Rivermead Behavioural Memory Test (Wilson, et al., 1985).
19. Ross Test of Higher Cognitive Processes (Ross & Ross,'79)
20. The Word Test (Jorgenson, et al., 1981).
21. Test of problem solving (Zachman, et al., 1984).
22. Token Test-Revised (McNeil and Prescott, 1978)
23. Wechsler Adult Intelligence Scale-Revised (WAIS-R) (Wechsler, 1981).
24. Weschsler Memory Scale-Revised (Wechsler, 1985).
25. Western Aphasia Battery (WAB) (Kertesz, 1982).
26. Wide Range Achievement Test (Jastak and Jastak, 1978).
27. Woodcock-Johnson Psychoeducational battery (Woodcock and Johnson, 1977).

Table IV : Standardized tests applicable to the traumatic brain injured population.

demonstrate a range of neuropsychological deficits following the trauma. These include impairment of memory (Levin, 1979), attention (Bock, 1982) and language (Ewing, 1985).

Studying the residual language deficits of children with CHI is particularly important due to the far reaching effects that problems in this area may have on both social interactions and academic achievement (Klonofftt, 1977). There are relatively few diagnostic tools, specifically designed to assess the linguistic abilities of children with CHI (Alexander, 1988).

According to Standard Doctrine (grown out of the early reports, Paquier and Van Dongen, 1991) the traditional description of clinical language picture of ACA is as follows:

- Relatively intact verbal comprehension.
- Speech invariably nonfluent and markedly reduced ranging from mutism to articulatory problems.
- Telegraphic speech.
- Absence of neologisms, jargon and logorrhoea.
- Rapid and complete recovery of language disorder.

Collignon (1968) observed 12 cases of ACA with the origin being traumatic. The features were -

- Initial mutism followed by reduced expression.
- Absence of logorrhoea.
- Presence of oral and written comprehension deficits.
- Impaired verbal naming.
- Poverty of lexical stock
- Articulation disorders.
- Rapid recovery especially if less than 10 years.

Recent studies stress on the fact that recovery of speech and language in cases of childhood TBI is overall better than recovery from other acquired conditions of childhood aphasia, but by no means complete (Van Dongen and Loonen, 1977). Problems in speech and language continue to be evident years after HI in children and adolescence (Gaidolfi and Vignolo, 1980).

The traditional six month cutoff for spontaneous recovery of function has recently been scrutinized by many researchers, particularly in relation to linguistic skills. Jordan and Murdoch (1993) indicated that although mildly CHI children typically demonstrate most recovery during the first 6 months post injury, severely CHI children appear to demonstrate more gradual improvement in speech and language skills with recovery continuing well after 6 month post injury.

In the area of TBI, review of literature suggests that various professionals continue to wrestle with terminology to describe adequately the cognitive and language disorder that has come to be associated with TBI. Terms such as aphasia, subclinical aphasia, and language of confusion have been used frequently to identify this neuro behavioural disorder. The terms aphasia and subclinical aphasia emphasize the focal language components of the disorder while neglecting its cognitive counterpart and the interplay between cognition and language. "Language of Confusion" narrows the category too severely. Recently, however the term cognitive communication disorder has been used or specifically cognitive language disorder (Hagen, 1981).

Fuld and Fisher (1977) have highlighted that impairments in working memory are one of the most common complaints following childhood CHI.

Previous studies have highlighted persisting high level linguistic deficits such as written expression problems, anomia and reduced verbal fluency following CHI in childhood (Ewing-Cobbs, 1985; Levin, 1979).

Sarno et al., (1986) classified the linguistic processing deficits following severe CHI as a "subclinical aphasia disorder", and enlighted that this group also demonstrated dysgraphias and impaired expression of oral language abilities and verbal fluency and confrontation naming.

TBI result in diffuse and global damage to the brain and the language deficit following TBI is distinct from other forms of aphasia. As mentioned previously, it has been classified as subclinical aphasias' by Sarno (1980), and as "confused language' by Murdoch (1990), wherein the major deficits are in Short-Term Memory, abstract reasoning and organization of thought (Hagen, 1984). Mitton (1981) reported significant deficits in TBI patients in a number of areas (Prosody, affect, topic selection, topic maintenance, turn taking, conciseness and fluency).

In another study, Aram (1991) summarized the language status of children with acquired aphasia of different etiologies, stating that syntactic comprehension disorders have been found to persist following predominantly left hemisphere lesions. Lexical comprehension deficits have been associated with either left/right hemisphere lesions and syntactically simplified expressive language has been found

to persist subsequent to predominantly left hemisphere involvement. Further, impaired naming and lexical retrieval are most frequently documented after left hemisphere lesions.

In an interesting case study of TBI reported by Jordan (1992), a comparison between spontaneous language at 12 months post injury and 4 years post injury was carried out, wherein it was found that child had progressed from limited spontaneous language to production of syntactically correct, structurally complex utterances. The child evidenced occasional confusion with irregular forms. The verbal fluency in conversation was affected due to the word finding difficulties she faced.

Although the child made significant improvement in syntactic performance, the complexity of her utterances was still lower than expected. From this particular investigation, it was concluded that recovery of linguistic skills following severe TBI may continue to occur well beyond the traditional 6 months recovery period, with the potential for quite remarkable recovery even in the presence of poor prognosis during the acute stage post injury.

Paquier and Van Dongen (1993) reported that diffuse TBI in childhood produces less clearcut aphasia subtypes than do more circumscribed lesions.

According to Jordan (1995), all areas of language competence assessed appear to have been compromised by childhood BI. No single performance measure could be identified as more affected than the other. The observed generalized linguistic impairment reflects a generalized cognitive/intellectual decline rather than a specific impairment in any one linguistic domain.

Jordan (1996) indicated that children with HI do exhibit impaired performance on high level language tasks as assessed by the TLC-E (The test of language competence - expanded edition). These children exhibited poorer performance in the ability to create sentences with reference to social stimuli and also in the ability to interpret ambiguous/figurative expressions.

Specific linguistic deficits included reduced verbal fluency and compromised lexical retrieval and access (Dennis, 1990), these children find it difficult to provide definitions for words and in particular to cite different situations in which words may be used (Dennis, 1990).

The problem that the child with HI experiences with ambiguities may be due to their difficulties in lexical retrieval/access and verbal fluency. Performance on the subtest requiring the interpretation of figurative expressions may also have been similarly compromised.

Each aspect of language (content form and use) involves cognitive processing and impairment in any process can affect any/all parts of language. Depending on the individual's cognitive development initially, language eventually serves to shape and organize the environment, thereby shaping further cognitive development (Piaget and Inhelder, 1969).

Language becomes a cognitive instrument for categorizing, associating and synthesizing information. It is the interdependent relationship between cognition and language that allows the individual to generate, assimilate retain, retrieve, organize, monitor, respond to, and learn from the environment.

In 1987, ASLHA (Americal Speech-Language-Hearing Association) Sub-Committee of cognition and language identified several aspects of cognition that may affect language.

1. Impaired attention, perception, memory.
2. Inflexibility, impulsivity/disorganized thinking/acting.
3. Inefficient processing of information (rate, amount and complexity).
4. Difficulty processing abstract information.
5. Difficulty learning new information, rules and procedures.
6. Inefficient retrieval of old and stored information.
7. Ineffective problem solving and judgement.
8. Inappropriate/unconventional social behavior.
9. Impaired "executive' functions; self awareness of strengths and weaknesses, goal setting, planning, self initiating, inhibiting, monitoring, evaluating.

These disrupted processes in the areas of cognition and language processes of phonology, syntax, semantics and pragmatics and comprise the symptomatology after TBI, that is, cognitive, language and behavioural deficits.

Generalized cognitive-language disorders typically present after TBI result from an array of underlying cognitive dysfunction and range from severe to mild (Malkmus, 1982).

CHARACTERISTICS OF COGNITIVE LANGUAGE DISORDERS

The basis for language impairment of a generalized nature is the same as for behavioral impairment, that is, the

underlying cognitive dysfunction. Similarly, the results are random, fluctuating and variable depending on the integrity of the cognitive system, the environment and the effects of focal deficits (Malkmus, 1982).

Incidence studies

Heilman, et al., (1971) examined language in adults with CHI. Of 750 individuals, they identified only 13 as having aphasia (9 with anomia and 4 with Wernicke's aphasia).

Thomsen (1975) found that approximately 50% of the adults in his study demonstrated symptoms of aphasia, with the predominant features including naming errors and impaired self monitoring.

Filley, et al., (1987) studied groups of children with TBI injury types being diffuse axonal injury, focal injury and mixed injury. It was found that children with mixed injury demonstrated classic syndromes of aphasia and others displayed communication problems.

Language Use; disorders of pragmatics and competency :

"Pragmatics/the use of language in context, ties language and cognition to real situations, becoming a means

of viewing the individual's social interactive capacities" (Malkmus, 1983).

These communication deficits can be overlooked and not identified. Recently, however, we are identifying altered pragmatic skills, the result of impaired integration of social, emotional, cognitive and language components.

Pragmatic disturbances following TDI can be grouped into 4 categories, expressive disturbances, disorders of conversational rules/postulates, non-verbal aspects and overall communication competence. Malkmus and Becker (1983) identified expressive disturbances as disorganization of the message, impaired message selection and modification, incomplete messages/absence of detail, or excessive information included in the message. Paralinguistic features of intonation, facial expression, gestures, proxemics and eye contact can also be impaired/misused. Impaired use of conversational rules observed in TBI individuals includes -

(1) use of acknowledgements
(2) referencing and presupposing
(3) turn taking
(4) topic selection, maintenance, expansion, shifting, termination.

Other expressive disturbances include -

(1) Tangential Communication in Verbal and Written forms (Prigatano, 1986).

(2) Excessive Talking (Holland, 1982).

(3) Disorganization and lack of specificity (Weinstein, 1962) most studies in adults.

Disturbances in conversation :

Malkmus (1983) have identified disturbances in turn taking, topic maintenance and selection, excessive amounts of information and redundancy.

Non-verbal communication :

Individuals who have sustained TBI are frequently unaware of and unable to monitor these suprasegmentals because of the profound effects of impaired attention, inhibition, disorientation and initiation (Kennedy, et al., 1989).

Communication competency - refers to the actual communication performance in the environment and requires identifying the individual's needs, deficit areas (processes and behaviours), the communication situation and the compensatory strategies available to the individual.

A generalized diffuse injury in one person may produce only temporary cognitive and language disorganization (Hagen, 1984). Whereas the same type of injury in another may cause permanent cognitive and language dysfunction with focal symptoms.

Communicative Deficits Associated with TBI are -

- Dysarthria (spastic dysarthria due to bilateral damage to pyramidal and extrapyramidal tracts. Some others suggest mixed dysarthria to be more common.
- Initially cases exhibit confused language.
- Some demonstrate difficulty in auditory comprehension.
- Problems in reading and writing are present.
- Some persistent word finding problems present. Disturbed social interaction (severely affected pragmatic use of language).
- difficulty in turn taking.
- difficulty in selecting appropriate topic for conversation.
- problems in maintaining topic and cohesion.
- problems in being concise.
- problems in being relevant.

A major difference between aphasia and TBI is that the patient with TBI shows more pragmatic problems that the typical aphasic patient.

Most patients recover most of their language functions with in 30-60 days of trauma. Improvement may continue for a year or more. However, naming, reading, writing and auditory comprehension problems may persist.

TREATMENT OF TBI FOCUSES ON

A) Cognitive rehabilitation
B) Direct communication training

Brookshire (1992) recommends the following targets :

Initial treatment targets :

- Increase the patient's orientation to place, person and time (ask questions, model behaviours, give plenty of cues and prompts, written signs).

- Increase the patient's attention to surroundings (events, persons, daily routines).

- Stimulate the patient's mentation by providing progressively more challenging activities.

- Initially, decrease the variability in activities and schedules, gradually increase the variability.

- Use tangible reinforces as the patients do not seem to respond to verbal reinforcers in the early stages of recovery.

Later treatment strategies :

- continue to place contingencies on appropriate behaviors.

  ask patients to perform more complex activities that enhance their independence.

- begin to diminish special stimuli that control behavior (written signs, prompts, modelling).

- begin to teach self monitoring skills.

- teach compensatory strategies, if required :

a) teach patients to complete tasks in stages and to break them down to smaller components.
b) teach them to request information relative to time, date and so forth.
c) teach them to rehearse important information.
d) teach them to write down instructions, appointments, daily schedules, and so forth.
e) teach them to ask others to give written instructions.
f) teach them to establish consistent, manageable routines.
g) teach them to limit distraction.
h) teach them to keep possessions at specific places
i) teach them strategies of self cueing.

Specific cognitive impairment - children who have suffered a CHI have been found to experience limited processing resources and demonstrated difficulties with sequential planning (Imes, 1983). They also demonstrated problems with tasks that require abstract thought (Bassett, 1990).

In summary various studies and investigations have highlighted that to-day there are more survivors of TBI. Considering the multitude of problems these cases face, there is greater need for detailed assessment, adequate diagnosis and proper management of these cases which would be possible

only after a thorough understanding regarding this particular clinical group.

Previously it was believed that cases with TBI had the best prognosis among all types of ACA, the recovery being rapid and complete. However, recent studies report that though TBI cases have a better prognosis, the recovery is by no means complete and even years after injury, the problems continue to persist.

The damage in CHI is mostly diffuse and global and it has been found that no one measure is affected more than the other. Another fact that has now been accepted widely is that the recovery could occur beyond the traditional 6 month spontaneous recovery period.

The so called cognition - communication disorder present in these cases includes high level linguistic deficits due to diffuse and global damage to the brain. The predominant error areas are as follows:

- Impairments in memory (short-term memory), attention, reasoning, organization of thought and language.
- Initial mutism followed by reduced expression which is characterized by reduced lexical stock, lexical retrieval deficits, articulatory deficits, reduced verbal fluency, confrontation naming affected. Along with these syntactic

comprehension disorders, lexical comprehension disorders and syntactically simplified expressive language is present. In addition to these there are errors in prosody, affect, topic selection and maintenance, turn taking and conciseness in expression. Reading writing deficits are known to be present very frequently in these cases and usually persist for years. However, logorrhoea and jargon are two features that are generally absent in ACA following TBI. Also, social interactions and academic achievements are known to be affected following TBI in children.

Need for the present study :

The review of literature highlights very limited available information in this particular area, specially in the Indian context. The only available information was in a study by Bhavna (1995), however this investigation was regarding language impairments in adults following head injury.

The major findings of an exhaustive review of literature revealed predominance of the following features in CHI group: Impairments in memory (short-term memory), attention, reasoning, organization of thought and language. Initial mutism followed by reduced expression which is characterized by reduced lexical stock, lexical retrieval deficits, articulatory deficits, reduced verbal fluency, confrontation naming affected. Also syntactic and lexical comprehension disorders, syntactically simplified expressive language is

present. Errors in area of pragmatics are marked following TBI and this is a major current research area. Therefore, a need of extended formal testing was felt, so as to explore and understand this clinical group, thereby, leading to better and adequate management of these cases.

The present study was thus undertaken to probe into the language impairments in children subsequent to TBI.

CHAPTER III

METHODOLOGY

Aim :

The aim of the present study was to study language impairments in head injured children.

Subjects :

10 children, in the age range of 7-13 years with head injury (HI) with post morbid language impairment were taken as the subjects of this study.

Criteria :

The criteria for subject selection were

1) HI with post morbid language impairment
2) Age range 7-13 years
3) At least 3 years of formal education
4) Should know Hindi as the first/second language
5) Time elapsed since HI- 8 months-16 months.

Data collection was done at Department of Neurosurgery and Department of Neuropediatrics in Pant and LNJP Hospitals, Delhi respectively, during the follow-up clinic.

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Subject details

All cases had a Glasgow Coma Scale (GCS) of 8 or less thereby falling into the category of severe HI. Male to female ratio was 5:5. Of the 10 subjects, 4 had a fall, 5 suffered from hit (motor vehicular/road side accident and 1 was struck by blunt object (See Table-V).

Based on the CT scan report, 3 had hematomas, 3 had generalized cerebral oedema, 2 had extensive left tissue swelling, 1 had contusion and one of them didn't demonstrate any abnormality on CT scan.

Other problems

None of the cases exhibited any major associated problems. However, during the testing session problems such as temper tantrums, memory lapses restlessness, staring spells, boredom, fatigue were observed in these cases.

Tools

The tools used in present study were -

a) Detailed Language History
b) Linguistic Profile Test (LPT) - Hindi version
c) Children's Aphasia Screening Test (CAST)

DESCRIPTION OF THE TOOLS USED

a) Language History

The language history comprised of detailed personal history, details of handedness, the various languages known, language commonly used in various activities and the details of HI including different physiologic investigations.

b) Linguistic Profile Test (LPT)

The LPT was designed with the objective of evaluating and analyzing adequate linguistic samples at the phonological, syntactic and semantic levels. The test was originally designed by Karanth (1980) in Kannada. A parallel version of the test was developed in Hindi (Karanth, Pandit and Gandhi, 1986).

The LPT has 3 major sections dealing with phonology, syntax and semantics respectively, with discourse forming the tail end of the third section. The choice of methods within these sections covers a wide range of tasks such as pointing, repetition, naming, indication of grammatical and semantic acceptability, listing of lexical categories, sentence completion, matching synonyms and antonyms etc. (Karanth, 1980) (cited in Suchitra, et al., 1990).

The first section PHONOLOGY has 3 further subsections : Phonemic Discrimination, Phonetic Expression and Running Speech of these, running speech is not scored. SYNTAX forms a major section of the test. It was 11 subsections namely morphohonemic structures, plural forms, tenses,PNG markers, case markers, transitives, intransitivs, and causatives, sentence types, predicates, conjunctions, comparatives and quotatives, conditional clauses and participal constructions.

The third section SEMANTICS has 2 main divisions semantic Discrimination and Semantic Expression. Semantic expression has 11 subsections, which include naming, synonyms, paradigmatic relations, semantic contiguity etc.

The three sections have a score of 100 each, with a grand total of 300.

In the discourse section, there are 3 pictures which the subjects have to describe and they also have to talk on any topic for 5 min. The first picture is a market (fair) scene in which there is a book house, a sweets shop and a balloon seller. People are scattered all around buying things and children are buying balloons. In the second picture, there are 3 scenes. In one, a teacher is teaching in a classroom,

in the second, children are playing football and in the third one, boys are doing PT exercises. The third picture is a village scene with a bullock cart, a number of huts and a lady milking a cow.

However, in this particular study, discourse section was not studied.

CHILDREN'S APHASIA SCREENING TEST (CAST)

Designed by Whurr and Evans (1986) is a test for children with no age range specified. This is an untimed test.

This is a short screening test which aims to provide a profile of the communication process; e.g. listening, comprehension, speech, pre-reading, writing and gesture. It is meant to be used to identify language disturbance in the brain damaged who have an acquired moderate-to-severe impairment of language function. The profile may also prove helpful in planning treatment.

A ring binder contains a display book, manual test objects and cards. Record forms, transcription forms and drawing forms are also included.

There are 25 subtests, 12 of receptive and 13 of expressive function. Receptive subtests include tests of visual perception, and pre-reading test and auditory language tests.

The expressive category includes 4 pre-speech tests and six expressive language tests including naming, sentence formulation, picture description and conversational responses. Two drawing tests and a gestural test are also included. A profile of performance may be plotted on the summary record form. The results obtained are both quantitative as well as qualitative and are easy to interpret. These tools were taken up to assess the language of HI children in detail.

Test Environment

The subjects were seated comfortably in a quiet non-distracting environment. Any potential visual distractive stimuli were removed. Evaluation of the subjects was initiated once the subject's physical and mental condition was stable.

Procedure

Initially a detailed language history was taken followed by administration of LPT and finally CAST. The test were administered on the same day and by the same investigator. The tests were scored and a detailed analysis was done. Since all the tests had to be administered on each subject, adequate rest period and reinforcement were given to them in between each test.

After the completion of each test, scores were recorded in their respective response sheets by the investigator and calculation of the total scores was done as per the instruction given in their respective test manual.

The results are presented and discussed in the next chapter.

Sl. No.	Sex	Age at injury yrs/mon	Age at assmt. yrs/mon	Time post injury yrs/mon	GCS*	Nature of injury (cause)	Handed-ness	CT Scan	Associated problems
1.	F	7.02	8.00	0.10	3	Fall	Rt*	Hematoma	Headache restlessness
2.	F	7.06	8.02	0.08	3	Fall	Rt	Extensive left tissue swelling	Temper tantrums
3.	M	7.04	8.03	0.11	7	Hit (MVA)	Rt	Hematoma	Restlessness
4.	M	8.03	9.00	0.09	6	Struck by blunt objecr	Rt	No abnorma-lity detected	Temper tantrums
5.	F	8.00	9.00	1.00	*7	Hit (MVA)	Rt	Generalised cerebral Oedema	Staring spells
6.	M	8.05	9.01	0.08	5	Fall	Rt	Extensive left tissue swelling	Memory lapses
7.	F	9.03	10.2	0.11	7	Hit (MVA)	Rt	Contusion	Staring spell + temper tantrums
8.	F	9.05	10.09	1.04	5	MVA	Rt	Hematoma	Memory lapses
9.	M	10.02	11.05	1.03	6	Fall	Rt	Generalized cerebral swelling	Restlessness temper tantrums
10.	M	10.11	11.11	1.00	6	Hit (MVA)	Rt	Generalized cerebral oedema	Restlessness

* MVA = Motor Vehicular Accidents * Rt = Right * GCS = Glasgow Coma Scale.

Table V : Demographic details of the cases.

CHAPTER IV

RESULTS AND DISCUSSION

RESULTS

The present study was undertaken to explore the domain of language deficits in children subsequent to traumatic brain injury.

The tools used for language assessment were detailed language history. Linguistic Profile Test (LPT) - Hindi and children's Aphasia Screening Test (CAST).

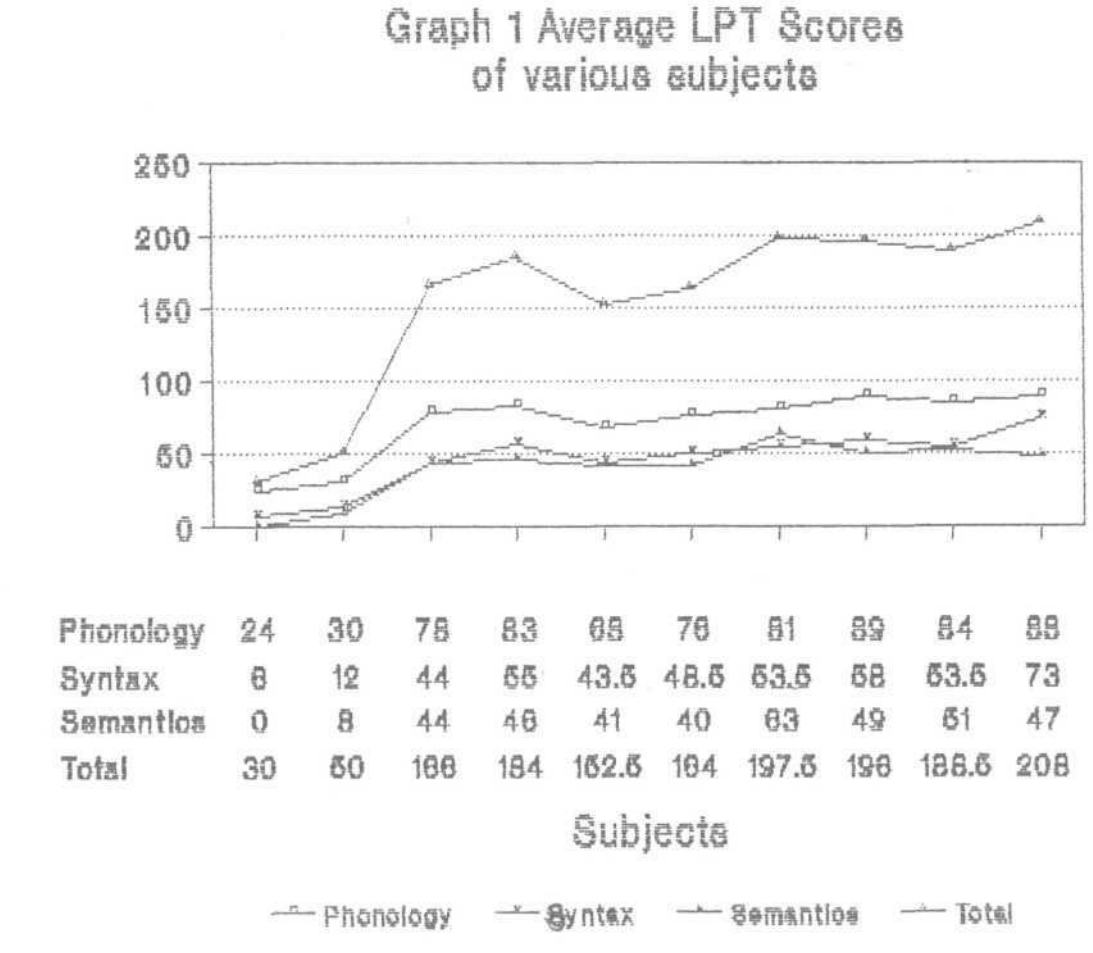
The scores obtained were tabulated and analyzed both quantitatively and qualitatively, the primary method of analysis being qualitative.

Now, coming to the results of the present study, the average scores for all the subjects on various sections of LPT i.e. phonology, syntax and semantics, along with average total score is given in Table VI and graphically represented in Graph I.

Sub. No.	Age (Yrs:mths)	Average scores - LPT Phonology	Syntax	Semantics	Total
1	8.00	24	6	0	30
2	8.02	30	12	8	50
3	8.03	78	44	44	166
4	9.00	83	55	46	184
5	9.00	68	43.5	41	152.5
6	9.01	76	48.5	40	164 5
7	10.02	81	53.5	63	197 5
8	10.09	89	58	49	196
9	11.05	84	53.5	51	188.5
10	11.11	88	73	47	208
	Average	69.9	44.75	38.9	153.55

Table-VI : Average LPT scores for various subjects

NOTE : Maximum score for each section is 100.
Maximum total score is 300.



The results indicated that the average score on phonology ranged from 24 to 89, the average for the whole group being 69.9. The average score on syntax ranged from 6 to 73, the average for the whole group being 44.75. On the semantics section the average score ranged from 0 to 63, the average for the whole group being 38.9. The average total score ranged from 30 to 208, the average total score for the group being 153.55.

As seen from the table, the average score obtained for phonology was higher than that for syntax and semantics. The scores obtained by all subjects on semantics were found to be the least. Also the scores in each section for all the subjects varied across a wide range. However none of the subjects performed anywhere near their chronologically expected level of performance which is evident from the markedly reduced scores on each section for each of the subjects. It was observed that as expected the scores were better for older subjects than the younger subjects.

In an earlier study (Karanth, 1984), children below 6 years were unable to carryout the task on Section II syntax - which calls for judgement of syntactic acceptability of a given item. These children tended to accept/reject all given items without discrimination. At around 6 years of age,

children were found to attempt the task and perform at a chance level of 50, gradually achieving about 95% proficiency by about 15 years of age, with a sharp rise in grammaticality judgement ability between 6-9 years of age. The mean total scores for normals in Section II i.e. syntax, ranges from (78.85 +/-7.53) to (93.77 +/-1.88) from Grade I to Grade X (Monika Sharma, 1995). However in our subjects, the scores were markedly reduced the range being 6 to 73.

In view of the fact that a chance factor is high in younger age groups in grammaticality judgement tasks specially in our subjects in whom there is an evident lowering of cognitive functioning, the grammaticality sensitivity index (A^1) as given by Linebarger, Schwartz and Saffran (1983) was computed for each child. The grammaticality sensitivity index (A^1) is a non-parametric index of sensitivity based upon the estimated area under the receiver operating characteristics (ROC) curve which is theoretically equal to the proportion of correct responses attainable in a two alternate forced choice procedure and as such provides a pure measure of sensitivity.

The mean scores of index of sensitivity (A^1) obtained by the different age groups on the different syntactic

structures in the current study is given in Table VII and are graphically represented in Graph II.

The average value of (A^1) across the 10 subjects seem to have increased from .55 to .99 indicating a higher grammatical sensitivity for older subjects when compared to younger subjects. As expected the maximum sensitivity was not attained by any of the subjects on any of the subtests.

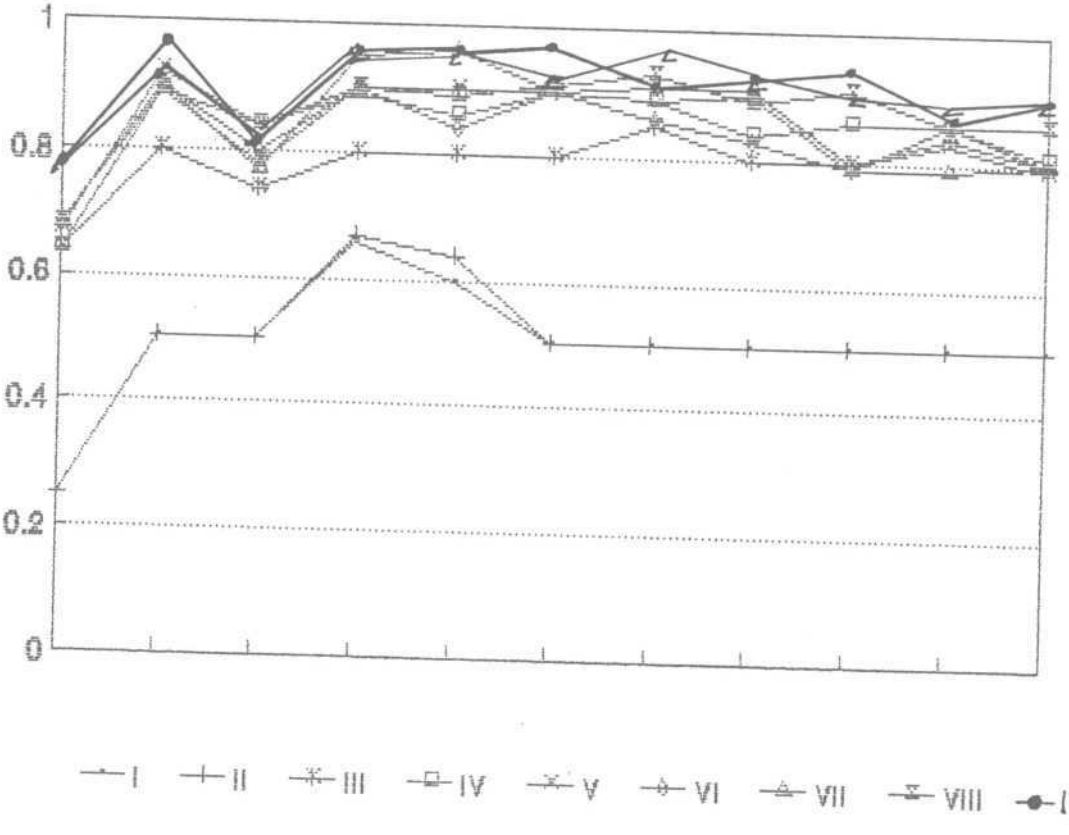
The findings also show different grammatical sensitivity across these categories. The sensitivity to PNG markers and case markers was comparatively higher throughout. On the other hand, sensitivity to morphophonemic structure was lowest. The older subjects had slightly better scores though. The other subcategories fell in between these extremes indicating differential sensitivity to different syntactic structures for different subjects. The various subcategories were also ranked in order of decreasing scores (based on sensitivity index) within the category with the highest score being ranked 1 and the lowest 11. The results are tabulated in Table VIII.

SI No	Item (SUBJECTS →)	I	II	III	IV	V	VI	VII	VIII	IX	X	Average
A	Morpho Phonemic structures	.25	.25	.64	.64	.67	.68	.68	.68	.77	.77	.60
B	Plural forms	.50	.50	.80	.89	.92	.90	.90	.89	.95	.92	.82
C	Tenses	.50	.50	.74	.84	.84	.80	.77	.78	.84	.84	.75
D	PNG Markers	.66	.67	.80	.89	.90	.90	.95	.90	.95	.95	.86
E	Case Markers	.60	.64	.80	.86	.90	.84	.96	.89	.95	.95	.84
F	Transitives Intransitives causatives	.50	.50	.80	.90	.90	.90	.90	.91	.96	.92	.82
G	Sentence Types	.50	.50	.85	.89	.91	.86	.89	.93	.90	.96	.82
H	Predicates	.50	.50	.80	.84	.91	.83	.90	.89	.91	.91	.80
I	Conjunctions Comparatives Quotatives	.50	.50	.80	.86	.80	.79	.79	.91	.93	.90	.79
J	Conditional Clause	.50	.50	.74	.86	.83	.86	.79	.86	.86	.89	.79
K	Participal construction	.50	.50	.70	.81	.79	.80	.80	.86	.89	.89	.75
	Average	.55	.55	.85	.93	.94	.92	.93	.95	.99	.99	

Table VII : Mean scores of index of sensitivity .84 for different subjects

As seen from the table on ranked sensitivity scores it was evident that PNG markers and case markers were the most sensitive in all the ten subjects studied here. The items on morphophonemic structure exhibited lowest sensitivity across all the subjects. The rest of the subcategories had a sensitivity in between these 2 extremes.

Graph 2 Mean Index of Sensitivity for different subjects



I		II		III		IV		V		VI		VII		VIII		IX		X	
R*	I*	R	I	R	I	R	I	R	I	R	I	R	I	R	I	R	I	R	I
1	D	1	D	1	G	1	F	1	B	2	BDF	1	E	1	G	1	F	1	G
2	E	2	E	4.5	BDEFHI	3	BDG	2.5	GH	4.5	GJ	2	D	2.5	FI	3	BDE	2.5	DE
5.75	BCFGH-IJK	5.75	BCFGHIJK	8.5	CJ	6	EIJ	5	DEF	6	E	4	BFH	4	D	5	I	4.5	BF
11	A	11	A	10	K	8.5	CH	7	C	7	H	6	G	6	BEH	6	H	6	H
				11	A	10	K	8	J	8.5	CK	7	K	8.5	JK	7	G	7	I
						11	A	9	I	10	I	8.5	IJ	10	C	8	K	8.5	JK
								10	K	11	A	10	C	11	A	9	J	10	C
								11	A			11	A			10	C	11	A
																11	A		

R* - Rank; I* - Item T-3L 6(J&7(fC75

Table-VIII : Ranking of subcategories (items on syntax section) based on sensitivity index (A*)

Under the semantic section, better performance was observed for items in section IIIA - Semantic discrimination as against Section IIIB - semantic expression. The average total scores for most of the items in section IIIA (semantic discrimination) Mere higher when compared to scores in section IIIB (semantic expression) where differential performance was observed for the items across all subjects. Slightly better performance on 1 and 2 (i.e. colours and furniture) as against the item No.3 (body parts) was found.

The mean score on item 1 - Naming, under section IIIB - semantic expression, indicated an overall better performance compared to other items in this section. However the subjects demonstrated clear cut deficits in the area of naming. The performance on other items in semantic expression (synonymy, homonymy, autonymy etc.) were all found to be greatly compromised in these subjects. In the semantics section the average total score ranged from 0 to 63, and the performance on this section was affected the most when compared to the sections of phonolgy and syntax.

The average scores for different items on the semantic section for various subjects are given in Table IX.

Item No.	Max.	Subjects-> I	II	III	IV	V	VI	VII	VIII	IX	X	Ave-rage
A1	5	0	1	3	5	5	5	5	4	5	5	3.8
2	5	0	1	3	5	5	5	5	4	5	4	3.7
3	5	0	2	4	3	3	2	3	2	2	3	2.4
B1	20	0	2	4	8	3	6	16	14	16	8	3.9
2	15	0	2	4	6	2	2	6	7	3	7	3.9
3	5	0	0	4	3	2	3	2	1	1	3	1.9
4	5	0	0	3	1	3	3	2	2	1	1	1.6
5	5	0	0	2	1	2	0	2	2	2	1	1.2
6	10	0	0	5	4	6	4	6	4	4	5	3.8
7	5	0	0	2	3	2	2	2	1	2	2	1.6
8	5	0	0	4	2	2	3	4	2	3	2	2.2
9	5	0	0	2	3	3	2	4	3	3	2	2.2
10	5	0	0	2	1	1	1	2	2	2	2	1.3
11	5	0	0	2	1	2	2	4	1	2	2	1.6
	100	0	8	44	46	41	40	63	49	51	47	38.9

Table-IX : Average scores for different items on the semantic section for various subjects.

Coming to the results on CAST, as seen in Table X. The scores on visual subtests ranged from 2 to 5 the average being 3.91. The scores on auditory subtests ranged from 1.83 to 4.67 the average being 3.78. These subtests were the ones with best performance, scores on visual subtests being slightly higher than auditory subtests.

The score on prespeech and speech subtests ranged from 0 to 3.75, the average being 2.55. The performance on expressive language subtests was quite low, the scores here ranged from 0.16 to 3.17 the average being 1.86. Coming to

drawing subtests, the scores ranged from 0 to 2.5 the average being 1.65. Finally, on the gesture (imitation use of objects), the performance was extremely poor, wherein 7 subjects did not score anything, the group average was 0.5.

The receptive total ranged from 23 - 58, the average for the whole group being 46.2. the expressive total ranged from 1 to 39, the average for the whole group being 25.2

The overall total scores ranged from 26-97, the average for the whole group being 70.4.

As mentioned above, the scores indicate that our subjects performed at a much lower level when compared to normal children (Whurr and Evans, 1986). Areas of maximum deficits being gesture (imitation use of objects) and drawing subtests followed by expressive language subtests. Performance on visual and auditory subtests was comparatively superior to all the other subtests. On the prespeech and speech tasks, the children scored scores that were in between these two extremes.

	SUBJECTS-ITEMS	I	II	III	IV	V	VI	VII	VIII	IX	X	Aver-age
A	Visual Subtests	2	2	4.2	5	4	2.8	4.3	4.8	5	5	3.91
B	Auditory Subtests	2.17	1.83	4.5	4.67	3.5	3.17	4.17	4.5	4.67	4.67	3.78
C	Prespeech and Speech subtests	0	0.5	3	3.5	3.25	1.5	3.25	3.5	3.75	3.25	2.55
D	Expressive Language Subtests	0.16	0.5	2.33	3	1.33	1	3.17	2.33	2.83	2	1.86
E	Drawing Subtests	0	0.5	2.5	2.5	1	1	2.5	2	2.5	2	1.65
F	Gesture	0	0	0	0	0	0	1	2	2	0	0.5
Receptive Total		25	23	52	58	45	36	51	56	58	58	46.2
Expressive Total		1	6	31	37	23	14	38	34	39	29	25.2
Overall Total		26	29	83	95	68	50	89	90	97	77	70.4

Table-X : Average scores on CAST for ten subjects

DISCUSSION

The results of the present study are in agreement with a number of studies which have been reviewed earlier. These are discussed below:

First of all coming to the information obtained by detailed history.

The first subject was an 8 year old female child tested 10 months post onset. She had suffered a fall and the GCS was 3. On CT scan hematoma was found. Associated problems were headache and restlessness.

The second subject was an 8 year 2 months old tested 8 months post onset. She too had suffered from a fall and the GCS was 3. CT scan showed extensive left tissue swelling. She exhibited temper tautrums very frequently as reported and as observed during the session.

The third subject, an 8 year 3 months old male child tested 11 months post onset had suffered from a hit (motor vehicular accident). The GCS was 7 and CT scan showed hematoma. The case was found to be very restless during the testing session.

The fourth subject was a 9 year old male child tested 9 months post onset. He was struck by a blunt object on the head. The GCS was 6. However on CT scan no abnormality was detected. He exhibited temper tantrums.

The fifth subject was a 9 year old female tested 1 year post onset. She had suffered from a hit (motor vehicular accident). The GCS was 7. CT scan highlighted presence of generalized cerebral edema. She was found to be having staring spells as associated problems.

The sixth subject was a 9 year 1 month old male, tested 8 months post onset. He had suffered from fall. The GCS was 5 and CT scan showed extensive left tissue swelling. This particular child was suffering from frequent memory lapses too as evident from his performance.

The seventh subject was a 10 year 2 months old female, tested 11 months post onset. Had suffered from hit (motor vehicular accident). The GCS was 7. CT scan showed contusion. The associated problems in this subject were staring spells and temper tantrums.

The eighth subject was 10 year 9 months old female tested 1 year 4 months post injury. The case suffered from motor vehicular accident. The GCS was 5. CT scan showed hematoma. Associated problem of memory lapses were evident.

The ninth subject was 11 year 5 months old male tested 1 year 3 months post onset. Had suffered from a fall. The GCS was 6. The CT scan showed generalized cerebral swelling. The associated problems were restlessness and temper tantrums.

The tenth subject was 11 years 11 months male, tested 1 year post onset. The case had suffered from hit (motor vehicular accident). The CT scan showed the presence of generalized cerebral swelling, and the case exhibited restlessness as an associated problem.

All the subjects were right handed pre and post injury.

The findings on LPT indicated overall reduction in scores for all the subjects across all the subtests, thereby indicating a diffuse effect across all areas of language following TBI. However, scores on phonology were comparatively higher than scores on syntax and semantics. On the semantics section, these children scored the least. The

scores, obtained by these children on all 3 sections of LPT, were compared with the normative data (Monika Sharma, 1995), and it was found that these children had performed quite poorly when compared to the normal children. It was also observed that the normal children also performed best on phonology followed by syntax and finally the semantics section of LPT. Thus, the lowering in scores across the three sections does somewhat match with the performance trend as observed in normal children.

Normal children (less than 6 years) have been found to exhibit difficulty in grammaticality judgement tasks (GJ tasks)(Karanth, 1984; Karanth and Suchitra, 1990). However, our subjects, in the age range of 7-13 years, i.e. of comparatively higher chronological age, had difficulty in GJ tasks. These were more for the younger subjects in our group. The reason for reduced performance on GJ tasks could be possibly due to an overall reduction in cognitive abilities. This is in agreement with a study done by Hagen, 1981, who pointed out the effect of reduction in cognitive abilities across various areas of performance in HI children.

Sensitivity Index (A^1) was calculated for the 10 subjects across the 11 items on syntax section of LPT. As

seen in the results (A^1) was found to be higher for older subjects, however when compared to normals these were found to be reduced. Also subject (1) and (2) have performed more or less at a chance level performance, this is basically because they either accepted/rejected all the presented sentences in terms of grammaticality judgement tasks. This fact of accepting/rejecting all sentences is also found in normal children less than 6 years. However, the reason why our subjects demonstrated this could again be due to the fact that the overall cognitive abilities of these children are lowered subsequent to TBI. Also, another important aspect which is highlighted here is that chronologically older subjects may demonstrate difficulty in GJ tasks subsequent to TBI, owing to the overall reduction in cognitive abilities. This could make the usage of test tools like LPT slightly inappropriate specially where the GJ tasks are involved. Therefore the overall cognitive abilities of children following TBI must be kept in mind while selecting assessment tools for these children.

Also, in the present study, ranking of items of syntax section based on sensitivity index was carried out. It was found that PNG markers and case markers were most sensitive in all the subjects and morphophonemic structures exhibited the lowest sensitivity. This is in agreement with the study

by Monika Sharma (1995) which was carried out on normal children. With this finding, we can again say that the influence of TBI on these children's performance on syntax section of LPT is compromised, but in accordance with the trend observed for normal children. Finally, all the scores of (A_1) on all subtests were lower than that obtained for normals (Monika Sharma, 1995).

The findings in the semantic section, that is, items in section III-A (semantic discrimination) are in agreement with the study by Huttenlocher, Smiley and Ratner (1974) on normal population. They found that the object concepts seem to be among first "natural language concepts" to be acquired. children comprehend and produce words and group perceptually similar objects, both animate and inanimate by approximately 14 months (Goldin Meadow, et al. 1976). The information involved in the categorization is perceptual and may be representable in the form of prototypes/images of the average unit. This early emergence might be also due to their having been named more frequently than any other category (Huttenlocher, Smiley and Ratner, 1983). Istomina (1963) and Johnson (1977) from their study report that even though among the earliest adjectives in children's vocabulary are colour words, young children are notoriously bad at using colour

words appropriately. This is true for the present study also wherein four children performed much below the expected level. The other six subjects could score a full 5/5 on the subtest.

On the semantic discrimination task, children scored least on body parts. The reason could be that body parts are acquired the last out of the three categories that is colours, furnitures and body parts. This is in agreement with the earlier study by Suchitra and Karanth (1990) and Monika Sharma (1995) on normal children, however here the subjects' scores are very much reduced as compared to the normal children.

One of the other problems noted was left and right identification. Some of the subjects could comprehend when said in English in place of Hindi. This finding has also been reported for normal children (Monika Sharma, 1995). Where in the borrowed English terms become more familiar because of speaker's use than the corresponding terms in Hindi.

Performance of these children on naming tasks seemed to be better. Although scores on this section were high when compared to other subtests in this section, it was found that

these children demonstrated some amount of deficits in naming task. Greater semantic similarity errors were found in brain injured children. This could probably be due to cognitive impairments (difficulty in working memory, planning, retrieval strategies, initiation and attention). This finding is in agreement with Appleton, et al, 1990, who also high light that due to such an impairment the performance on word fluency tasks would get compromised.

In another study, Jordan, et al. (1990)'found that only children with a severe CHI demonstrated significantly compromised naming skills when compared to a mild CHI group. As our group of subjects comprised only of those with severe CHI, naming deficits might have formed an important part of their overall reduced language abilities.

Sack and Berlin (1971) report that the ability to judge synonymy emerges later than the ability to understand the sentences being judged. It was also suggested that younger children may perform systematically worse than chance on synonymous sentence pairs.

The findings with TBI children suggest that performance on all the subtests such as synonyms, antonyms, homonymy,

semantic anomaly, syntagmatic relations and semantic contiguity was compromised to quite an extent. The results further highlight that children performed most poorly on the section of semantics.

Coming to performance on CAST, it was found that TBI children showed quite low scores when compared to normal children (Whurr and Evans, 1986). On the whole, performance on visual subtests was best, followed by that on auditory subtests. They performed poorly on prespeech and speech subtests. The performance on expressive language subtests and drawing subtests being still poorer. The worst performance was on the subtest of gesture (imitation use of objects).

The combined receptive scores were definitely higher than the combined expressive scores. However all the scores were lowered to quite an extent when compared to normal children.

Closed Head Injured demonstrate a diffuse shearing injury which affects many inter-connections in the brain, as each inter-connection is sheared in relation to the next at the moment of impact. The children with CHI in the present study had experienced a severe HI according to the GCS score,

indicating a significant compromise of brain function involving the presence of coma for some time post injury.

An overall decline in performance on combined measures of listening, speaking skills and semantic skills was reported rather than a specific impairment in one area.

Evidence right now is not conclusive in determining the differential effects of CHI. As discussed it could probably be the result of the insensitivity of the measures employed. Future research should move in the direction of employing psycholinguistically controlled measures such as that proposed by Kay, et al. (1992) (PALPA-Psycholionguistic Assessment of Language Process in Aphasia). Our results also indicate that TBI children exist as a separate clinical entity. They exhibit certain deficits that could be classified into cognition communication disorders, as studied by Bon Yishay, et al. (1970), New York Medical Center, who are the pioneers in the field of cognitive rehabilitation for TBI cases.

CHAPTER V

SUMMARY AND CONCLUSION

The present study was undertaken with the primary aim of studying the language characteristics in children subsequent to head injury.

Ten children were taken as subjects for the present investigation. These subjects had a history of head injury with post morbid language impairment.

A detailed language history was taken which was followed by administration of (LPT) Linguistic Profile Test and (CAST) Children's Aphasia Screening Test. All subtests of these tests except discourse section were investigated. The discourse section could not be studied primarily due to time constraint involved during data collection.

The scores obtained on different sections of LPT and CAST were tabulated and analysed. (A^1) was calculated for items in syntax section of LPT. A comparison of this was made with the available Indian norms. It was found that the HI as a group performed poorly than normals. Performance on all the sections of LPT was found to be compromised for our subjects with the performance being relatively better on

phonology section when compared to the syntax and semantics section. The performance on semantics was found to be reduced maximally.

Coming to the performance of these children on CAST performance on all the subtests was found to be reduced with maximum effect observed on expressive language subtests followed by drawing subtests and gesture imitation use of object, in increasing order.

Hence, it was concluded that head injured children do have some peculiar and unique characteristics which need to be probed into by extensive testing in order to ensure better and thorough understanding of language impairments in children subsequent to head injury. This would ensure better rehabilitation of head injured children, in future.

Taking into consideration the findings of the present investigation, specially the results on LPT, we can conclude that severe CHI children do exhibit considerable language impairment even after 6 months post onset period, that is even after the completion of essential spontaneous recovery period.

These impairments may vary from minor errors to gross errors such as impairments in memory, attention, reasoning organization of thought and languge. Reduced expression, lexical retrieval deficits, articulation, fluency, and naming errors, being few of them. These errors are going to be detected only by formal testing. Also, the recovery of linguistic skills following TBI may continue to occur well beyond the traditional 6 months recovery period with the potential for quite remarkable recovery even in the presence of poor progress during the acute stage post injury. This could possibly be due to the diffuse kind of impact on the brain due to CHI and therefore even the recovery could be slow and gradual and may easily exceed the traditional 6 months spontaneous recovery period.

Thus, the management team for HI children including his/her family should bear in mind these obvious/not so obvious errors that might affect these children in their daily life as well as in their schools. So, attention needs to be paid to them and the services of speech language pathologist needs to be availed of. We hope this study would be beneficial in some way for those involved in the rehabilitation of the head injured children, finally leading to a better management of these cases and aiding them to live a better way.

In conclusion, subtle deficits in the use of language, in addition to the many other cognitive and emotional changes frequently associated with head injury, offer both opportunities for understanding and exploring the potential routes for intervention. The pragmatic communication of psychosocial actions involved in the communication area may enable researchers and professional practitioners to try out and experiment novel and additional avenues in their efforts to assist in the recovery and rehabilitation process for the TBI cases.

LIMITATIONS

This particular investigation has its own limitations which are presented below. Future researches could aim to overcome these limitations and thereby make their investigation more conclusive.

1. The sample size of the present investigation is small therefore the generalization of results is limited.
2. Only severe head injured children were taken as subjects for the study.
3. Psychological evaluation in detail was not available, hence cognitive and language impairments were not correlated with each other.
4. Only closed head injured children were taken for the investigation.

5. No subgroups were formed within the group, such as that related to period of recovery, cause of injury and language impairment etc.

6. Spontaneous speech and discourse were not studied.

7. Comparison of the obtained scores for TBI cases with a controlled group was not carried out.

8. Recovery patterns over extended periods of time were not studied for this groups of TBI children.

SUGGESTIONS FOR FUTURE RESEARCH

Keeping in mind the limitations of the present study, the following suggestions are made :

- further work could be carried out considering degree of head injury and whether it is closed head injury/open head injury.
- psychological testing could be done in detail and an attempt could be made to correlate cognitive impairments with language impairments ih these cases.
- the recovery patterns could be studied.

Thus, head injury in children exists as a specific category of Acquired Childhood Aphasia, with deficits spanning across various aspects of language including expression and comprehension. In order to obtain clearer picture of speech and language characteristics in head injured children and its eventual outcome, this kind of study should be carried out on larger sample in a longitudinal pattern.

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