DISCLAIMER

The information contained within this document does not constitute medical advice or diagnosis and is intended for education and information purposes only. It was current at the time of publication and every effort is made to keep the document up to date.

The information contained herein includes both psychological and non psychological interventions. The delivery of psychological services requires a medical referral whilst non psychological services do not.

Each person is an individual and has a unique psychological profile, biochemistry, developmental and social history. As such, advice will not be given over the internet and recommendations and interventions within this website cannot be taken as a substitute for a thorough medical or allied health professional assessment or diagnosis.

Post Concussive Syndrome / Head Injury

Article QUICK LINKS :

INTRODUCTION

The human brain is the most precious commodity a person has. It commands every facet of bodily function, and its very manner of functioning controls our thoughts, dreams, emotions and feelings, as well as our behaviour and perceptions of the world about us. It is a truly remarkable organ. But it is also subject to many disorders, as well as being vulnerable to dysfunction through direct and indirect injury. "Injury" may occur through a number of means: as a result of genetics, the birthing process, exposure to neurotoxic chemicals - including medications, anoxia (lack of oxygen to the brain), or even a simple knock to the head. Collectively these 'injuries' to the brain are now known as 'acquired brain injury'.

In fact, a hit to the head during a sporting event may be worse than you think. New studies scrutinised the issue on a scientific level and found that 'bumps' to the head can create changes in mental function. Most recently, studies reveal specific insights into how knocks to the head can have serious, sometimes lasting, effects on brain function.

Another study that measured electrical activity in the brains of athletes with concussions also found that injuries of this type are tied to attention deficits. It is generally accepted that attention is not a unitary cognitive process but rather, comprises a variety of different components (Cohen, 1993). Deficits in sustained (vigilance), selective (focussed attention and divided attention) and phasic alertness (easily distracted by external stimuli) are common in a person who has experienced brain injury.

Of concern in 2002, are amusement park rides, particularly those that subject the participant to substantial gravitational forces (G-forces), such as roller coasters and bunjee jumping. In today's competitive market place many companies are competing for superlatives in height and speed, subjecting riders to powerful G-forces, not to mention twists, jerks and yaws. The G-forces generated by some of these rides exceeds those that fighter pilots and the astronauts of the space shuttle are exposed to (and they have 'G-suits' and are trained to peak physical condition to withstand them!). Most people riding these amusements will undertake several rides per day and the most vulnerable group is the 10-14 year olds. Whilst the brain is protected within the casing of the skull, it is potentially vulnerable to the sudden application of these extraordinary forces, risking subdural haemorrhage and neuronal shearing. The American Association of Neurological Surgeons (funded by an American amusement park giant) and the Brain Injury Association of America (funded by an organisation of doctors, lawyers and people with brain injuries) are currently undertaking separate studies to determine whether a causal relationship exists between brain dysfunction/injury and G-forces. (Dana Foundation, The Brain In The News, 2002)

THE HUMAN BRAIN

For thousands of years people have tried to understand the brain's workings and many descriptives exist. The ancient Greeks likened it to a radiator to cool the blood; recent analogies include a switchboard, or a computer and any number of machines yet to be invented, yet no analogy is adequate for it is unique in the universe.

Is the brain like a computer? In fact, a computer pales in comparison to the human brain, which contains connections between more than 100 billion nerve cells, or neurons, and a trillion supporting cells. But, like a computer, the brain is "wired together".

The brain's wiring system nerve fibers called axons that grow along specific paths to connect with other fibers called dendrites -- was first described more than a hundred years ago. Scientists learned that axons grow by following an elongated tip called a growth cone. Yet the systems that guide axons to connect with their targets are so complex that they are only now being unravelled.

Many advances in the understanding of its function have taken place in recent years, and indeed, the 1990's were known as 'The Decade of the Brain'. Knowledge gained from neuroanatomy in terms of how the brain is 'assembled', and from neurophysiology, have begun to reveal how these elements and the chemicals they consist of function together as a causal biochemical system.

In terms of architecture, the brain has been likened to a ramshackle old house that has been added onto over the years.

The concept of the triune brain was proposed by Paul D. MacLean MD, and is a model consisting of three separate but functionally and structurally integrated brains that cap the neural chassis. The three divisions of this model are the reptilian brain, the mammalian brain and the neocortex. These designations are in accord with the evolutionary concept.

The neural chassis according to MacLean consists of everything behind the diencephalon and commands reflexive vital life functions such as breathing, digestion and the beating of the heart.

For an overview of brain anatomy and likely dysfunction due to injury to specific brain areas please see the article titled The Human Brain.

TRAUMATIC BRAIN INJURY

Traumatic brain injury (TBI) occurs as a result of physiological disruption of normal brain function, such as trauma from either external (an object striking the head or the head striking an object) or internal events (the rapid acceleration/deceleration of the brain within the cranial vault) or both.

There are two basic types of traumatic brain injury- open and closed. Open head injuries are usually caused by penetrating objects. Closed head injuries are the more common of the two and usually are caused by a rapid movement of the head during which the brain is bounced back and forth within the casing of the skull. Closed head injuries often result from motor vehicle crashes, falls and injuries sustained during sports and other recreational activities (i.e., football, bicycling). Closed head injuries of this type result in axonal shearing (in turn resulting in the death of neurons) and often does not show up on CT or MRI scans but can be correlated to functional scans such as SPECT, PET, fMRI and QEEG. Areas most vulnerable to injury are the frontal and temporal lobes.

The most widely accepted concept of brain injury divides the process into primary and secondary events. Primary brain injury is considered to be more or less complete at the time of impact, while secondary injury evolves over a period of hours to days after trauma.

PRIMARY INJURY

- **Skull fracture:** Breaking of the bony skull; in a depressed skull fracture, these bone fragments exert pressure on the brain.

- **Contusions or bruises:** will often occur under the location of a particular impact. They are also common in the tips of the frontal and temporal lobes, where the force of the injury can drive the brain against the bony ridges on the inside of the skull.

- **Hematomas or blood clots:** result when small blood vessels are broken by the injury. They can occur between the skull and the brain (epidural or subdural hematoma), or inside the substance of the brain itself (intracerebral hematoma). In either case, if they are sufficiently large they will compress or shift the brain, damaging sensitive structures in the brain stem. They can also raise the pressure inside the skull and eventually shut off blood supply to the brain. Prompt surgical removal of such large blood clots is often lifesaving. However, certain smaller hematomas can be safely allowed to resolve themselves without surgery.

- **Lacerations:** Tearing of frontal and temporal lobes or blood vessels caused by brain rotating across ridges inside skull.

Diffuse Axonal Injury: After a closed brain injury, the shifting and rotation of the brain inside the skull will result in shearing injury to the brain's long connecting nerve fibers or axons. This can be microscopic and potentially reversible in mild brain injury, but following more severe brain injury it can be devastating and result in permanent disability or even prolonged coma. At present, there is no special treatment for diffuse axonal injury. However, recent studies have shown that some of the damage to axons progresses over the first 12 to 24 hours after the injury. For this reason, there is hope that it may be possible to prevent this progression in the future with specific treatments. Because of these recent findings, diffuse axonal injury is now thought of as a combination of primary and secondary damage.

When traumatic brain injury (TBI) occurs, connections between neural circuitry are also disrupted which leads to aberrant brain wave activity. This can occur through diffuse axonal shearing, or more directly as damage to specific brain areas.

Whilst the site of injury is unlikely to repair itself, (without stimulus the neurone is likely to undergo involution and eventually die), other neural pathways can be stimulated to be evoked by the brain, compensating for and perhaps in time performing the functions of those damaged.

SECONDARY INJURIES

Delayed secondary injury at the cellular level has come to be recognized as a major contributor to the ultimate tissue loss that occurs after brain injury. A cascade of physiologic, vascular, and biochemical events is set in motion in injured tissue. This process involves a multitude of systems, including possible changes in neuropeptides, electrolytes such as calcium and magnesium, excitatory amino acids, arachidonic acid metabolites such as the prostaglandins and the leukotrienes, and the formation of oxygen-free radicals. This secondary tissue damage is at the root of most of the severe, long-term deficits a person with brain injury may experience. Procedures that minimize this damage can be the difference between recovery to a normal or near-normal condition or permanent disability.

Diffuse blood vessel damage has been increasingly implicated as a major component of brain injury. The vascular response appears to be biphasic. Depending on the severity of the trauma, early changes include an initial rise in blood pressure, an early loss of the automatic regulation of cerebral blood vessels, and a transient breakdown of the blood-brain barrier. Vascular changes peak at approximately 6 hours post-injury but can persist for as long as 6 days. The clinical significance of these blood vessel changes is still unclear, but may relate to delayed brain swelling that is often seen, especially in younger people. Oxygen-free radical scavenger drugs prevent or reverse these changes experimentally, suggesting that such drugs may come to play an important role in the management of brain injury in the near future.

The process by which brain contusions produce brain necrosis (death of cells) is equally complex and is also prolonged over a period of hours. Toxic processes include the release of free oxygen radicals, damage to cell membranes, opening of ion channels to influx of calcium, release of cytokines and metabolism of free fatty acids into highly reactive substances that may cause vascular spasm and ischemia (local anemia due to mechanical obstruction). Such processes may also be interrupt able by therapeutic agents such as lipid antioxidants, calcium channel blockers, and glutamate antagonists.

Free radicals are formed at some point in almost every mechanism of secondary injury. Their primary targets are the fatty acids of the cell membrane. A process known as lipid peroxidation damages neuronal, glial and vascular cell membranes in a geometrically progressing fashion. If unchecked, lipid peroxidation spreads over the surface of the cell membrane and eventually leads to cell death. Thus free radicals damage endothelial cells, disrupt the blood-brain barrier, and directly injure brain cells, causing edema and structural changes in neurons and glia. Disruption of the blood-brain barrier is responsible for brain edema and exposure of brain cells to damaging blood-borne products.

Free iron, as found in contusions and hematomas, is particularly toxic, probably by catalyzing the formation of hydroxyl radical (one of the most destructive of all the free radicals). These products may result in progressive secondary injury to otherwise viable brain tissue through several mechanisms, for example, by producing further ischemia or altering vascular reactivity, by producing brain swelling (edema or hyperemia), by injuring neurons and glia directly, or activating macrophages that result in such injury, or in the case of penetrating brain injury, by establishing conditions favorable to secondary infection. In other words, much of the ultimate brain loss may be caused not by the injury itself, but by an uncontrolled vicious cycle of biochemical events set in motion by the trauma. The control of this complex cascade of cellular events remains one of the most important challenges in the acute management of brain injury. As with diffuse axonal injury, it offers a potential therapeutic window of opportunity during which brain swelling and nerve cell death may be prevented during the first few hours after an injury has been sustained.

SECONDARY INTRACRANIAL INSULTS

In the minutes and hours after a brain injury, a variety of other damage may occur.

- Hematoma (epidural, subdural and / or intracerebral)
- Brain swelling / oedema
- Increased intracranial pressure
- Cerebral vasospasm
- Intracranial infection
- Epilepsy

In one recent survey of 100 individuals with severe, moderate and minor brain injury associated with other, 92% were found to have one or more type of intracranial insult occurring for periods of 5 minutes or longer while being managed in a well staffed and well equipped intensive care unit.

SECONDARY SYSTEMIC INSULTS

Secondary systemic insults (outside the brain) that may lead to further damage to the brain are extremely common after brain injuries of all grades of severity, particularly if they are associated with multiple injuries. Thus people with brain injury may have combinations of low blood oxygen, blood pressure, heart, and lung changes, fever, blood coagulation disorders, and other adverse changes at recurrent intervals in the days following brain injury. These occur at a time when the normal regulatory mechanism by which the cerebrovascular vessels can relax to maintain an adequate supply of oxygen and blood during such adverse events is impaired as a result of the original trauma.

Some of the more common forms of secondary systemic insults are listed below:

- Hypoxemia (Low blood oxygen)
- Arterial hypotension (high or low blood pressure)
- Hypercarbia (carbon dioxide accumulation)
- Severe hypocarbia
- Pyrexia (fever)
- Hyponatremia (low sodium)
- Anaemia
- Abnormal blood coagulation
- Lung changes
- Cardiac (heart) changes
- Nutritional (metabolic) changes

Brain injuries are generally classified in terms of severity (i.e., mild, moderate, severe):

MILD BRAIN INJURY (CONCUSSION)

A mild brain injury is usually defined as one in which an individual experiences at least one of the following:

1. Any period of loss of consciousness;
2. Any loss of memory of events immediately preceding and/or following the injury;
3. Any alteration in mental state at the time of the injury;
4. Focal neurological deficit(s) that may or may not be transient.

The most common symptoms of mild brain injury fall into the following categories:

- **Physical** (headache, dizziness, nausea, sleep problems, fatigue)
- **Cognitive** (decreased attention span, concentration, mental speed and short-term memory)
- **Behavioural** (irritability, emotional labiality, depression, anxiety)

The majority of individuals who sustain a mild brain injury will recover spontaneously and with no residual deficits within one to three months, although some individuals may require longer periods of time. Researchers now warn that even with a mild concussion, a relatively subtle amount of damage occurs and some people will be left with permanent disability or deficits.

MODERATE BRAIN INJURY

Distinctions between moderate and severe brain injury are not as clearly defined as that of mild brain injury. Usually, a moderate brain injury is one that results in a loss of consciousness lasting only a few minutes to a few hours, followed by days and/or weeks of confusion. People who sustain a moderate brain injury usually have physical, cognitive and / or behavioural impairments which can last for many months and may become permanent. These impairments are similar to those experienced by individuals with severe brain injury. With treatment, however, individuals with moderate brain injuries usually are able to make a complete recovery or successfully learn to compensate for their deficits.

SEVERE BRAIN INJURY

Severe brain injury generally results from prolonged unconsciousness or coma which can last days, weeks and even months after the injury. Coma is defined as a state of unconsciousness from which the individual cannot be awakened. In this state, the individual responds minimally or not at all to stimuli and initiates no voluntary activities. Although persons who sustain a severe brain injury can make significant improvements in the first year after the injury and continue to improve at a much slower rate for many years, they are often left with permanent physical, cognitive or behavioural impairments.

THE CAUSES OF BRAIN INJURY ARE AGE RELATED

The causes and consequences of brain injury vary considerably with the age of the person. Children for example are most vulnerable to falls when not vigilantly supervised, serious injury in motor vehicles unless adequately restrained, and through abuse such as is evident in shaken baby syndrome.

Adolescents are susceptible through the generally impulsive, rashness of youth. The teenage years bring the special problems of peer pressure, underage drinking, abuse of alcohol and drugs and inexperienced and impaired driving. Because of this, teenagers are very vulnerable to brain injuries and other serious injuries. Dares- for instance, diving from heights etc. - diving into shallow water, high speed driving, ignoring safety rules, sports, and violence - are all prominent causes of traumatic brain injury in this age group.

Physical injury is the leading cause of death among adults under 45 years of age and brain injury is responsible for the majority of these deaths. In the adult population (22-65 years of age) motor vehicle crashes are probably the leading cause of brain injuries. Alcohol is a significant factor in the occurrence of adult brain injury. More than 50% of persons with brain injury were intoxicated at the time of injury (Kreutzer et al., 1990; Ruff et al., 1990).

Each incidence of brain injury is unique, requiring individualized treatment, therapy and rehabilitation. Methods of brain injury treatment depend on several factors including: degree of severity, source of injury, pre-injury health and age (Patrick, 1996). Treatments and outcomes are vastly different for person's of different age/social groups.

There are physical changes in older individuals that make their brains more vulnerable to injury and reduce their adaptability to recover (Patrick, 1996). Generally speaking, older individuals have longer hospital stays, take longer to recuperate, need more time and effort to reach the same level of recovery that younger individuals attain and often have a less positive prognosis, recovery and outcome (Pilisuk & Feinberg, 1996). Studies have shown that the incidence of brain injury goes up sharply after age 70 (Pilisuk & Feinberg, 1996). Falls are particularly notorious for the older person, and it should be noted that some medications prescribed to older people may affect their visual perception and balance.

Impairments and dysfunction due to brain injury can be divided into three major categories: physical, cognitive and behavioural.

PHYSICAL IMPAIRMENTS

- Speech, vision, hearing and other sensory impairments
- Headaches
- Lack of coordination
- Muscle spasticity (A condition that causes stiff, tight muscles, especially in the arms and legs, making movements stiff, jerky or uncontrollable)
- Paralysis
- Seizure disorders
- Problems with sleep
- Dysphagia (a disorder of swallowing)
- Dysarthria (a disorder of articulation and the muscular/motor control of speech)

COGNITIVE IMPAIRMENTS

- Short- and long-term memory deficits
- Slowness of thinking
- Problems with reading and writing skills
- Difficulty maintaining attention and concentration
- Impairments of perception, communication, reasoning, problem solving, planning, sequencing and judgment
- Lack of motivation or inability to initiate activities

BEHAVIOURAL IMPAIRMENTS

- Mood swings
- Denial
- Depression and/or anxiety
- Lowered self esteem
- Sexual dysfunction
- Restlessness and/or impatience
- Inability to self-monitor, inappropriate social responses

Difficulty with emotional control and anger management:

- Inability to cope
- Excessive laughing or crying
- Difficulty relating to others
- Irritability and/or anger
- Agitation
- Abrupt and unexpected acts of violence
- Delusions, paranoia, mania

OUTCOMES AFTER PAEDIATRIC BRAIN INJURY

The assumption that a child is simply a smaller version of an adult is not true.

Nor is the adage that the younger the child is when he/she sustains a brain injury, the better they will do.
This assumption is made because the very young child has yet to use many parts of his/her brain and it is thought that despite brain injury to a particular region, there is ample room for a good outcome (Wedel-Sellars and Hill-Vegter, 1997).

However, recent studies examining the causes of injury and the outcome of the young child seem to cast doubt on this theory (Wedel-Sellars and Hill-Vegter, 1997). When assessing and treating brain injury in a child, factors such as cognitive, personality and psychosocial development need to be considered. Unlike adults, the effects of brain injury on brain function interact with the maturation or development of the child. Skills that are emerging or developing may be affected differently by brain injury than skills that are already established.

A child with a brain injury is unique not only in comparison with peers of the same age, but also to other children with brain injuries. Each child's recovery process, outcome and family are different and unique. Although this is true for any man, woman or child who sustains a brain injury, nowhere is it more different than in the very young child (Wedel-Sellars and Hill-Vegter, 1997).

RETURNING TO SCHOOL AFTER A BRAIN INJURY

Since the child's brain is still maturing, the full impact of a brain injury may not become evident for many months or even years. This time delay makes it difficult for parents, educators and clinicians to establish the relationship between an earlier injury and altered abilities to learn and function in the classroom and school environment. The pattern of quicker physical recovery among children and the emergence of cognitive and behavioural impairments over time make accurate assessments much more complicated. As schoolwork gradually becomes more difficult with each year, the education of a student with brain injury becomes more complex over time. Outcomes from paediatric brain injury are rarely predictable and neither is the student's progress in school.

Therefore, before the child returns to school, it is necessary for the student, parents, rehabilitation and educational professionals to sit down and complete an Individualised Educational Plan (IEP). An IEP is an educational plan designed by the public school system outlining the special learning needs of a child, including:

- The amount of special education or resources which needs to be provided
- The educational and learning goals
- The frequency of the interventions within and without the school (usually revised yearly)

It can be extremely challenging for parents and educators to work together to develop and continue supporting an IEP for a student with such unique and complex needs. However, an IEP is essential for the successful academic progress of a child with a brain injury.

ADULT BRAIN INJURY OUTCOMES

Investigations of outcome on adults with severe brain injury have documented persistent cognitive, academic and behavioural impairments (Ewing-Cobbs et al., 1985). Following brain injury, deficits in function are likely in wide-ranging areas involving everyday skills that require differing degrees of mental alertness, information processing, planning, execution and mental monitoring of daily actions (Mattson, 1999). Since different methods are used to grade the severity of brain injury and because of the lack of reliable outcome studies, it is not possible to accurately predict outcome in adults with brain injury.
However, provided the individual and their family are prepared to work together with clinicians, over time adults can learn to compensate for deficits.

ELDERLY BRAIN INJURY OUTCOMES

Most current knowledge about outcome in older individuals with brain injury comes from studies involving age groups (Englander and Cifu, 1999). After the age of 40, brain injury can have enormous ramifications. The older a person is when the injury occurs correlates to poorer prognosis and outcome. (Englander and Cifu, 1999). Older individuals in good health tend to have better outcomes than people who are in poorer health, have medical conditions or other problems associated with aging. The severity of the injury and the time it takes to receive the proper medical attention all affect the outcome in these instances.

The National Institute on Disability and Rehabilitation Research (NIDRR) in the United States supports these findings in their "TBI Model Systems Data Set that revealed that individuals aged 55 and older:

- Had significantly longer, more costly stays on rehabilitation units.
- Recovered approximately half as quickly.
- Had greater cognitive impairment at discharge than a group of individuals 55 and under who were matched for similar injury and severity" (Cifu et al., 1996)

As always, the only sure cure for brain injury is prevention.

The rehabilitation process after brain injury is different for everyone.

Just as no two people are exactly alike, no two brain injuries are exactly alike, therefore rehabilitation programmes need to be individualised, catering to each person's unique and differential needs. The person with a brain injury and their family should always be the most important members of the treatment team. Cultural, religious, social and economic backgrounds must always be taken into consideration when planning a person's rehabilitation programme.

Rehabilitation channels the body's natural healing abilities and the brain's relearning processes so that an individual recovers as quickly and efficiently as possible. The process also involves learning new ways to compensate for abilities that have permanently changed due to brain injury. There is much that is still unknown about the brain and brain injury rehabilitation. Treatment methods and technology are rapidly advancing as knowledge of the brain and it's functions increases.

BRAIN PLASTICITY, LANGUAGE PROCESSING AND READING

Many scientists once believed that as we aged the brain's networks cemented in place. But now an enormous amount of evidence uncovered in the past two decades finds that the brain never stops changing and adjusting. One line of research is showing that this flexibility can help maintain language processing even in the face of severe obstacles. Futher more, some research suggests that special brain exercises can tap into the brain's adaptive capacities and help people overcome certain language and reading problems.

"The plasticity of the living matter of our nervous system is the reason why we do a thing with difficulty the first time, but soon do it more and more easily and finally, with sufficient practice, do it semi mechanically or automatically.
The brain is built for change and functions in the environment in which it grows. The brain of every individual is continuously shaping its own processing and performance capabilities. Our capabilities reflect not just WHAT we've learned, but also how our brain has evolved TO learn. By its very nature the brain's self organising process is time based." (M. Menzeanh, Society for Neuronal Regulation Conference Monterey California, October 2001.)

During early development, genes prompt the brain's neurons to form trillions of connections. These connections are fine-tuned by the neurons' electrical activity: useful connections are maintained or added, while others often disappear. Early experiments showed that many brain functions have a "critical period" during which most of this fine-tuning takes place, usually the first few years after birth. Scientists once thought that, except for areas involved with memory, brain functions are usually stable after this time.

Scientists are still uncertain whether adult brain reorganisation results from formation of new connections or strengthening of existing, previously unused connections. A loss or increase of neuronal activity in a certain area may let normally silent connections gain the upper hand and 'win' more brain territory.

EEG BIOFEEDBACK AND BRAIN INJURY

Substantial, rapid recovery is observed with this modality in cases of minor traumatic brain injury. EEG biofeedback traditionally utilises the natural 'plasticity' of the brain and its tendency toward self-regulation. Many symptoms of this type of injury relate to disregulation of arousal, and of these, the majority is depressive in character: depression, attentional deficits, irritability, effort fatigue, chronic pain, and frequent waking. Some symptoms though relate to overarousal: mania, impulsivity, anxiety, fear, anger, and sleep onset problems. Yet others relate to cognitive function: dyslexia, loss of short term memory, articulation problems, and word retrieval problems. Other problems relate more to frontal lobe function: behavioural disinhibition, obsessive-compulsive disorder, exacerbated motor and vocal tics, perseveration. Some problems relate to instabilities in the brain such as seizure activity. Characteristically, all of these symptoms are remediable to some degree through EEG operant conditioning. Some deficits related to organic structural injury will remain, but even these may demonstrate significant recovery with training over time, presumably through dendritic regrowth or rearborisation. For further information please see the article on Neurofeedback - EEG Biofeedback.

COGNITIVE SKILLS RETRAINING

Especially useful for traumatic brain injuries, cognitive memory retraining involves rehabilitation of visual and auditory short term memory and linear sequential processing, and is achieved through a variety of methods including the use of specialised computer programmes, speech and language tools.

NUTRITIONAL HEALING FOR THE BRAIN

Our brains like any other organ in the body can be in better shape or worse "The brain needs care and feeding too" (John Ratey 1997). The most fundamental intervention of all is to ensure that we eat "brain-healthy" foods.

CONCLUSION

The goal of any rehabilitation programme is to help people regain the most independent level of functioning possible. Clinical experience shows that early intervention is necessary and most effective if undertaken as soon as practicable after the injury. Since the brain and the body are not two separate entities and work in concert, the approach to rehabilitation at Learning Discoveries Psychological Services is multi-modal and holistic, encompassing the physical, cognitive, emotional, and spiritual dimensions of human healing.

FURTHER READING SUGGESTIONS

- The Human Brain
- Quantitative Electroencephalography - (QEEG)
- Neurofeedback - EEG Biofeedback - a Drug-Free Strategy for ADHD, Learning Disorders and Other Conditions

For more information or to make an appointment please contact us on (02) 9637 9998 during business hours.

AUSTRALIAN BRAIN INJURY LINKS

PLEASE NOTE :
Learning Discoveries offers the links below as a convenience to our clients and the users of this website. However, we do not control third party websites and we are not responsible for the websites content.

AUSTRALIAN NATIONAL AND STATE PEAK BODIES FOR BRAIN INJURY SUPPORT AND SERVICES

- **Arbias Ltd**

  http://www.arbias.org.au/

  Arbias Ltd provides specialist services in alcohol and other substance related brain impairment.

- **Brain Injury Australia**

  http://www.bia.net.au/

  Brain Injury Australia is the peak acquired brain injury (ABI) advocacy body representing, through its State and Territory Member Organisations, the needs of people with an acquired brain injury, their families and carers.
  It works at a national level to ensure that all people living with acquired brain injury have access to the supports and resources they need to optimise their social and economic participation in the community

- **Brain Injury Association of New South Wales**

  http://www.biansw.org.au/

  The Brain Injury Association of New South Wales is the only statewide organisation in NSW dedicated to serving all persons affected by acquired brain injury - those with acquired brain injuries, family members, friends, professionals, and the broader community.

- **The Brain Injury Association of Queensland**

  http://braininjury.org.au/portal/

  The Brain Injury Association of Queensland seeks to be the lead community-based organisation in Queensland providing support, advocacy and information to people with ABI, their families, and to individuals or organisations that share the ABI experience in any way and for any reason.

- **Brain Injury Association of Tasmania**

  http://www.biat.org.au/

  The Brain Injury Association of Tasmania is a non-government, state-wide, not-for-profit organisation that has a range of members.

- **Brain Injury Network of South Australia Inc**

  http://www.binsa.org/

  Is a state wide service that is dedicated to improving the quality of life of people affected by conditions of the brain and providing support to their families.

- **Brain Link Services Limited - Victoria**

  http://www.brainlink.org.au/

  Is a state wide service that is dedicated to improving the quality of life of people affected by conditions of the brain and providing support to their families.

- **Headway Gold Coast**

  http://www.headwaygoldcoast.org/

  Headway Gold Coast Inc. is a locally formed not-for-profit organization founded in 1985 with the intention of rehabilitating people suffering from Acquired Brain Injuries.

- **Headway Rebuilding Lives** (formerly known as Headway Support Services Tasmania)

  http://www.headwaytas.net.au/content/index.php?/hss/welcome/

  Headway Rebuilding Lives (HRL) is a specialist community based rehabilitation service for people with disabilities, specialising in supporting people with acquired brain injury (ABI), their families and social networks.

- **Headwest** (formerly known as the Head Injured Society of Western Australia)

  http://www.headwest.asn.au/

- **Somerville Community Services** - Northern Territory

  http://www.somerville.org.au/Disability.html

  The Disability Services Supported Accommodation Programme provides supported accommodation for persons with severe to profound intellectual and/or physical disabilities or acquired brain injuries within the urban and rural community of Darwin, Howard Springs and Katherine.

- **The Developing Foundation** (formerly known as Friends of Brian Injured Children)

  http://www.developingfoundation.org.au/

  We support families caring for a child or adult with brain injury or developmental disability.

INTERNATIONAL BRAIN INJURY LINKS

- **Brain Injury New Zealand (BIANZ)**

  http://brain-injury.org.nz/

  Represents the regional Brain Injury Associations around New Zealand. These regional associations provide education, advocacy, support and information to any person with a brain injury and their families and carers.

- **Brain Injury Association of America (BIAA)**

  http://www.biausa.org/

  Represents the regional Brain Injury Associations around New Zealand. These regional associations provide education, advocacy, support and information to any person with a brain injury and their families and carers.

- **Brain Injury Association of United Kingdom (Headway)**

  http://www.headway.org.uk/home.aspx

  Headway is a charity set up to give help and support to people affected by brain injury. It offers a wide range of services, including rehabilitation programmes, carer support, social re-integration, community outreach and respite care.

- **Centre for Neuro Skills**

  http://www.neuroskills.com/

  Since 1980 CNS has delivered post acute medical treatment, therapeutic rehabilitation and disease management services with highly-trained staff for individuals recovering from acquired brain injury.

  Our cost-effective, patient-centered programs maximize treatment effect, learning generalisation and stability of gains in real-world settings. The goal: to facilitate skill acquisition and help each patient resume a normal rhythm of living.

- **Children's Neurobiological Solutions, Santa Barbara, California, USA**

  http://www.cnsfoundation.org/site/PageServer

  CNS is a non profit research foundation improving the lives of children disabled by neurological disorders through research focused on brain repair and regeneration.

- **Neuroscience for Kids**

  http://faculty.washington.edu/chudler/neurok.html

  This site has been created for all students and teachers who would like to learn about the nervous system.

- **Ontario Brain Injury Association**

  http://www.obia.ca/

  To enhance the lives of Ontarians living with the effects of acquired brain injury through education, awareness and support.

- **Subtle Brain Injury Permanency from Concussion**

  http://www.subtlebraininjury.com/

  The Brain Injury Law Group was founded by Attorney Gordon S. Johnson, Jr., with the objective of assuring that our mission of education and advocacy for persons with brain injury reaches people throughout the country. We believe that the representation of those with a brain injury requires specialized background and training.

- **While you are waiting**

  http://www.waiting.com/

  waiting.com is maintained and edited by the Brain Injury Law Group, Attorney Gordon S. Johnson. It provides information About Brain Injury: Intracranial Pressure, Coma, The Rancho Los Amigos Scale, Neurosurgery, Brain Anatomy, Brain Functions and Pathology, and a complete Glossary of terms you may encounter.

- **The Perspectives Network Inc.** (FAQ's available in different languages)

  http://www.tbi.org/

  The Perspectives Network, Inc.'s primary focus is positive communication between persons with brain injury, family members/ caregivers/friends of persons with brain injury, those many professionals who treat persons with brain injury and community members in order to create positive changes and enhance public awareness and knowledge of acquired/traumatic brain injury.

- **Traumatic Brain Injury Survival Guide**
  By Dr. Glen Johnson, Clinical Neuropsychologist
  Clinical Director of the Neuro-Recovery Head Injury Program
  Traverse City, Michigan, USA

  http://tbiguide.com/

  Nearly all of the survivors of a traumatic head injury and their families with whom I have worked have had one complaint: There is nothing written that explains head injury in clear, easy to understand language. Most say the available material is too medical or too difficult to read. The goal of this online book is to better prepare the head injured person and family for the long road ahead.

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