What types of brain injuries are there?

There are two general types of traumatic brain injury categories: closed and open head trauma. The following terms are descriptions of different types of head injuries.

** Not all head trauma results in traumatic brain injury.

- **Closed head trauma** is typically caused by blunt force and non-penetrating objects. Blunt trauma is the most common form of head injury with 75-90% resulting in mild concussion, or otherwise known as classic cerebral concussion. Closed head injuries may also result from acceleration followed by sudden deceleration.

- **Open head trauma** is typically caused by penetrating and projectile, missile type objects. Open head trauma results in exposure of the sterile contents within the cranium to be exposed to debris and contaminants from the external environment. This causes the victim to have an increased risk for infection. Penetrating objects, that create tracts through the brain, cause a reaction in the injured tissues that may result in tissue disintegration and demyelination of white matter along the path of the injury. Traumatic brain injury victims with penetrating open head trauma and concurrent unconsciousness, flaccid or decerebrate posturing have a very high mortality rate.

- **Coup injuries** refer to the point of impact from direct contact between the skull and an object. In general, coup injuries may cause contusions, skull fractures and/or scalp hematomas.

- **Contrecoup injuries** result from the brain hitting the inside of the skull on the opposite side of the point of impact because of the force that causes the brain to bounce inside of the cranium. The inside of the skull has bony prominences, especially where the eyes and sinuses are located on the skull. So the brain may be injured after bouncing into the bony parts located inside of the skull. Victims traveling at a high rate of speed and then coming to a sudden stop may be subject to acceleration and sudden deceleration forces high enough to cause contrecoup injuries. The mechanism of injury determines the degree and severity of coup and or contrecoup injury. Coup and contrecoup injuries may occur separately or together. Coup and contrecoup injuries occur from one continuous transfer of force within the skull. For example, the victim will be hit on the head and the force causes the brain to bounce within the cranium resulting in a rapid sequence of injury in various locations within the brain and head. Coup injuries appear more severe, but contrecoup injuries may exert significant impact on the victim and result in traumatic brain injury. Contrecoup injuries tend to be the more severe and are associated with shearing and

tearing forces that cause bleeding and swelling inside and adjacent to the brain.

- **Focal Brain Injury** is responsible for over half of the head injury mortality rate. Focal brain injury is objective and may affect the surface and internal adjacent structures surrounding the point of impact. This term refers to the observable presence of brain contusions and hematomas. These physical findings are the result of force and tearing of soft tissue and vascular structures. Focal injury is coup or contrecoup injury. The most frequent site of focal injury is the frontal lobes of the brain. Focal brain injuries from objects striking the front of the head are more likely to result in coup injuries. But injuries sustained by blunt trauma to the back of the head generally result in both coup and contrecoup injuries due to the anterior aspect of the cranial anatomy and its bony prominences. Blunt trauma to the side of the skull is not well tolerated in comparison to injury to the front or back of the skull. In general, a force to the side of the skull is less tolerated then an equivalent force to the front or back of the skull and more is likely associated with diffuse axonal injury. Trauma to the frontal lobe results in any or all of the following symptoms: shortened attention span, mood, emotion, impulse control, long term planning and behavior.

- **Diffuse Axonal Injury (DAI)** is one of the main mechanisms by which symptoms manifest and is responsible for less than half of the head injury mortality rate. In general, the severity of axonal injury is the underlying cause that drives the presentation of symptoms following a head injury and the underlying pathology that impacts recovery. Diffuse axonal injury is generally present with severe head injury in the young population and may be present with moderate head injury in the elderly population. While DAI may occur in closed head injuries with no outward sign of trauma, it has a profound effect on severity of disability in head injury survivors. DAI is often the underlying pathology in persistent vegetative states and altered level of consciousness. DAI may be categorized as mild, moderate and severe. In mild forms, coma may last for 6 to 24 hours. In moderate DAI, tearing of axons is identified. Coma may last longer than 24 hours. In severe DAI, approximately 65% of victims survive and live with significant residual neurological impairment after prolonged periods of coma.

- **Concussion** refers to the disturbance of neurological function when axons are injured. Different grades of concussion have been identified by the neurology experts. Grade I concussion is associated with momentary amnesia, confusion and disorientation. Grade II concussion is associated with confusion and retrograde amnesia. The victim may lose memory of events that occurred just prior to the injury. Grade III concussion is associated with confusion, retrograde and anterograde amnesia that remains present after the traumatic event. Anterograde amnesia means a loss of memory of events that shortly follows a traumatic head injury.

Grade IV is also described as classic cerebral concussion. Classic cerebral concussion is associated with loss of consciousness, retrograde and anterograde amnesia, and symptoms suggestive of a neurological disconnect without anatomical evidence of axonal injury. Classic cerebral concussion may be complicated, with focal brain injury; or uncomplicated, without focal injury.

- **Skull fractures** are indicative of or often associated with penetrating injuries or significant blunt force against unforgiving surfaces. And skull fractures are often associated with bleeding and hematomas. Fractures may be linear, compound and in multiple locations. The location of a skull fracture helps the provider determine the direction and degree of force that the victim was subjected to. It also provides a clue as to what type of soft tissue complications may unfold during the course of recovery. Bone fragments may lacerate adjacent soft tissues of the brain and meninges as they are pushed inward from blunt trauma or penetrating projectiles.