

Hello again. Justin told me his narration of the Anatomy & Physiology of the Head, Neck, & Spine lesson was inspiring. I hope you feel the same way.

So now, let's explore Head, Neck and Brain injuries. Part A of this lesson reviews Traumatic Brain and Skull Injuries. Part B examines Intracranial Pressure, Concussions and Wounds to the Neck.

As you go through this lesson, consider how the material may assist you in Identifying skull and brain injuries and their emergency care.

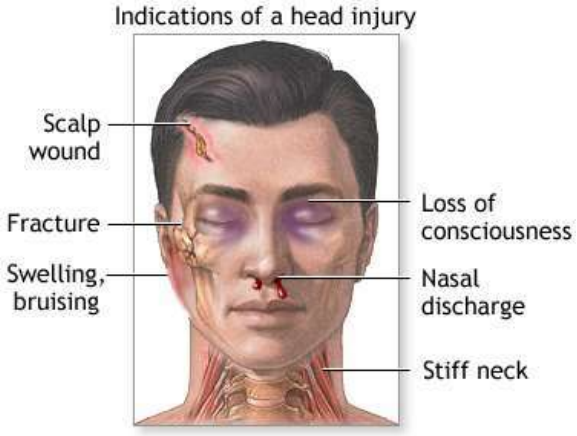
And if you like to read as you listen, first start the video, and then click on the link for speech text below.

Good Studying.

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Overview Head Injuries

- Scalp injuries
  - Lots of blood vessels
  - Profuse bleeding
- Skull injuries
  - Open head injury
  - Closed head injury



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A head injury is any sort of injury to your brain, skull, or scalp. This can range from a mild bump or bruise to a traumatic brain injury. Common head injuries include concussions, skull fractures, and scalp wounds. The consequences and treatments vary greatly, depending on what caused your head injury and how severe it is.

Scalp, skull, and brain are the different classifications of a head injury. These injuries can be further subdivided into concussions, contusions, lacerations, and hematomas. The skull is fractured in an open head injury. The skull is

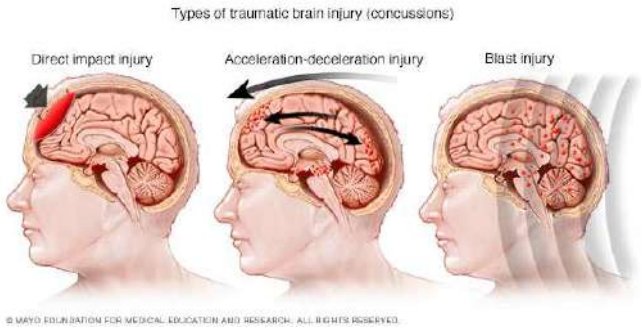
intact in a closed head injury. Whenever you suspect a skull or brain injury, also suspect spine injury.

It can be hard to assess how serious a head injury is just by looking. Some minor head injuries bleed a lot, while some major injuries don’t bleed at all. It’s important to treat all head injuries seriously and follow the appropriate assessment and treatment protocols.

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Overview - Head Injuries

- Closed injuries
  - Diffuse axonal | shaking, whiplash
  - Concussion
  - Intracranial hematoma
  - Cerebral contusion



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Closed head injuries are the most common type of brain injury, accounting for about 75% of the estimated two million brain injuries that occur annually. When a head injury is closed, nothing directly touches the brain. Instead, the injury comes from the brain rattling in the skull. If the head is hit with sufficient force, the brain may even be bruised by the skull itself.

Common types of closed brain injuries include:

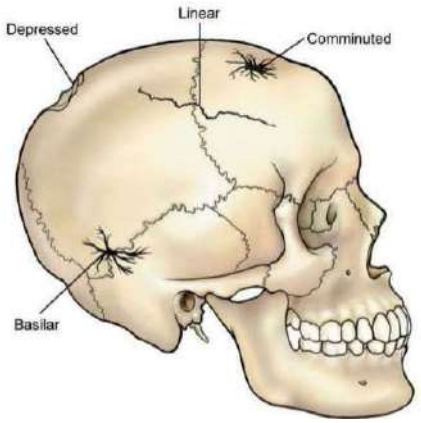
- Diffuse axonal injury: These injuries are fairly common and are usually caused by shaking of the

brain back and forth, which can happen in car accidents, from falls or shaken baby syndrome.

- Concussion: Concussions usually result in only temporary disruption of brain function. Moreover, if a concussion is not promptly treated and swelling continues, the concussion survivor can die.
- Intracranial hematoma: This occurs when a ruptured blood vessel results in a pool of blood either around the brain or in between the brain and skull. It can cause intense pressure on the brain that may be fatal or permanently damaging if not promptly treated. There are three types of hematomas: Epidural, Subdural and Intracebral.
- Cerebral contusion: A contusion is a bruise to the brain itself. A contusion causes bleeding and swelling inside of the brain around the area where the head was struck. When trauma is not the cause, the most common causes are long-standing, high blood pressure in older adults, bleeding disorders in either children or adults, or the use of medications that cause blood thinning or certain illicit drugs.

Overview - Head Injuries

- Open injuries | Skull Fractures
  - Linear
  - Diastatic
  - Depressed
  - Basilar
- May be bleeding and exposed brain tissue



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Open head injuries occur when something hits the head forcefully enough to penetrate the skull. They are often caused by penetrating trauma. As a result, there is an opening from the brain to the outside world.

There may be bleeding and exposed brain tissue. Severe bleeding, blood clots, and other life-threatening injuries can also occur.

Most doctors differentiate between four different types of open wound brain injuries that involve skull fractures.

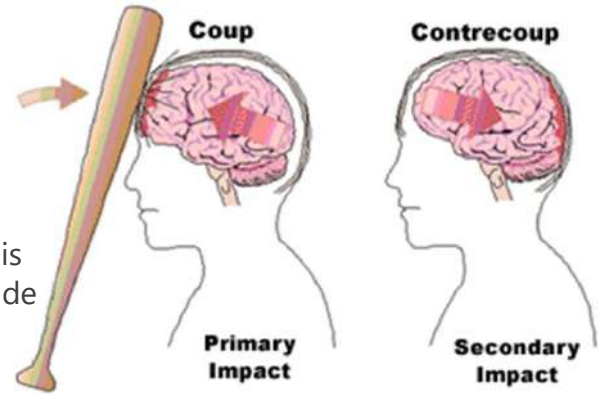
Those include:

- Linear skull fractures: This is the most common type of skull fracture. In a linear fracture, there is a break in the bone, but it does not move the bone, nor is there any penetration in the brain.
- Diastatic skull fracture: These are fractures that occur along the suture lines in the skull. The sutures are the areas between the bones in the head that fuse when we are children. In this type of fracture, the normal suture lines are widened. These fractures are more often seen in newborns and older infants.
- Comminuted or Depressed skull fracture: In this fracture, part of the skull is actually sunken in from the trauma. The injury occur when the skull is penetrated, often by a sharp object, leaving broken pieces of the skull in contact with the brain.
- Basilar skull fracture. This is the most serious type of skull fracture, and involves a break in the bone at the base of the skull. Patients with this type of fracture frequently have bruises around their eyes and a bruise behind their ear. They may also have clear fluid draining from their nose or ears due to a tear in part of the covering of the brain.

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Overview - Brain Injuries | Direct vs Indirect

- Primary or Direct injuries
  - Brain is lacerated, puncture, or bruised by broken bones or by a foreign object.
- Secondary or Indirect injuries
  - The shock of impact on the skull is transferred to the brain and include concussions and contusions.
- Coup-contrecoup



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Direct or Primary injury occurs at the moment of initial trauma. It may occur when the brain is lacerated, punctured, or bruised by broken bones or by a foreign object. Types include:

- skull fracture (breaking of the bony skull),
- contusions (bruise/bleed on the brain) that can lead to hematomas (blood clots in the meningeal layers or in the cortical/subcortical structures as a result of the trauma),
- concussions (low velocity injury resulting in

functional deficits without pathological injury),

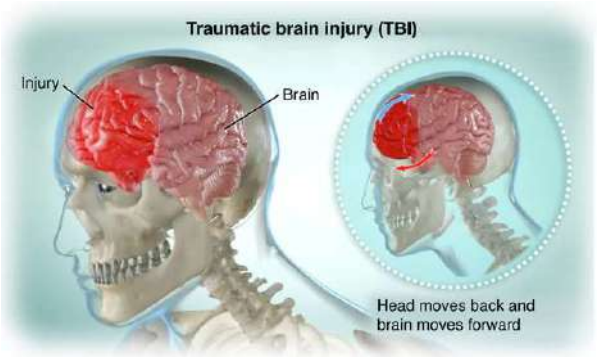
- lacerations (tears in brain tissue or blood vessels of the brain),
- diffuse axonal injury (traumatic shearing forces leading to tearing of nerve fibers in the white matter tracts).

Secondary or Indirect brain injuries occur when the shock of impact on the skull is transferred to the brain and include concussions and contusions. Secondary injuries include:

- ischemia (insufficient blood flow);
- hypoxia (insufficient oxygen in the brain);
- hypo/hypertension (low/high blood pressure);
- cerebral edema (swelling of the brain);
- raised intracranial pressure (increased pressure within the skull), which can lead to herniation (parts of the brain are displaced);
- hypercapnia (excessive carbon dioxide levels in the blood);
- meningitis (infection of the meningeal layers) and brain abscess;
- biochemical changes (changes in levels of neurotransmitters, sodium, potassium, etc.);
- epilepsy.

Overview – Traumatic Brain Injuries

- An injury that disrupts the normal functioning of the brain
- Traumatic insult to the head that may result in injury to soft tissue, bony structures, or the brain
- Motor vehicle crashes are the most common MOI.
- Other common MOIs include assault, falls, and sports-related injuries.



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The CDC defines a traumatic brain injury (TBI) as a disruption in the normal function of the brain that can be caused by a bump, blow, or jolt to the head, or penetrating head injury.

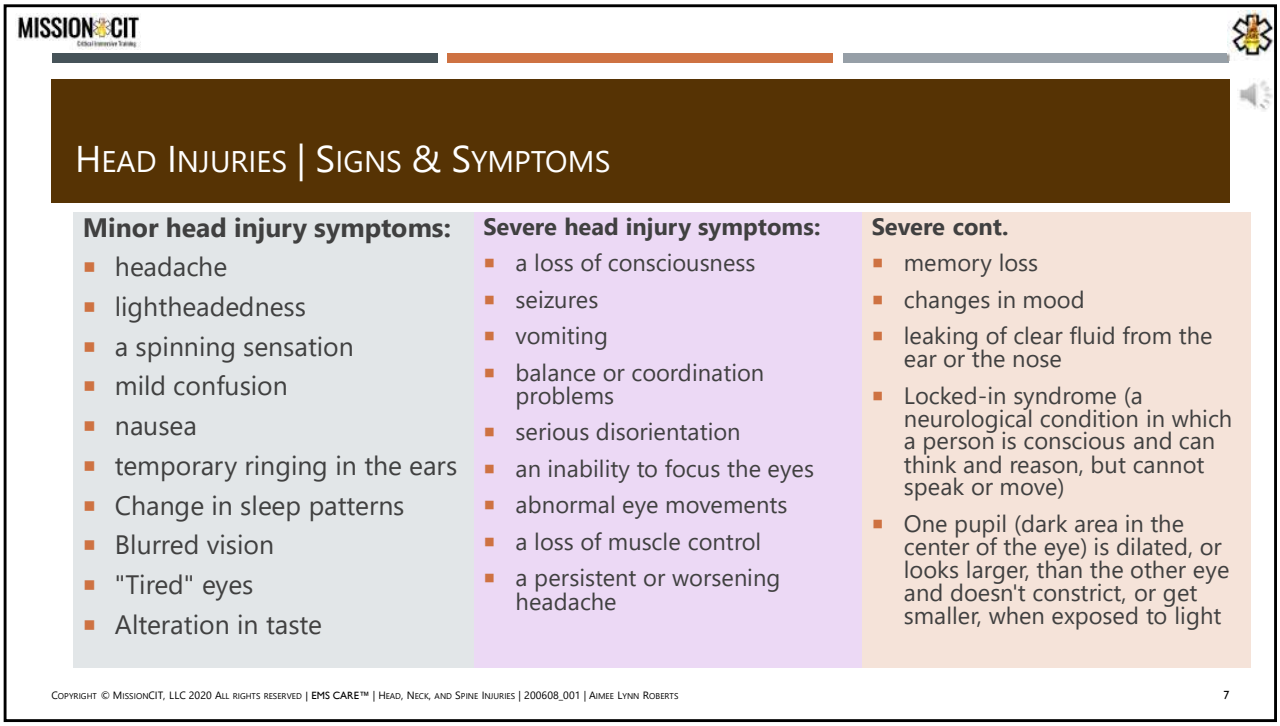
A TBI is caused by a bump, blow or jolt to the head or a penetrating head injury that disrupts the normal function of the brain. Not all blows or jolts to the head result in a TBI. The severity of a TBI may range from "mild," i.e., a brief change in mental status or consciousness to "severe," i.e., an extended period of

unconsciousness or amnesia after the injury.

With respect the bruising of the brain and the damage to the internal tissue and blood vessels, is often due to a mechanism called coup-countrecoup. A bruise directly related to trauma, at the site of impact, is called a coup lesion. As the brain jolts backwards, it can hit the skull on the opposite side and cause a bruise called a countrecoup lesion. The jarring of the brain against the sides of the skull can cause shearing (tearing) of the internal lining, tissues, and blood vessels that may cause internal bleeding, bruising, or swelling of the brain.

Motor vehicle crashes are the most common Method of Injury (MOI). Other common MOIs include assault, falls, and sports-related injuries.

Note that Head injuries account for more than half of all traumatic deaths. And Be alert to the fact that the patient may have sustained additional trauma.



Based upon the Method of Injury, the person may have varying degrees of symptoms associated with the severity of the head injury. The following are the most common symptoms of a head injury. However, each individual may experience symptoms differently.

As your read through the many symptoms, consider that the symptoms may be physical, cognitive, emotional or sleep related. Also, keep in mind that There are many causes of head injury in children and adults. The most common traumatic injuries are from motor vehicle

accidents (automobiles, motorcycles, or struck as a pedestrian), from violence, from falls, or as a result of child abuse. And that Subdural hematomas and brain hemorrhages can sometimes happen spontaneously.

Finally, consider that during your patient assessment, your role as an EMT is to not only to recognize TBI symptoms, but do your best to mitigate the effects of secondary brain injury. We'll speak more about this later as we discuss assessment, treatment and transport.

Scalp Lacerations

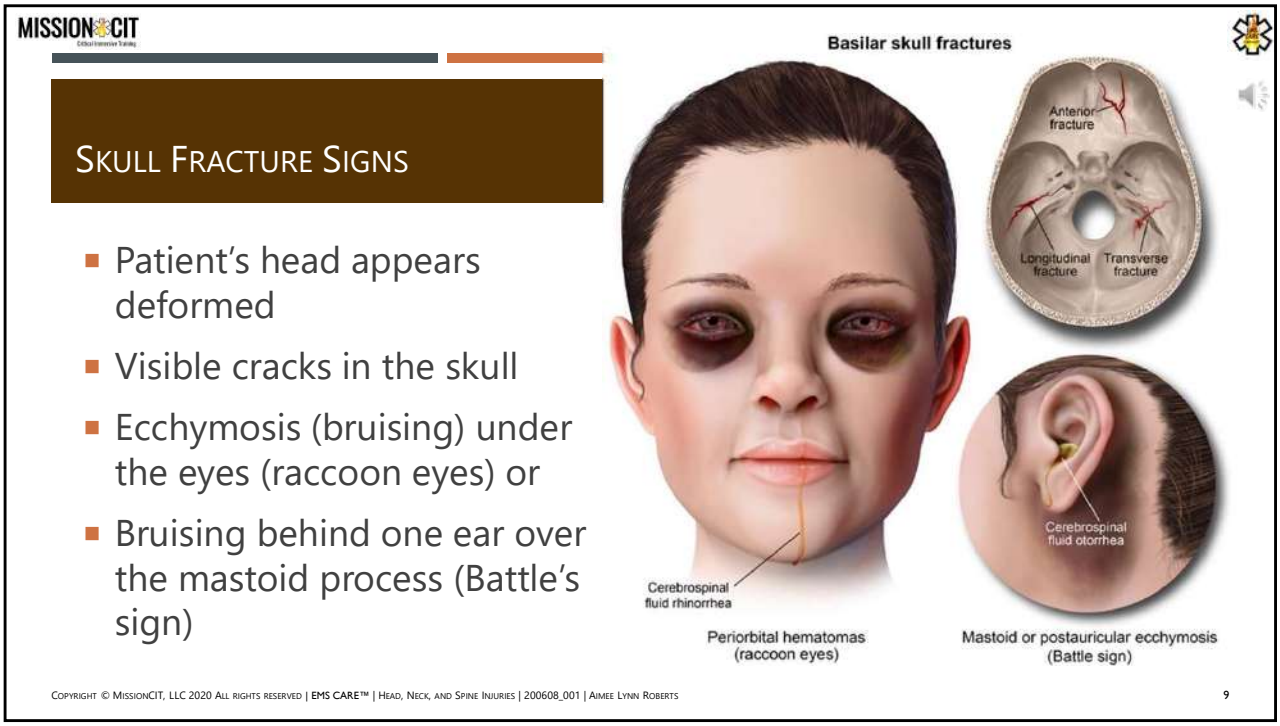
- Can be minor or serious
- Small lacerations can lead significant blood loss.
  - Especially in children



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A scalp laceration is a pattern of injury in which blunt forces result in a tear in the skin and underlying tissues. Lacerations in the scalp are different from lacerations in other parts of the face and body due to differences in the anatomy and blood supply. The scalp is lying on stretched skin tissue that lies on the bone that makes it more prone to be lacerated.

Scalp lacerations can be minor or serious. Even small lacerations can quickly lead to significant blood loss, especially in children.



Signs of a skull fracture include:

- The Patient's head appears deformed
- Visible cracks in the skull
- Ecchymosis or bruising under the eyes – often called raccoon eyes.
- Ecchymosis behind one ear over the mastoid process, also called Battle's sign.

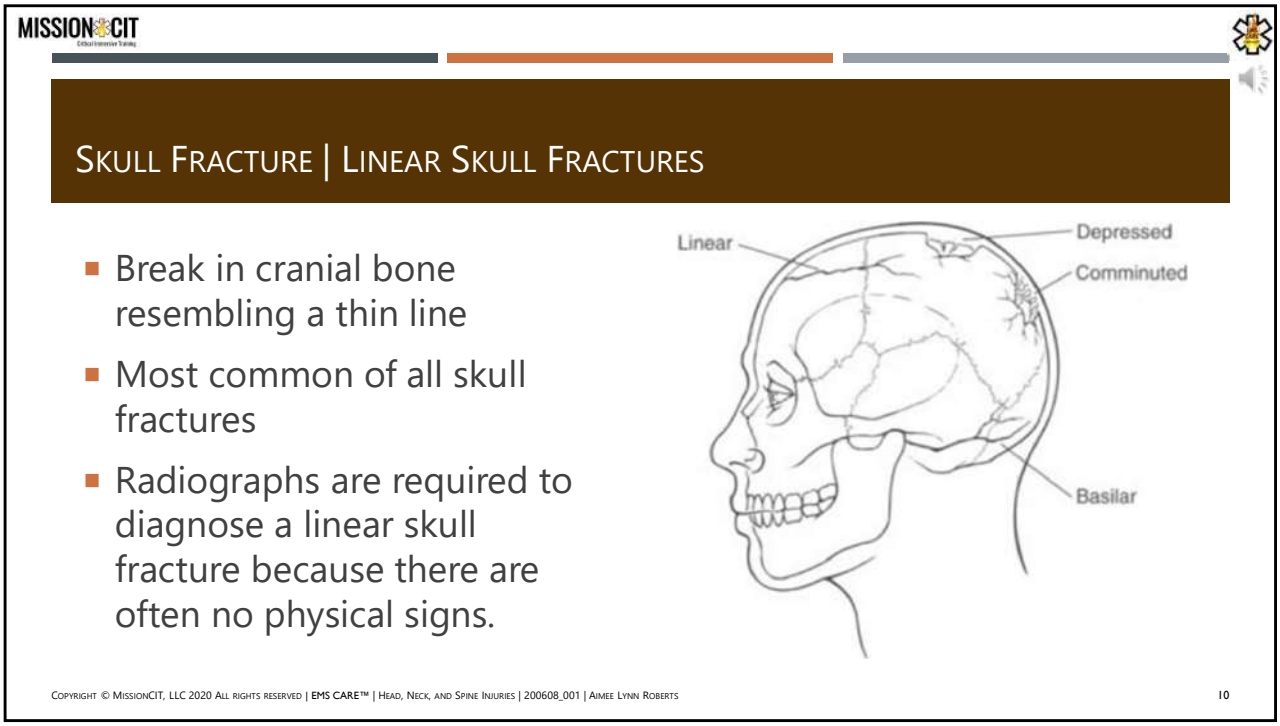
In people with a skull fracture, brain damage may be more severe than in people with a head injury but no fracture. How serious a skull fracture is depends partly

on the type and location of the fracture. Often, if skull bones break but remain in place, the brain is not damaged.

Some fractures, especially those at the back and bottom (base) of the skull, tear the meninges, the layers of tissue that cover the brain. Fractures at the base of skull, which is very thick, indicate that the injury was high-impact and brain damage is more likely.

If a fracture breaks the skin, bacteria may enter the skull through the fracture, causing infection and severe brain damage.

As we previously discussed, there are four types of skull fractures which we will review over the following slides.



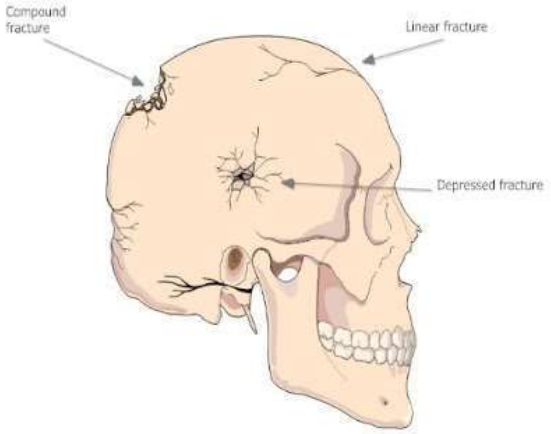
A linear skull fracture is a break in a cranial bone resembling a thin line, without splintering, depression, or distortion of bone. This is the most common type of skull fracture. In this skull fracture type the bone breaks, but does not move from its original placement. It does not require any kind of surgery or invasive intervention. Usually, patients with this skull fracture type are admitted to the hospital and kept under observation for a day as a precautionary measure.

Radiographs are often required to diagnose a linear skull

fracture because there are often no physical signs such as deformity.

Skull Fracture | Depressed skull fractures

- Sunken Skull
- Result from high-energy direct trauma to the head by a blunt object
- Bony fragments may be driven into the brain, resulting in injury



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In a depressed skull fracture, part of the skull is actually sunken in from the trauma. The injury occurs when the skull is penetrated, often by a sharp object, leaving broken pieces of the skull in contact with the brain. A depressed skull fracture is a type of comminuted fracture.

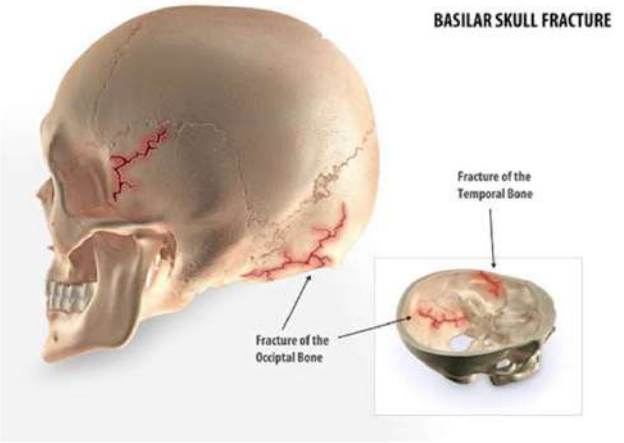
Depressed skull fractures often result from high-energy direct trauma to the head by a blunt object. The frontal and parietal bones of the skull are most susceptible. Patients often present with neurologic signs such as loss

of consciousness.

Compound depressed skull fractures occur when there is a laceration over the fracture, putting the internal cranial cavity in contact with the outside environment, increasing the risk of contamination and infection. In complex depressed fractures, the dura mater is torn. Depressed skull fractures may require surgery to lift the bones off the brain if they are pressing on it by making burr holes on the adjacent normal skull.

Skull Fracture | Basilar skull fractures

- Linear fractures at skull base.
- Associated with high-energy trauma
- Signs include CSF drainage from the ears, raccoon eyes, and Battle's sign



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Basilar skull fractures are linear fractures that occur in the floor of the cranial vault (skull base), which require more force to cause than other areas of the neurocranium.

This is the most serious type of skull fracture, and involves a break in the bone at the base of the skull. Patients with this type of fracture frequently have bruises around their eyes and a bruise behind their ear. They may also have clear fluid draining from their nose or ears due to a tear in part of the covering of the brain

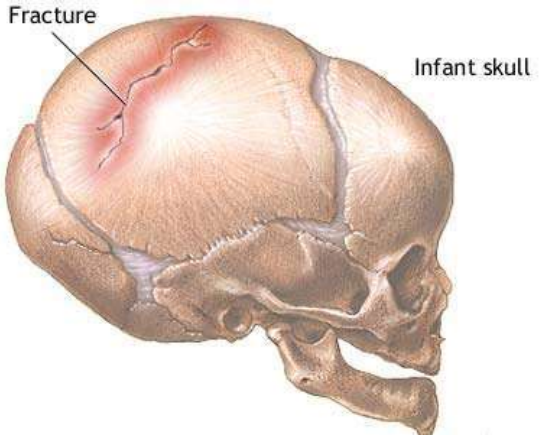
– called retroauricular ecchymosis known as "Battle's sign" which is bruising over the mastoid process.

Basilar skull fractures are associated with high-energy trauma, but usually occur following diffuse impact to the head. These injuries generally result from extension of a linear fracture to the base of the skull and can be difficult to diagnose without radiography.

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Skull Fracture | Pediatric Related

- Diastatic Fracture
  - Fractures along the suture line
- Growing Fracture
  - From tear in dura mater
- Cranial Burst
  - Infants less than 1 year



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Certain types of skull fractures are more associated with infants and children.

- Diastatic skull fractures occur along the suture lines in the skull. The sutures are the areas between the bones in the head that fuse when we are children. In this type of fracture, the normal suture lines are widened. These fractures are more often seen in newborns and older infants.
- Cranial burst fractures usually occurring with severe injuries in infants less than 1 year of age. It is a closed, diastatic skull fracture with cerebral extrusion

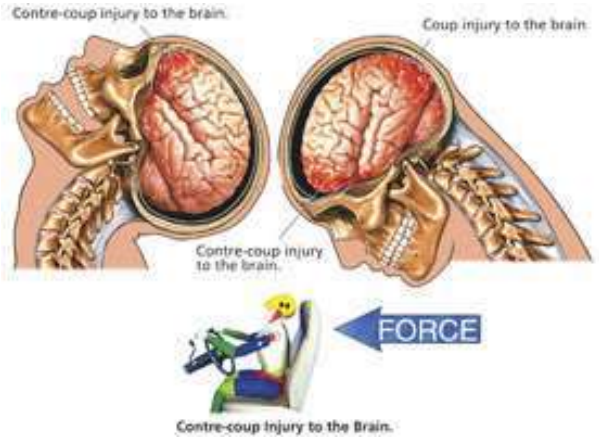
beyond the outer table of the skull under the intact scalp.

- Growing Skull Fracture is a rare complication characterized by progressive diastatic enlargement of the fracture line, seen mainly in infancy and early childhood. The primary causative factor is a tear in the dura mater.

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TRAUMATIC BRAIN INJURIES | REVIEW

- Most serious of all head injuries
- Two broad categories: primary (direct) injury and secondary (indirect) injury
- Primary brain injury results instantaneously from impact to the head.
- Secondary brain injury increases the severity of the primary injury.



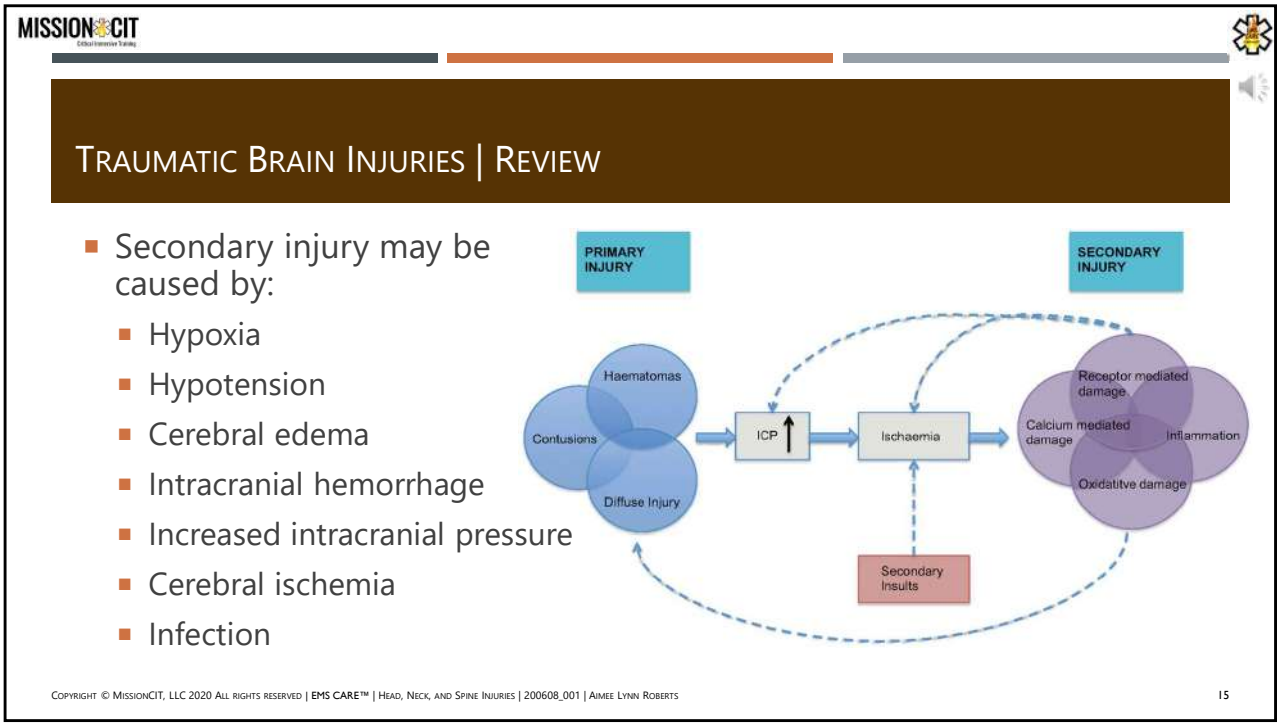
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So, lets review what we have learned about Traumatic Brain Injuries (TBI). These are the most serious of all head injuries.

They are Classified into two broad categories: primary or direct injury and secondary or indirect injury. A primary brain injury results instantaneously from impact to the head. A Secondary brain injury increases the severity of the primary injury and may result in a number of additional complications.

Traumatic brain injury occurs when a sudden trauma causes damage to the brain. TBI can result when the head suddenly and violently hits an object, or when an object pierces the skull and enters brain tissue.

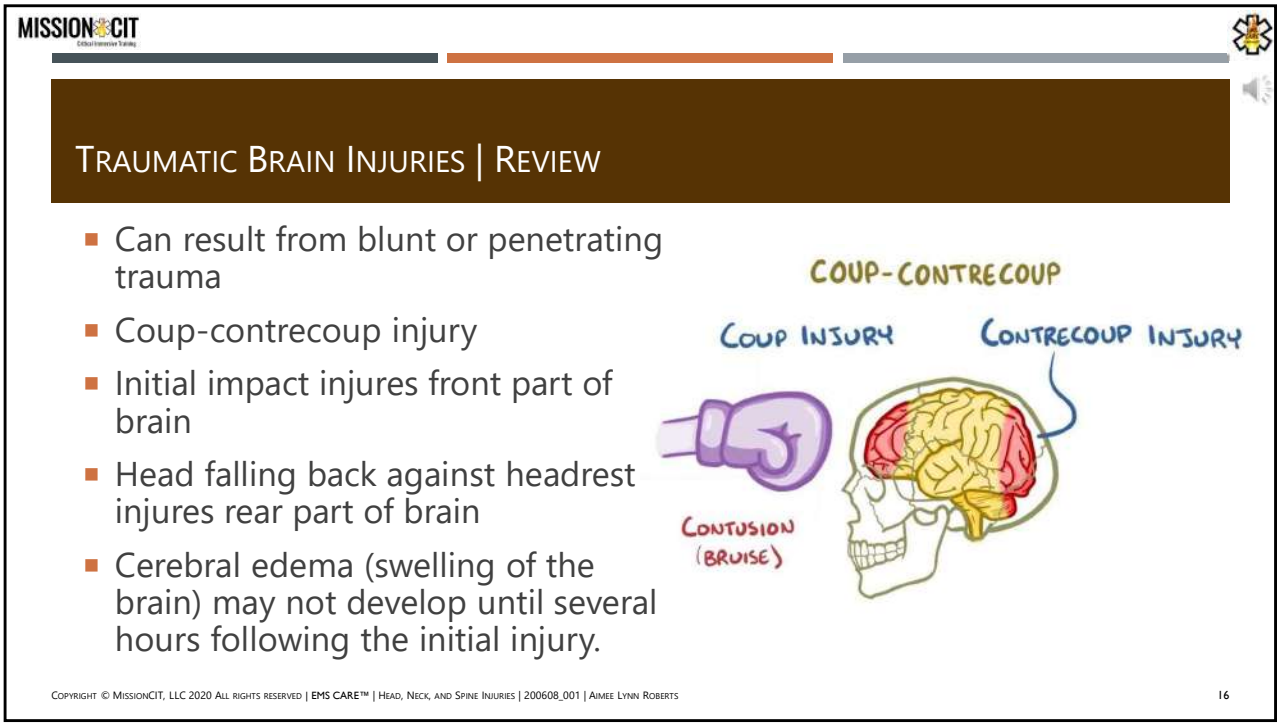
Symptoms of a TBI can be mild, moderate, or severe, depending on the extent of the damage to the brain. A person with a mild TBI may remain conscious or may experience a loss of consciousness for a few seconds or minutes.



Secondary brain injury increases the severity of the primary injury, and may be caused by:

- Hypoxia
- Hypotension
- Cerebral edema
- Intracranial hemorrhage
- Increased intracranial pressure
- Cerebral ischemia, or
- Infection

Hypoxia and hypotension are the two most common causes of secondary brain injury.



Continuing our review, TBI can result from blunt or penetrating trauma. A Coup-countercoup injury generally results from when an Initial impact injures the front part of the brain. As a result, the head falling back as in whiplash, injures the rear part of the brain.

A Cerebral edema or swelling of the brain may not develop until several hours following the initial injury. Cerebral edema is a life-threatening condition that causes fluid to develop in the brain. This fluid increases the pressure inside of the skull — more commonly referred to as intracranial pressure (ICP). We will discuss

ICP more in Part B of this topic.

When encountering a likely cerebral edema, monitor the patient's oxygen level. Low blood oxygen levels aggravate cerebral edema and can be minimized by maintaining high oxygen saturations.

Note that cerebral edema may also result from Stroke infection, tumors, drugs, viral infections, carbon monoxide poisoning and poisonous bites.

So, we have completed Part A of this lesson on Head Neck & Brain Injuries. I will be back with you shortly to continue with Part B.

Good Studying.