Linear and Depression fractures;

Description, etiology, management, outcome

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What we know about the skull?

- Skull contains three layers:
  - Lamina externa (compact)
  - Diploe (trabecular)
  - Lamina interna (compact)
Skull

- Thick bone sides
  - Glabella
  - External occipital protuberance
  - Mastoid process

- Thin bone sides
  - Where the skull is covered with muscles
Etiology

• In newborns (“ping-pong” depressed fracture)
  • During delivery (Baby’s head impinging against the mother’s sacral promontory)
  • The use of forceps

• In infants
  • Fall, abuse

• In children
  • Fall, bicycle accidents

• In adults
  • Motor vehicle accidents, violence, sport accidents
Signs and symptoms

- Pain, tenderness or swelling at the site of injury
- Contusions, lacerations or hematomas to the scalp
- Deformity of the skull
- Blood or CSF leaking from the ears, nose or mouth (otorrhea, rhinorrhea)
- Bruising around the eyes (raccoon eyes)
- Bruising behind the ears (Battle’s sign)
Diagnosis

• Radiographs: In 1987, the skull x-ray referral criteria panel decided that skull films are suboptimal in revealing basilar skull fractures.

• Skull x-ray has no benefit when a CT scan is obtained.

• CT scan: Standard modality, CT reconstructions are useful

• MRI/ MRA: Not in the standard, ancillary value

If CSF leak;

• Tissue paper test: A clear ring around the blood stain (halo sign)

• Biochemistry: Analyzing the glucose level and tau-transferrin ($\beta_2$)
Types of skull fractures

- Linear skull fracture
  - Diastatic skull fracture
  - Basilar skull fracture
  - Growing skull fracture
- Depressed skull fracture
- Compound skull fracture
Linear skull fracture

• Fracture line is transverse the full thickness of the skull from the outer to inner table

• No displacement of the bone

• Usually not associate with any neurological sign

• If fracture line is involve suture, venous sinus groove or vascular channel
  • Suture diastasis
  • Epidural hematoma (middle meningeal artery !)
  • Sinus thrombosis
  • Growing fracture in young kids !
Linear skull fracture

Occipital fracture
Diastatic fracture

- The fracture line transverses one or more sutures of the skull causing a widening of the suture

- Usually seen in infants and young children as the sutures are not yet fused

- In adults it usually affects the lamboidal suture
Diastatic fracture

Diastasis of coronal and sagittal sutures
Basilar skull fracture

- Linear fractures occur in the floor of the skull
- Require more force to cause than other areas of the cranium
- Blood may be seen in the paranasal sinuses
- Rhinorrhea, otorrhea, periorbital ecchymosis (raccoon eyes), retroauricular ecchymosis (Battle’s sign)
Basilar skull fracture

Fracture at the ethmoidal cells

Fracture at the anterior fossa
Basilar skull fracture

- Fractures of the petrous temporal bone
  - Ossicular chain disruption and conductive deafness (temporary)

- Transverse temporal bone fractures
  - VII nerve palsy (facial paralysis)
  - VIII nerve palsy (nystagmus, ataxia, permanent hearing loss)

- Occipital condylar fracture (type III)
  - Lower cranial nerve palsy
  - Cervical spine injury
Basilar skull fracture

Transverse temporal fracture

Longitudinal temporal fracture
Growing skull fracture

• Usually associated with linear skull fractures of the parietal bone in children under 3

• A diastatic enlargement of the linear fracture line with CSF accumulation outside of the skull
Growing skull fracture

Growing fracture at the parietal bone
Depressed skull fracture

• Broken outer layer is displaced inwardly to the inner layer place or more deeply

• A high risk of increased pressure on the brain

• Dural tear risk

• It can associate with subdural or intracerebral hematoma
Depressed skull fracture

Depressed fracture at the parietal bone

Depressed fracture at the temporal bone
Compound skull fracture

- A fracture occurs in conjunction with an overlying laceration which tears the epidermis and the meninges or runs through the paranasal sinuses and the middle ear structures.

- The outside environment being in contact with the cranial cavity.

- Compound fractures may either be clean or contaminated.

- The most serious complication is infection.

- Pneumocephalus may occur.
Compound skull fracture

Compound fracture at the frontal bone
Treatment

CONSERVATIVE

- Adults with simple linear fractures who are neurologically intact

- Infants with simple linear fractures should be admitted for overnight observation regardless of neurological status

- Temporal bone fractures with tympanic membrane rupture usually heals on its own

- Simple depressed fractures in neurologically intact infants

- Head elevation for cases with otorrhea or rhinorrhea

- Cervical collar for occipital condyle fractures (type I and II)
Treatment

MEDICAL

• Open fractures, if contaminated, may require antibiotics in addition to tetanus toxoid

• Seizure medications are recommended if the chance of developing seizures is higher than 20%

• Otorrhea, rhinorrhea might not need antibiotic prophylaxis
Treatment

SURGICAL

• Open depressed fractures

• Elevate depressed skull fractures; if the depressed segment is more than 5 mm below the inner table of adjacent bone

• Craniotomy may be performed if there is dural tear or hematoma

• Craniectomy may be need if the underlying brain is damaged and swollen

• Unstable condyle fracture (type III) needs stabilization procedure

• If CSF leakage do not heal with conservative treatment or spinal drainage
Prognosis/ Outcome

• In infants and children, a simple linear fracture, if associated with a dural tear, can lead to a growing skull fracture. (This may take up to 6 months to develop)

• The risk of infection is not high even without routine antibiotics after basilar skull fracture

• Sudden onset facial palsy at the time of fracture usually with poor prognosis

• If facial palsy starts with a 2- to 3-day delay is responsive to steroids

• Lower cranial nerves (IX, X, XI, and XII) may be involved in occipital condylar fractures
Prognosis/ Outcome

• The chance of a concomitant cervical spine injury is 15%

• Sphenoid bone fracture may affect the III, IV, and VI cranial nerves and also may disrupt the internal carotid artery and potentially result in pseudoaneurysm formation and caroticocavernous fistula

• The overall risk of seizures after depressed fracture is low but is higher;
  • if the patient loses consciousness for longer than 2 hours,
  • if an associated dural tear is present,
  • if the seizures start in the first week of injury
Thank you