CT of Maxillofacial Injuries

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Technology changes the diagnosis
Technologic Evolution

Topics to Cover

- Struts and buttresses
- Orbital fractures
- Naso-orbital ethmoid (NOE)
- Zygomaticomaxillary complex – (ZMC)
- Le Fort midface patterns
- Ocular
- Mandible
- Boom!
Facial Struts

Anterior coronal struts consisting of frontal (1), zygomaticofrontal (2), nasofrontal (3), anterior maxillary (4), anterior alveolar (5) components.

Posterior coronal struts consisting of posterior wall of maxillary sinus (1) and pterygoid plates (2).

Horizontal struts superior (1), middle (2), and inferior (3) parts.

Sagittal struts consisting of median (1), parasagittal (2), and lateral (3) parts.

Concept of Facial Buttresses

- Major support for facial skeleton to maintain form and function (I-beams)
- Attach directly or indirectly to skull base or cranium
- 3 vertical and 3 horizontal
- Buttresses accommodate screw fixation
- Maintain facial width and height
- Establish functional support (orbits and teeth)

Hopper RA, Sizemore S, Sze RW. Diagnosis of Midface Fractures with CT: What the Surgeon Needs to Know. Radiographics 2006; 26:793-793
Highlights of Facial Anatomy - Orbit

Orbital sutures and thin orbital bony plates allow suture diastasis and fractures of thin bone to absorb impacting energy.

This mechanism plus orbital fat and muscles cushions the globe and preserves vision in high-energy impacts to the orbit.

Orbital Blow-out Fractures:
Significant Imaging Features

- Evidence of muscle or fat entrapment (position/shape of muscle)
- Pure or impure fracture (?intact inferior orbit rim)
- Orbital hematoma (up to 24% orbital injuries)
- Complications: enophthalmus, diplopia, hypoesthesia
- Size (area) of floor defect or associated fractures
- Calculations of blow-out fractures of the orbital floor by 3D-CT and 2D-CT method are accurate for assessing the area of fracture

Orbital blow-out fracture

Orbit Blow-out Fracture
Herniated Inferior Rectus

Orbit Blow-out Fracture
Isolated or associated 20-40% with floor fracture
More common to cause orbital emphysema
Rarely surgically repaired
Complications: Horizontal gaze palsy, enophthalmous, epistaxis
Medial wall fracture - entrapment

Medial blow-out with herniation
Orbital Blow-in fracture

Orbital Blow-in fracture: MRI with brain herniation
Orbital Blow-up fracture

- Rare
- Orbital roof fragments explode into frontal lobe
- Typical – dural tears and CSF leak
- Frontal sinus involvement common
Orbital Blow-up fracture

Naso-orbital-ethmoid Complex

- Nasal bridge, lower frontal sinus, medial orbits
- Comminution, depression, and lateral spread of bones
- Soft tissue injury; medial canthal ligament, lacrimal drainage, nasofrontal sinus
- Usually associated
Naso-orbital Ethmoid Fractures

- N = 21
- Clinical findings:
  - Widened intercanthal distance (71%)
  - Increased nasofrontal angle (28%)
  - Epistaxis (100%)
  - Visual disorder (62%)
  - Cerebrospinal rhinorrhea (33%)
  - Enophthalmos (23%)
  - Facial paralysis (14%)

Naso-orbital-ethmoid Complex
Naso-orbital-ethmoid Complex

NOE and repair
Nasomaxillary Fracture

Kicked by horse

Sagittal mid-face pattern
Zygomatic-maxillary Complex (ZMC)

- Impact on malar eminence
- 4-point fracture
- Displaces posterior and medially
- Simple type vs. hi-grade variant

- Always involves orbital floor
- May involve medial orbit wall
- Lateral canthal ligament and inferior orbital nerve
- Coronoid process impact
Zygomatic-maxillary Complex (ZMC) – hi-grade
Optic neuropathy and ophthalmoplegia

- Loss of cranial nerves II, III, IV, opthalmic division of V, and VI
- Blindness, fixed dilated pupils, proptosis, ptosis

- Causes: inflammatory, infectious neoplastic, iatrogenic/traumatic, and vascular conditions
LeFort Fracture Patterns

- Described as symmetric mid-face lines of weakness - experimental
- Often asymmetric clinically and combined with ZMC, NOE
- Always involves pterygoid plate fractures
- Higher energy usually leads to higher grade
- Any pattern of Lefort 1,2,3 fractures can occur

In 1901 the French surgeon, Dr. Rene LeFort (1869-1951), French army surgeon from Lille, published his results from experiments aimed to describe fracture patterns. He performed a number of experiments on cadaver heads. These experiments included blows to the cadaver head at different angles with a wooden club. He also hurtled the head against stationary objects and kicked it in various places in the face.
LeFort Fracture Patterns

LeFort Fracture 1

- Fracture all 6 walls of maxillary sinuses
- Floating palate
- Typically: nasal septum & maxillary nasal spine
- Airway compromise - rare
LeFort Fracture I +

- Mobile nose and maxilla (a portion of the upper transverse maxillary buttress [orbital rim] is involved in mobile segment)
- Fx. Lateral maxillary sinus, medial orbital floor, nasal bridge, pterygoids (pyramidal)
- Soft tissues: medial orbit, infraorbital nerve

LeFort II Fracture Patterns
Unilateral LeFort 2/3

LeFort Fracture III
LeFort Fracture III

Lefort II/III: highly comminuted
GSW through the medial orbit – monocular blindness
Mandibular Fractures

<table>
<thead>
<tr>
<th>Fracture Type</th>
<th>Prevalence</th>
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<tbody>
<tr>
<td>Body</td>
<td>30 - 40 %</td>
</tr>
<tr>
<td>Angle</td>
<td>25 - 31 %</td>
</tr>
<tr>
<td>Condyle</td>
<td>15 - 17 %</td>
</tr>
<tr>
<td>Symphysis</td>
<td>7 - 15 %</td>
</tr>
<tr>
<td>Ramus</td>
<td>3 - 9 %</td>
</tr>
<tr>
<td>Alveolar</td>
<td>2 - 4 %</td>
</tr>
<tr>
<td>Coronoid process</td>
<td>1 - 2 %</td>
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Mandibular Angle Fracture
ORIF angle/body fx – oops!

Mandibular Fracture – Dislocation
Mandibular Fracture - Dislocation

Mandible fracture-dislocation (sagittal split)
LeFort I/II/III: Comminuted mandible fractures

Bilateral TMJ dislocation - yawning
Attempted suicide: Bit blasting cap

GSW: Facial explosion
Fibular graft reconstituting maxillary contour