MANDIBLE FRACTURES:
EVALUATION AND MANAGEMENT

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OVERVIEW

- Review of anatomy
- Review of occlusion
- Types and locations of fractures
- Patient evaluation and initial management
- Definitive Management
  - Timing of fracture repair
  - Maxillomandibular fixation
  - Open reduction and internal fixation (ORIF)
- Post-operative care
- Complications
ANATOMY

- **Regions**
  - Symphysis
  - Parasympyseal region—spans canine to canine
  - Body—from canine to angle
  - Alveolar process—contains teeth, resorbs if teeth are lost
  - Angle—non-tooth bearing region between body and ramus
  - Ramus
  - Condyle
  - Coronoid process

- **Inferior alveolar/mental nerves**

- **Muscle attachments**

- **Weak points**
  - Condylar neck
  - Angle—especially if third molar is present
  - Mental foramen

Cummings/Ballenger
OCCLUSION

Angle’s Classification

Class I: mesiobuccal cusp of the maxillary first molar rests within the mesiobuccal groove of the mandibular first molar

Class II: maxillary molar is more anterior (retrognathic)

Class III: maxillary molar is more posterior (prognathic)

Small Figure—Ballenger’s Fig 55-1
Large Figure—Myer’s Fig 92-5
CROSSBITE

- Normal: maxillary buccal cusps lie lateral to the mandibular buccal cusps
- Lingual crossbite: maxillary buccal cusps are positioned medially
- Buccal crossbite: maxillary buccal cusps are positioned laterally
FRACTURE CLASSIFICATION

- Simple/Compound/Comminuted/Greenstick
- Anatomic location
- Dentition status
- Stability
FRACTURE CLASSIFICATION

- **Simple**
  - Oral mucosa and external skin are intact

- **Compound (open)**
  - Laceration of mucosa or skin is present
  - Fracture passes into a tooth root

- **Greenstick**
  - Involves only one cortex
  - Most common in children

- **Comminuted**
  - Multiple fragments of bone
FRACTURE CLASSIFICATION

Anatomic location

- Condyle
  - Head
  - Neck
  - Subcondylar region

- Body
- Angle
FRACTURE CLASSIFICATION

• Dentition status
  • Dentulous
  • Edentulous
    • Decreased mandibular height
    • Tenuous blood supply
    • Superficial location of the mental foramen
    • Accuracy of re-approximation less important
• Pediatric
  • Uninterrupted dentition must be avoided
  • Deciduous teeth hold wire poorly
- Stability: Favorable vs unfavorable
  - Due to upward forces of the temporalis and masseter and downward forces of the suprahyoid musculature
  - Almost all angle fractures are unfavorable

Favorable (A) vs unfavorable (B) fractures.

Temporalis and masseter forces on the proximal fragment, and gastric/suprahyoid musculature forces on the distal segment, stabilize the fracture in A but destabilize it in B.
Patient Evaluation

• ABC’s take precedence

• Airway
  • Integrity must be ensured
  • Sources of compromise
    • Soft tissue swelling
    • Nasal/oral/oropharyngeal bleeding
    • Bilateral mandible body fractures—loss of tongue support
    • Concomitant laryngeal/tracheal injuries
  • Low threshold to establish a definitive airway
    • Intubation
    • Tracheotomy
PATIENT EVALUATION

- Cervical spine injury
  - Must be ruled out in all patients
  - Rate is 5% to 8% if an isolated facial fracture is present
  - Rate is 7 to 11% if 2 or more facial fractures are present
  - Stabilize cervical spine with C-collar at presentation

PATIENT EVALUATION

• History
  • Often limited by patient being intubated, unconscious, intoxicated, etc
• Mechanism
  • Assault, motor vehicle collision, fall, gunshot
• If patient is conscious and cooperative, assess for:
  • Presence/location of pain
  • Subjective malocclusion
  • Trismus
  • Intraoral bleeding
  • Numbness, particularly in the mental nerve region
PATIENT EVALUATION

• Physical Examination
  • May be limited by swelling, hematoma, C-collar, tubes
  • First assess the general appearance of the face
    • Note lacerations, ecchymoses, edema, areas of distortion
      • Chin lacerations indicate possible subcondylar fractures
  • Palpate the mandible, note sensitive regions, mobility
    • Include palpation of the condylar heads through the external auditory canals—pain may indicate presence of condylar head fracture
  • Note intraoral mucosal tears, ecchymoses, bleeding
  • Occlusion
    • Quality of dentition, tooth involvement in fracture lines, fractured teeth
    • Missing teeth—if acute, chest x-ray is needed
    • Look for deviation of the mandible, premature molar contact, open bite, crossbite, trismus
  • Full cranial nerve examination if patient is conscious, with special focus on cranial nerves V and VII
PATIENT EVALUATION

- Radiography
  - Panoramic tomography (Panorex)
    - Superior sensitivity for mandible fractures than 3 mm CT scans
      Preferred by some surgeons as the sole imaging modality of the mandible
  - Non-contrasted maxillofacial computed tomography (CT)
    - 1 mm fine cuts have superior sensitivity to Panorex (100% vs 86%)
    - Usually obtained in patients due to need to evaluate for other facial fractures
    - 3-D reconstructions can be rendered and are helpful in some cases, such as comminuted fractures
Grainger & Allison’s, Fig 63.41; right parasympheseal and left angle fractures; note full condyle view
• Right parasymphyseal and left ramus fractures.
- Right ramus and left anterior body fractures
- Marx: Rosen’s Emergency Medicine, Figure 39-7
MANAGEMENT
INITIAL MANAGEMENT

- With rare exception, mandible fractures are not surgical emergencies
- If surgical intervention is needed, it should be undertaken as soon as it is safe to do so
- Soft diet
- Pain control
- Antibiotics for all open fractures (includes fractures involving tooth roots)
  - Penicillins, cephalosporins, and clindamycin are appropriate options
Timing of repair

- Champy and others once advocated repair within 24 hours
- Often not feasible, commonly resulting in delays
- Barker et al, Laryngoscope 2011, University of Virginia
  - Retrospective chart review of 83 patients over 5 years
  - Mean time to fixation was 6.7 days
  - No correlation found between increased time to repair and rate of complications (infection, nonunion, malunion)
  - Trend found between fewer complications and increasing time to surgical repair

ANTIBIOTICS

• Numerous studies have shown no benefit with routine use of post-operative antibiotic therapy beyond 24 hours

• There is, however, evidence to support pre and perioperative antibiotic use
  • Any fracture extending to the dentoalveolar ridge is an open fracture and requires antibiotic therapy
  • Closed condyle fractures do not require antibiotics

• Ancef 1 g IV prior to surgery then one additional dose 8 hours later
  • Reduced mandible fracture infection rate from 42% to 14% in a prospective clinical trial by Chole and Yee

Prior to routine antibiotic use, pulling an involved tooth was recommended to reduce the incidence of infection.

Current recommendations are to remove a tooth in the fracture line if it is carious, if the tooth or its root are fractured, or if the presence of the tooth is preventing proper fracture reduction.

Removal of the third molar tends to destabilize angle fractures and should be avoided if possible.
DEFINITIVE MANAGEMENT

- Soft diet
  - Optimal treatment for some non-displaced ramus fractures and subcondylar fractures
  - Must be no malocclusion

- Closed reduction—maxillomandibular fixation (MMF)
  - Arch bars
  - Eyelet wires
  - IMF screws

- Open reduction and internal fixation (ORIF)
  - Mini plates vs larger reconstruction plates
  - Lag screws
GENERAL PRINCIPLES

- Restore the patient’s pre-morbid occlusion
- Repair both skeletal and soft tissue injuries
- Use lacerations when possible
- Use mucosal incisions when possible
- Reduce all fractures
- Stabilize fractures
- Fixate all fractures adequately to allow bone healing
CLOSED REDUCTION: INDICATIONS

- Nondisplaced favorable fractures
- Pediatric fractures
  - Open reduction best avoided due to risk of injuring tooth buds
- Grossly comminuted fractures
  - Avoids periosteal stripping of the bone fragments
- Condyle fractures
  - Controversial, though closed treatment is generally appropriate
  - Bilateral condyle fractures can result in loss of mandibular height if closed reduction is the only treatment
CLOSED REDUCTION: CONTRAINDICATIONS

• Compromised pulmonary function
  • Severe asthma
  • Severe COPD

• Poorly controlled seizures

• Severe nausea

• Psychiatric or neurologic disorders
CLOSED REDUCTION

Erich arch bars
- Standard for MMF
- Use 24 gauge circumdental wire to fasten each bar to the dentition
- Lugs must open AWAY from the crowns of the teeth
- Place patient in maximum intercuspation and place MMF wires or elastics

Text from Resident Manual

Ballengers: Fig 55-17
CLOSED REDUCTION

IMF screws
- 2.5 mm self-drilling and self-tapping screws
- Placed adjacent to the canine tooth roots
- Alternative if arch bars cannot be applied or for temporary MMF during ORIF

AO foundation website
ORIF: INDICATIONS

- Displaced unfavorable angle fractures
- Complex facial fractures requiring a stable mandibular base
- Atrophic edentulous mandibles with minimal cancellous bone, and poor osteogenesis and healing potential
- Some condyle fractures
  - Absolute indications
    - Displacement into the middle cranial fossa or EAC
    - Inability to obtain adequate occlusion
    - Lateral extracapsular dislocation
    - Contaminated open joint wound
ORIF: APPROACHES

- Intraoral
  - Preferred
  - More direct
  - No external scars
  - Low risk to the facial nerve
  - Disadvantage—decreased exposure

- External
  - Improved exposure of the posterior body, angle, and ramus
  - Often required for severely comminuted fractures
  - Disadvantages—cervical scar, risk of injury to branches of the facial nerve

- Approach chosen should allow adequate exposure to reduce and immobilize the fracture(s)
ORIF: COMPETING PRINCIPLES

- Arbeitsgemeinschaft für Osteosynthesesfragen (AO)
  - Large, load-bearing plates
  - Bicortical screws

- Champy
  - Small, load-sharing plates
  - Monocortical screws
ORIF: COMPETING PRINCIPLES

• Bouloux et al (Emory), J Oral Maxillofac Surg, 2012
  • Randomized, nonblinded, prospective trial over 2 years
  • 127 initial patients, 53 of whom completed the required follow up
  • Exclusions: clinical infection, previous treatment, comminuted fractures, condyle fractures, gunshot injuries, mandibular atrophy
  • Two groups: AO (control) and Champy (experimental)
  • All received perioperative antibiotics, follow up was at least six weeks, and no MMF was used
  • Top fracture types
    • 42% had a left angle fracture
    • 23% had a right parasymphyseal fracture
    • 19% had a right angle fracture
  • Primary outcome: fracture union status at 6 weeks
    • 81% union in the AO group and 89% in the Champy group (P = 0.95, not significant)
  • Complications—no significant difference between groups
    • Infection—AO 15% vs Champy 11% (P = 0.70)
    • Hardware removal—AO 4% vs Champy 19% (P = 0.19)
    • Prolonged antibiotic therapy—AO 12% vs Champy 4% (P = 0.35)
- Intraoral vestibular approach best
- Arch bars placed and MMF wires secured prior to incision
- Incision is made from canine to canine, leaving at least a 1 cm cuff of tissue from the mucogingival junction for closure
- Dissection carried to bone
- Freer used to dissect below the periosteum to the inferior border of the mandible
- Mental nerves identified and preserved
- Fracture line debrided, reduced, and MMF tightened
- Four hole 2.0 mm system titanium plate secured just below the tooth roots with monocortical screws
- Four to six hole 2.3 to 2.7 mm system titanium plate is shaped to the lower border of the mandible and secured with at least two screws on each side
- MMF wires cut and occlusion checked; if satisfactory, incision is closed.
- If no other fractures require the arch bars, they are also removed prior to closing
BODY FRACTURES

- Intraoral approach best
- Arch bars placed and MMF wires secured prior to incision
- 5 cm incision made in the gingivobuccal sulcus over the fracture, leaving a 1 cm cuff of tissue from the mucogingival junction for closure
- Mucosa only incision made anteriorly; blunt dissection used to identify and dissect out the mental nerve from the labial flap of tissue
- Dissection carried to bone
- Freer used to dissect below the periosteum to the inferior border of the mandible
- Mental nerves identified and preserved
- Fracture line debrided, reduced, and MMF tightened
- Four hole tension band secured between the tooth roots and mental foramen with monocortical screws
- Larger 2.3 to 2.7 mm system titanium plate is shaped to the lower border of the mandible and secured anteriorly through the intraoral incision with 2-3 screws. If needed, a percutaneous drill guide is placed in the cheek to reach the posterior screw holes and 2-3 screws are placed
- MMF wires cut and occlusion checked; if satisfactory, incision is closed.
- If no other fractures require the arch bars, they are also removed prior to closure of the incision
ANGLE FRACTURES

- Non-displaced fractures can be treated with MMF x 6 weeks
- Intra-oral approach is similar to approach for a body fracture, with incision more posterior and extended superiorly over the external oblique ridge
- Arch bars placed prior to incision, but MMF is performed after dissection
- Fracture line is exposed and reduced
- Plating options include two mini plates, a superior mini plate and heavier lower plate, and a 2 mm 8 hole strut plate
- Percutaneous drill guide is required to drill holes and place the screws
ANGLE FRACTURES

- **External approach**
  - 5 cm incision is made 2 to 2.5 cm below the angle of the mandible and extended posterosuperiorly toward the earlobe.
- Deep subcutaneous dissection is performed inferiorly on top of the platysma.
- Platysma is incised inferiorly and dissection is carried down to the posterior belly of the digastric.
- Once the digastric is identified, dissection is carried superiorly to the inferior border of the mandible.
- Periosteum is incised and a freer is used to elevate the periosteum from the bone, exposing the fracture.
- Fracture is debrided and reduced, and the patient is placed in MMF.
- Plating options include two mini plates, a superior mini plate and heavier lower plate, and a 2 mm 8 hole strut plate.
- After plating, MMF is released and occlusion checked; if satisfactory arch bars are removed unless needed for other fractures.
- Intraoral incisions closed with chromic or vicryl suture.
- For external approach, platysma is closed with a running locking vicryl suture, deep dermal interrupted monocryl sutures are placed, and the skin is closed with 5-0 FAST gut or 5-0 nylon/prolene running suture.
RAMUS FRACTURES

- Most ramus fractures can be treated with MMF x 6 weeks
- Intraoral plating is very difficult
- External approach for plating is similar to that of angle fractures
CONDYLE FRACTURES

- Most condyle fractures can be treated with MMF x 2-4 weeks
- If the head is involved, MMF is limited to 2 weeks to prevent TMJ ankylosis
- Frequent scenario is a condyle fracture with contralateral parasympyseal, body, or angle fracture—treat contralateral fracture with ORIF and condyle fracture with MMF x 2-4 weeks
- When plating is required, an external approach is preferred
- External approach is similar to the angle approach but with the superior end of the incision brought to about 2 cm from the earlobe
CORONOID FRACTURES

- Uncommon, usually associated with a ZMC fracture
- No treatment is required in the majority of cases
• Wire cutters kept at bedside upon leaving the OR and sent home with the patient

• No benefit to extending antibiotics beyond 24 hours post-op

• Oral hygiene is stressed to the patient
  • Daily brushing of teeth and arch bars
  • Water pick is very effective

• Dental wax to protect the buccal mucosa

• Some authors advocate weekly follow up until arch bars are removed
INFECTION

- Occurs in 10-15% of patients

- No significant decrease in the infection rate with extended post-op antibiotics

- Thought to result from fracture instability and movement instead of contamination with oral flora

- Predisposing factors
  - Local
    - Poor reduction/immobilization
    - Poorly closed oral wounds
    - Fractured teeth in the fracture line
    - Diminished blood supply
    - Devitalized tissue
    - Comminuted fractures
  - Systemic
    - Alcoholism
    - Poorly controlled DM
    - Immunocompromise

- Treatment is surgical drainage, removal of infected hardware, and prolonged antibiotic therapy

- Placement of a heavy reconstruction plate may be required
NONUNION

• Occurs in 3-5% of fractures

• Most common cause is inadequate reduction and immobilization

• Treatment
  • Control infection if present
  • Debride devitalized tissues
  • Remove hardware, freshen fracture ends, and place a new heavy plate
  • Place bone graft if needed
MALUNION

• Improper alignment of the healed bony segments
• Caused by improper reduction, inadequate occlusal alignment, and inadequate stability of the fracture
• May be clinically insignificant if occlusion is good
• Treatment
  • Minor discrepancies can be treated with orthodontics
  • Major discrepancies require open surgical repair with refracturing and/or osteotomies
• Mandibular condyle fuses to the glenoid fossa

• Predisposing factors
  • Intra-articular hemorrhage
  • Condyle head fracture

• Prevention
  • Shorter period of MMF (2-3 weeks)
  • Physiotherapy

• Definitive treatment may require arthroplasty or total joint replacement
• Inferior alveolar nerve frequently injured when fracture involves the mandibular canal

• Mental nerve at iatrogenic risk especially during parasymphysseal and body fracture repairs

• Important to document deficits prior to surgery
Facial Nerve Injury

- In a trauma patient, the nerve can be injured anywhere along its course.
- Main trunk can be injured from fractures or surgery around the condylar neck.
- Marginal mandibular branch at risk during submandibular external approaches.
- Frontal branch at risk if an external pre-auricular approach is used.
- Facial nerve function should be documented prior to surgery.
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