

# Facial Trauma- Mandibular Fractures /P.1

## Fracture classification

The basic orthopedic classification:

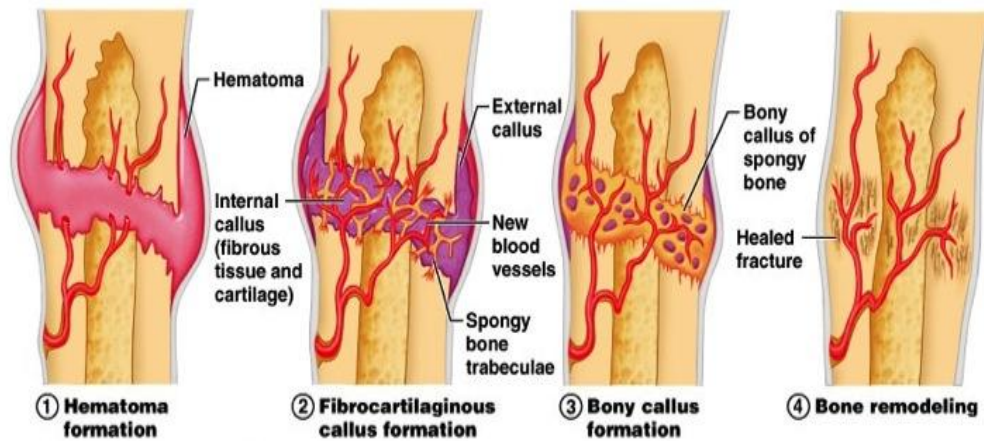
- 1. Simple (closed):** These include closed linear fractures, not opened into the skin or into the oral cavity or into the sinonasal cavities, such as # of the condylar process, coronoid process and ramus of the mandible, and # of the body of the edentulous mandible.  
**The 'greenstick' fracture** is a rare variant of the simple fracture and is found exclusively in children, when only one cortex is fractured with the other being bent.
- 2. Compound (Opened):** Fractures of the tooth-bearing portions of the mandible and midface are nearly always open into the mouth via the periodontal membrane. More rarely, fractures may be compound through the overlying skin. Nasal and zygomatic fractures are technically 'open' into the sinonasal airway tract.
- 3. Comminuted:** A comminuted fracture is one where the bone is fragmented into multiple pieces. This usually requires considerably more energy than does a simple fracture. Direct violence to the mandible from penetrating sharp objects and missiles may cause limited or extensive comminution. Such fractures are usually compound and may be further complicated by bone and soft tissue loss.
- 4. Pathological:** Fractures are termed pathological when they result from minimal trauma to a bone already weakened by a pre-existing pathological condition (such as osteomyelitis, neoplasms or generalized skeletal disease). In the face this is most commonly seen in the mandible.

## Fracture Healing

- A fracture is defined as a break in the continuity of the bone which happens either as a result of violence or because the bone is unhealthy and unstable to withstand normal stresses.
- The healing process following a fracture can be considered as two aspects; healing of the soft tissues and healing of the bone. The entire healing process relies heavily on the viability of the 'soft tissue envelope', specifically its blood supply. If the blood supply is compromised, there will be greater chances of infection, non-healing and bone loss.
- Bone healing occurs in two ways direct and indirect. Direct bone healing requires sufficient bone to bone contact and no mobility across the fracture line, Compression across a fracture is believed to facilitate this healing. Unfortunately in the face this is only possible in the mandible, because direct

healing requires heavy plates and large screws to achieve the necessary degree of rigidity and compression.

- Indirect healing is a different process and occurs across a fracture where some degree of mobility persists. This is seen in limbs treated with orthopaedic casts and is the natural healing process seen in land mammals. The indirect healing starts as Initial hematoma formation that is followed by the ingrowth of fibrovascular tissue. Gradual ossification occurs and the fracture is encased by 'immature bone' or callus which is replaced by the remodeling process into the lamellar or 'mature' bone.



- Owing to its prominence, the mandible is more commonly fractured than the midface.
- The force required to produce mandibular fracture is much higher than that of the maxilla, fractures of the midface have been shown to occur with forces between one fifth and one third of those required to produce simple fractures of the mandible.
- Precise anatomical reduction is not essential in every case. Because of the relatively thick soft tissue coverage of the lower jaw, minor discrepancies in imprecisely anatomically reduced fractures are generally not detected.

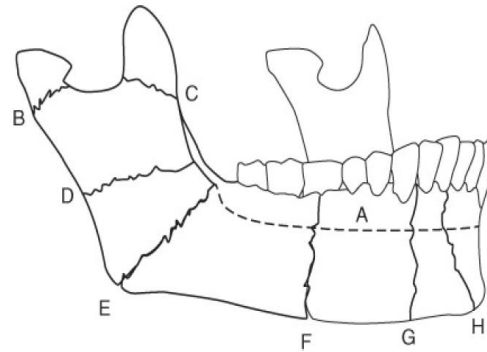
## Surgical Anatomy

- ✓ The mandible has two vertical rami that are joined together by a horseshoe shaped strut of tooth supporting bone (alveolar bone). Each ramus carries two processes: the condyle, which articulates with the glenoid fossa to form the temporomandibular joint, and the coronoid process that receives the insertion of the temporalis muscle. The condylar head is supported on a relatively slender condylar neck – a frequent site for fracture.
- ✓ Anatomically, the lower jaw is divided into a number of areas that also correspond to sites at which fractures usually occur; therefore the Mandibular fractures classified (as the below diagram illustration) into:

### A. Dentoalveolar

### B. Condylar (the most common)

- C. Coronoid
- D. Ramus
- E. Angle
- F. Body (molar/premolar area)
- G. Parasymphysis
- H. Symphysis(H).



### Anatomical Considerations:

#### ▪ Periosteum

- The periosteum is a most important structure in determining the stability of a mandibular fracture.
- The periosteum of the mandible is a tough fibrous membrane, and gross displacement of fragments cannot occur if it remains intact and attached to the bone.
- Once the periosteum has been breached by injury or surgical exposure, displacement and movement of the bones can occur more easily under the influence of the attached muscles.

#### ▪ Teeth

- The teeth play a major role in determining where the fracture occur, the long canine tooth and partially erupted or unerupted wisdom teeth, teeth sockets present lines of relative weakness, the teeth themselves are a potential source of infection in many mandibular fractures.
- However, any fracture of the mandible with a tooth in the fracture line is nevertheless a compound fracture and the tooth which may have been devitalized, represents a potential source of infection.

#### **indications for removal of a tooth from the fracture line:**

1. Fracture involving the root.
2. Presence of periapical infection.
3. Advanced periodontal disease.
4. Acute pericoronitis.
5. Infected fracture line.
6. A displaced tooth prevents reduction of the fracture.

#### ▪ Nerves and blood vessels

1. The *inferior alveolar nerve and vessels* enter the bone via the mandibular foramen, passing forward through the inferior dental canal, which provide sensory innervation and nutrition to the lower teeth.
2. The *mental nerve* exits the mandible through the mental foramen in the premolar region providing sensory innervations to the lower lip, when damaged; results in paraesthesia of lower lip.

3. **Branches of the facial nerve** lie superficial to the mandibular ramus and are vulnerable to direct trauma to this area. Occasionally the marginal mandibular division of the facial nerve is damaged in association with a fracture of the body or angle.
4. Blood vessels include the **inferior dental artery** which is associated with brisk haemorrhage in mandibular body fractures, **dorsal lingual vein** which is associated with sublingual haematoma, and the **facial vessels** are also vulnerable where they cross the lower border of the mandible.

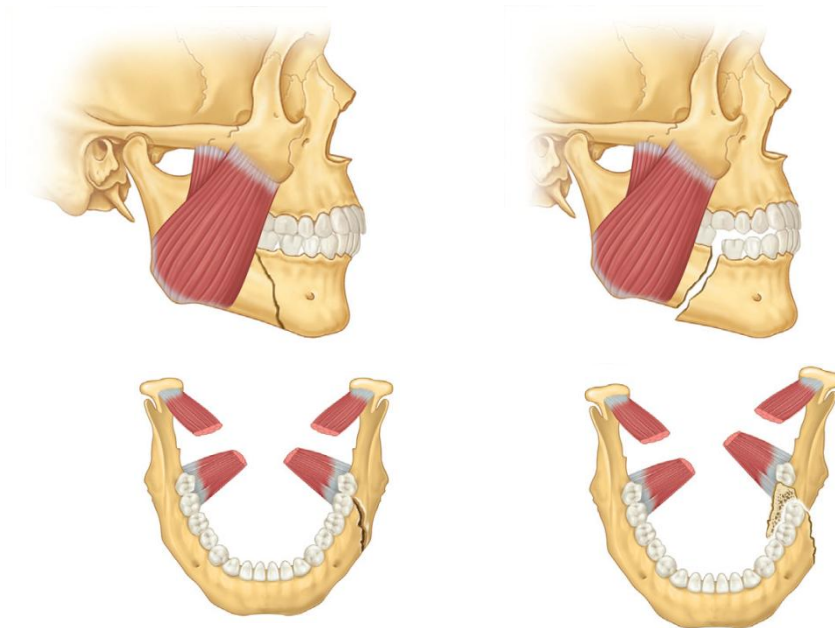
#### ▪ Muscle attachments

- The mandible has a number of powerful muscles inserted along its length. These include the muscles of mastication (temporalis, masseter and medial and lateral pterygoids), together with the suprahyoid muscles (digastric, geniohyoid and mylohyoid). Collectively, these muscles control the jaw movements.

- Some of them may play an important role as displacing forces across a fracture.

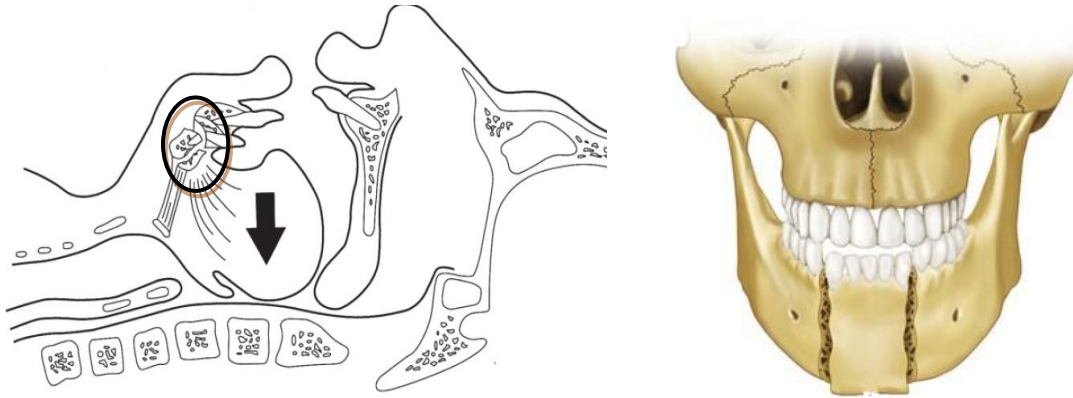
- Mandibular fractures are classified according to their tendency to displace as a result of the pull of the attached muscles into **favourable** when the muscles tend to pull the fragments together (minimizing displacement) and **unfavourable** when they are significantly displaced by the muscles. These are further considered as **vertically** or **horizontally** favourable or unfavourable, depending on the direction of displacement.

In midline fractures of the symphysis the mylohyoid and geniohyoid muscles sometimes act as a stabilizing force, an oblique fracture in this region will tend to overlap under the influence of these muscles.



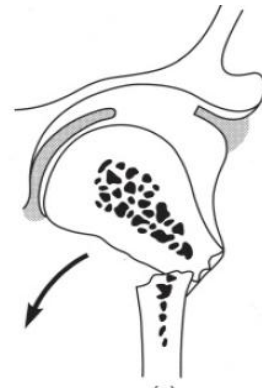
Mand. Angle fractures - above: **Masseter pull, Horizontally Favorable and unfavorable #**  
 - below: **Medial Pterygoid Pull, Vertically Favorable and unfavorable angle #**

When a bilateral parasymphiseal fracture occurs it is usually displaced posteriorly under the influence of the **genioglossus muscle** (which forms the bulk of the tongue and inserted at the genial tubercles). If consciousness is not impaired, considerable disorganization of the anterior mandible and the adjacent soft tissue can take place without any significant loss of voluntary control of the tongue, but there is a risk of airway obstruction if the level of consciousness is impaired.



When a fracture of the condylar neck occurs; the condylar head is frequently displaced within the articular fossa. The most frequent direction of displacement is medially and forward under the influence of the **lateral pterygoid muscle**.

Condylar displacement forward medially



### Direct and indirect fractures

When the force is applied to the mandible, the point of application of the force is causing **direct fracture** and the resultant vector travels along the bone causing **indirect fracture**. Common combinations of direct and indirect fractures are:

- **Symphiseal (direct)** combined with **bilateral subcondylar (indirect)** fractures also called **parade ground fracture** or **guardsman's fracture**.
- **Parasymphiseal (direct)** combined with **contralateral subcondylar or angle (indirect)** fracture.
- **Body (direct)** combined with **contralateral angle or subcondylar (indirect)** fracture.

### Common signs and symptoms of mandibular fracture(s)

- Pain: especially on talking and swallowing
- Numbness of the lower lip due to injury to inferior alveolar nerve, except fractures anterior to mental foramen (e.g symphesial #)
- Swelling
- Trismus and difficulty in moving the jaw
- Bone tenderness over fracture site
- Altered occlusion
- Loosened teeth and gingival bleeding
- Mobility of fractured segment
- Bleeding from the fracture site especially in body fractures when the inferior alveolar artery is torn, or bleeding from the ear as in some cases of condylar fractures.
- Haematoma; especially sublingual (pathognomonic)
- Step deformity palpable at the site due to displacement of the fracture segments

### The Treatment:

In general; there are three treatment options for the management of facial fractures:

1. No treatment
2. Non surgical treatment (conservative or closed treatment)
3. Surgical treatment

### Factors affecting the treatment:

- a) The fracture pattern
- b) Operator's skill,
- c) Patient's medical condition
- d) The available resources, degree of contamination
- e) The presence of other injuries

### Treatment principles are:

- Reduction, then
- Fixation, then
- Immobilization, then
- Rehabilitation

#### ✓ Reduction;

- Reduction of a fracture means the restoration of functional alignment of the bone fragments; reduction is either **open reduction** which facilitates anatomical reduction and fixation, and subsequent restoration of function or **closed reduction**.



- In the dentate mandible reduction must be precise when healthy occluding teeth are involved. Less precise reduction may be acceptable if the patient is edentulous or there are no opposing teeth.

#### ✓ Fixation;

- Fracture fixation may be either **internal fixation** or **external fixation (external pin fixation)**
- Internal Fixation can be either rigid or semi-rigid or non rigid fixation.
- Rigid fixation means that there will be no movement across the fracture site. This produces a level of stability that direct bone healing can take place (assuming there is sufficient bone-to bone contact). Rigid fixation therefore requires strong 'load bearing' fixation devices, usually large plates and bicortical screws.
- These devices tend to be bulky and can only be used in the mandible. The other bones of the face are too friable to support such plates therefore semi rigid fixation (miniplates and microplates) is the preferred choice. In semi-rigid fixation there is still adequate support, stability but a variable amount of 'micro movement' will still occurs, and they are much smaller in size

#### ✓ Immobilization;

- Traditionally, immobilization of the jaws involves linking them temporarily to each other by some form of InterMaxillary Fixation (IMF) - also called MandibuloMaxillary Fixation (MMF).

#### ✓ Rehabilitation: Physiotherapy

### A. Closed Treatment

- It consists of closed reduction with indirect fixation and immobilization with IMF.
- It is the **traditional conservative treatment** of mandibular fractures.
- Closed reduction is achieved without surgical exposure of the fracture site; it utilizes the teeth to achieve normal occlusion and immobilization of the fractured fragments.
- This method can be used as a definitive treatment of mandibular fractures or as temporary fragment stabilization in emergency cases.



IMF by using Erich Arch bar

The **main indications** of closed treatment are:

1. Non-displaced favorable fractures.

2. Limited resources and facilities for open treatment.
3. Medically compromised patients.
4. Grossly infected fractures.
5. Pediatric fractures with mixed dentition phase.
6. Edentulous fractures.

**Advantages of** closed treatment

- ✓ Non-invasive, simple, easy to master.
- ✓ Can be performed under local anesthesia.
- ✓ Less expensive.

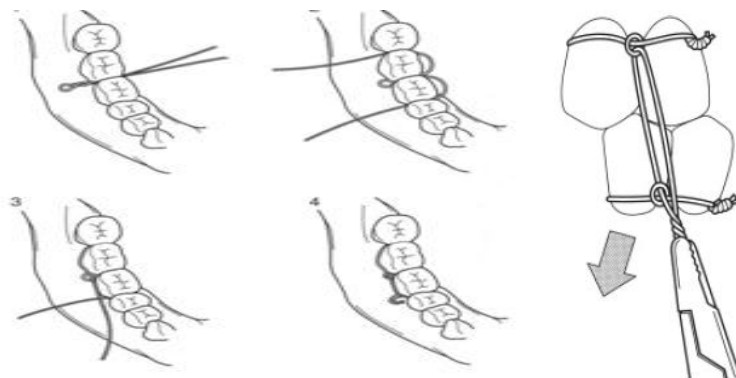
**Disadvantages of** closed treatment

- 1) The closed treatment does not ensure precise anatomical reduction of the fractures.
- 2) Difficult to apply in cases of malocclusion, missing, diseased, or damaged teeth.
- 3) The immobilization may not be adequate which delays the healing.
- 4) IMF prevent the normal jaw function and affecting on feeding (restrict the diet to a liquid or semi-solid consistency, weight loss is common) and on speech.
- 5) Oral hygiene is difficult to maintain.
- 6) In many patients there is also a significant reduction of ventilatory volume.

**Contraindications** include some conditions, e.g., epilepsy, chronic respiratory diseases, in compliant patient, or chronic alcohol or drug abuse.

**Methods of immobilization (IMF):-**

- **Bonded orthodontic brackets** By bonding a number of modified orthodontic brackets onto the teeth and applying light wires or intermaxillary elastic bands.
- **Interdental wiring** This method is **only applicable when the patient has a complete, or almost complete, number of suitably shaped teeth.** 0.5 mm soft stainless wire is usually used. Many different techniques for wire fixation exist; direct interdental wiring, eyelet wiring (commonly used) and Ernst ligatures.

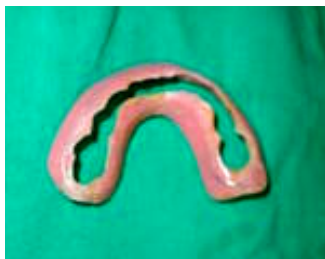




- **Arch bars** They are tooth borne devices and the **most versatile form of IMF**. They are used mandibular fractures, for fixation of avulsed teeth, and dentoalveolar fractures. Arch bars are **indicated where the patient has an insufficient number of suitably shaped teeth or when a direct linkage across the fracture is required**. They can be custom made or commercially manufactured. Many patterns or designs of arch bars are present; Erich and Jelenko patterns are the most common. Recently hybrid arch bar systems that use bone support have been developed.
- **IMF Screws:** These screws are self-drilling and self-tapping. The screw head is elongated and contains holes for wire placement. They are inserted through small incisions in the labial vestibule avoiding injury to the apices of the nearby teeth, it is regarded as a rapid method to achieve IMF.



- **Cap splints:** a cap splint made of acrylic or metal can be fabricated and used for fixation of the fracture. The splint is secured to the mandible by circum-mandibular wiring, using a bone awl.
- **Dentures or Gunning-type splints:** for edentulous jaw fractures, complete denture can be used as a splint and if the patient is not denture wearer Gunning-type splints can be fabricated, they take the form of modified dentures with a space in the incisor area to facilitate feeding. They are fixed to the jaws by circum-mandibular and maxillary wires or screws, IMF is achieved by connecting the two splints with wire loops or elastic bands.



Cap splint

Gunning splint

- **External pin fixation:** This method is seldom used nowadays, it is indicated in special conditions, such as infected fractures, fractures caused by gunshot injuries or pathological fractures. Ideally, at least two self-tapping screw pins are placed either side of the fracture or defect. The fracture is then reduced and the pins linked by an external bar framework.

### Period of immobilization:

With early uncomplicated treatment in a healthy young adult; union can on average be achieved after 3 weeks, at which time the fixation can be released. Further **1–2 weeks should be added for** each of:

1. Where a **tooth is retained** in the fracture line.
2. Patients aged **40 years** and over.
3. Patients who are **smokers**.
4. Mobile or **comminuted fractures**.

**This is the End of the Lecture, Good Luck**