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Effected of Fracture of mandible on oral cavity.

A Project Submitted to The College of Dentistry, University of Misan, Department of oral surgery in Partial Fulfillment for the Bachelor of Dental Surgery

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صدق الله العلي العظيم

Dedication

We dedicate this humble work to our parents who have been our source of inspiration and gave us strength when we thought of giving up. Also to everyone who support us during the seventeen years ago.

Acknowledgments

First and foremost, I am grateful to Allah (Almighty), the Lord of the World, for providing me with His assistance and grace in enabling me to fold the days' tiredness and complete this humble work, and I owe a great debt of gratitude to Allah's prophet Mohammed (peace and blessings be upon him and his family), the first teacher who showed us the way.

I extend my greatest thanks and appreciation, to my supervisor **(Assist. Lect.Dr. Afrah Adel)**, for her gentle handling, excellent ideas, confidence in my abilities, and firm direction of my work.

Special thanks to all my honorable teachers, who did not hesitate to extend a helping hand to me.

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Abstract

This research talk delves into the mandibular bone fracture, and explain in details it's important role in digestive system, speech, and facial esthetics. For these important functions of mandibular bone, it is vital that surgeons should not only treat function but also consider the esthetics together. Its aim to explain that mandibular fractures are among the most common traumatic injuries of the maxillofacial region. Even though treatment modalities are well established and being practiced for a long time, untreated and postoperative Complication still decrease.

1.1 Introduction

Lower jaw (mandibular) fractures are the third most common type of facial Fractures, after fractures of the nose and cheekbone. Mandibular fractures can be caused by many different types of injuries to the lower face **(Lee et al, 2021) .**

Mandibular fractures are among the most common (60–70%) maxillofacial fractures observed in emergency rooms Naeem A 2017 .Due to its prominent and vulnerable position, traffic accidents and other physical injuries result in a high incidence of mandibular fracture. Research has revealed the mandible to be the most involved bone in maxillofacial fractures related to interpersonal violence.K .H . Lee 2009The average age of patients with mandibular fracture is 38 years for men and 40 years for women **(Doerr, 2015)**. Men are mainly involved (male-to-female ratio 5:1) **(Jadhav et al., 20151)** more than 2,500 people suffer a mandibular fracture every year in the USA Afrooz PN 2015 Pediatric mandibular fractures occur at a relatively low frequency compared to adults, accounting for approximately 5% of all maxillofacial traumas Sumaiya Nezam A, 2018 In children, mandible fractures are the second most common type of facial fractures, with the condyle and symphysis being the most frequent sites. Symphysis and para-symphysis fractures are more common due to developing canine tooth buds that can create a stress point in this location. Condyle and symphysis fractures account for a significant proportion of cases in children, while body, angle, and ramus fractures are relatively low in incidence but increase with adolescence. Dentoalveolar fractures are also common but are often treated in an office setting and not reported **(Goth, 2012)**.

1.1.1 Embryology

The development of the mandible originates from the branchial apparatus. The branchial apparatus divides into three main components. The components are the branchial clefts, arches, and pouches. The branchial clefts are made up of ectoderm. The only significant branchial cleft is the first one. This first branchial cleft will develop into the external acoustic meatus. The composition of the branchial arches is of neural crest cells and mesoderm. The branchial arches are responsible for developing into the muscles, bones, and nerves of the face and neck. While the branchial pouches will develop into the organs in the face and neck such as the tonsils, parathyroid, and thymus. Simultaneously, the arterial system in the head, face, and neck will develop from the aortic arches; the aortic arches will differentiate around the same time as the structures from the branchial apparatus.

The first branchial arch will form the mandible. The grooves and impressions in the mandible will develop as the other tissues differentiate. As the inferior alveolar nerve and artery develop and travel toward the oral cavity, the mandibular foramen will develop. The mandibular foramen will form to protect the inferior alveolar nerve and vessels **(Nguyen et al, 2021).**

1.1.2 Structures of the mandible

The mandible is made up of the following parts:

1.1.2.1 Body

The body is the anterior portion of the mandible and is bound by two surfaces and two borders. The body ends and the rami begin on either side at the angle of the mandible, also known as the gonial angle.

a. External surface:The external surface contains the mandibular symphysis at midline, detected as a subtle ridge in the adult. The inferior portion of the ridge divides and encloses a midline depression called the mental protuberance. The edges of the mental protuberance are elevated, forming the mental tubercle. Laterally to the ridge and below the incisive teeth is a depression known as the incisive fossa. Below the second premolar is the mental foramen, in which the mental nerve and vessels exit. The oblique line courses posteriorly from the mental tubercle to the anterior border of the ramus.
b. Internal surface:The internal surface contains the median ridge at midline and mental spines, which are just lateral to the ridge. The mylohyoid line begins at midline and courses superiorly and posteriorly to the alveolar border.
c. Alveolar border: The alveolar border, which is the superior border, contains the hollow cavities in which the lower sixteen teeth reside.
d. Inferior border: The inferior border creates the lower jawline and contains a small groove in which the facial artery passes **(Breeland et al,2021).**

1.1.2.2 Ramus

The ramus contributes to the lateral portion of the mandible on either side. The coronoid process and condyloid process are located at the superior aspect of the ramus. The coronoid process is anterior, and the condyloid process is posterior, the two are separated by the mandibular notch. The ramus is bound by two surfaces and four borders and contains two processes **(Breeland et al, 2021).**

a. Lateral surface: The lateral surface contains a portion of the oblique line, which began on the external surface of the body. This surface also provides the origin for the masseter muscle.
b. Medial surface: The medial surface contains the mandibular foramen through which the inferior alveolar nerve and inferior alveolar artery enter and subsequent course the mandibular canal. At the anterosuperior aspect of the mandibular foramen is a sharp process called the lingula of the mandible. At the posteroinferior aspect of the mandibular foramen is the mylohyoid groove, against which the mylohyoid vessels run.
c. Superior border: The superior border which gives rise to the coronoid and condyloid processes.
d. Inferior border: The inferior border is continuous with the inferior border of the mandibular body and contributes to the jawline.
e. Posterior border: The posterior border is continuous with the inferior border of the ramus and is deep to the parotid gland. This border is used in conjunction with the inferior border of the mandibular body to determine the gonial angle.
f. Anterior border: The anterior border is continuous with the oblique line of the external surface of the body **(Breeland et al, 2021).**

1.1.2.3 Coronoid Process

The coronoid process is located at the superior aspect of the ramus. Its Anterior border is continuous with that of the ramus, and its posterior Border creates the anterior boundary of the mandibular notch. The Temporalis muscle and masseter insert on its lateral surface **(Breeland et al, 2021).**

1.1.2.4 Condylar Process

The condylar process is also located at the superior aspect of the ramus And is divided into two parts, the neck, and the condyle. The neck is the Thinner portion of the condyloid process that projects from the ramus. The condyle is the most superior portion and contributes to the Temporomandibular junction by articulating with the articular disk ***(*Breeland *et al*, 2021*)*.** **1.1.3 Blood supply** of the mandible is mainly of a periosteal pattern coming from the perimandibular branches of the maxillary artery, the facial artery and the external carotid artery **(Blackwood, 1965; Bradley, 1972, 1981; Ham- parian, 1973)**. The inferior alveolar artery is the only artery of the mandible that is known to be endosteal and supplying part of the ramus and the body of the lower jaw.

The mandibular teeth are supplied by dental branches from the inferior alveolar artery.

Lymphatic drainage of the mandible and mandibular teeth are primarily via the submandibular lymph nodes; however, the mandibular symphysis region drains into the submental lymph node, which subsequently drains into the submandibular nodes.

1.1.4 Muscles

1.1.4.1 Muscles Originating from the Mandible

a. Mentalis – originates from the incisive fossa.
b. Orbicularis oris – originates from the incisive fossa.
c. Depressor labii inferioris – originates from the oblique line.
d. Depressor anguli oris – originates from the oblique line.
e. Buccinator – originates from the alveolar process.
f. Digastric anterior belly – originates from the digastric fossa.
g. Mylohyoid – originates from the mylohyoid line.
h. Geniohyoid – originates from the inferior portion of the mental spine.
i. Genioglossus – originates from the superior portion of the mental Spine.
j. Superior pharyngeal constrictor – originates partially from the Pterygomandibular raphe, which originates from the mylohyoid line.

1.1.4.2 Muscles Inserting on the Mandible

a. Platysma – inserts on the inferior border of the mandible.
b. Superficial masseter – inserts on the lateral surface of the ramus and angle of the mandible.
c. Deep masseter – inserts on the lateral surface of the ramus and angle of The mandible.
d. Medial pterygoid – inserts on the medial surface of the mandibular angle and ramus of the mandible.
e. Inferior head of the lateral pterygoid – inserts on the condyloid process.
f. Temporalis – inserts on the coronoid process.

2.1 Etiology of the mandible fracture

The mandible is one of the most commonly fractured facial bones, along with the nasal and zygomatic bones. Most frequently, fractures are a result of trauma, such as motor vehicle accidents, physical altercations, industrial accidents, falls, and contact sports. For this reason, it is critical to evaluate patients with mandible fractures for other associated traumas, to include cervical spine and traumatic brain injuries.

This can include a fall onto the chin or a hit from the side. Rarely they may be due to osteonecrosis or tumors in the bone.The most common area of fracture is at the condyle (36%), body (21%), angle (20%) and symphysis (14%). Rarely the fracture may occur at the ramus (3%) or coronoid process (2%) **(Murray ' Jm may 2013) .**

3.1 General classification of fracture of bone

3.1.1 Simple fracture:- This type of fracture is not exposed to the external environment as the overlying soft tissue cover is intact .

3.1.2 Compound fracture:- In such type of fractures, the fracture line is exposed to the external environment .

3.1.3 Simple :- Comminuted fracture Comminuted fractures have multiple fracture lines and more than two bony fragments

It is a comminuted fracture not exposed to the external environment .

3.1.4 Compound comminuted fracture :- This type of fracture is a comminuted one which is exposed to the external environment

3.1.5 Complicated fracture :- This fracture involves vital structures like adjacent nerves, vessels, or joint, directly or indirectly The fractured fragments inter-digitate to an extent that there is no appreciable clinical movement.

3.1.6 Impacted fracture :- Such a fracture is unusual in the mandible and is commonly seen in the maxilla.

3.1.7 Greenstick fracture :- it is an incomplete fracture presenting as cortical bending rather than breaking. It is commonly seen in children as their bones are more elastic in nature. This elasticity allows the bone to bend. This type of fracture is commonly seen in long bones and mandibular condyle of children.

3.1.8 Pathological fracture :- This fracture occurs readily with minimal trauma or sometimes even during normal physiological function as the bone is significantly weak due to existing undermining pathology **(Cray et al , 2013) .**

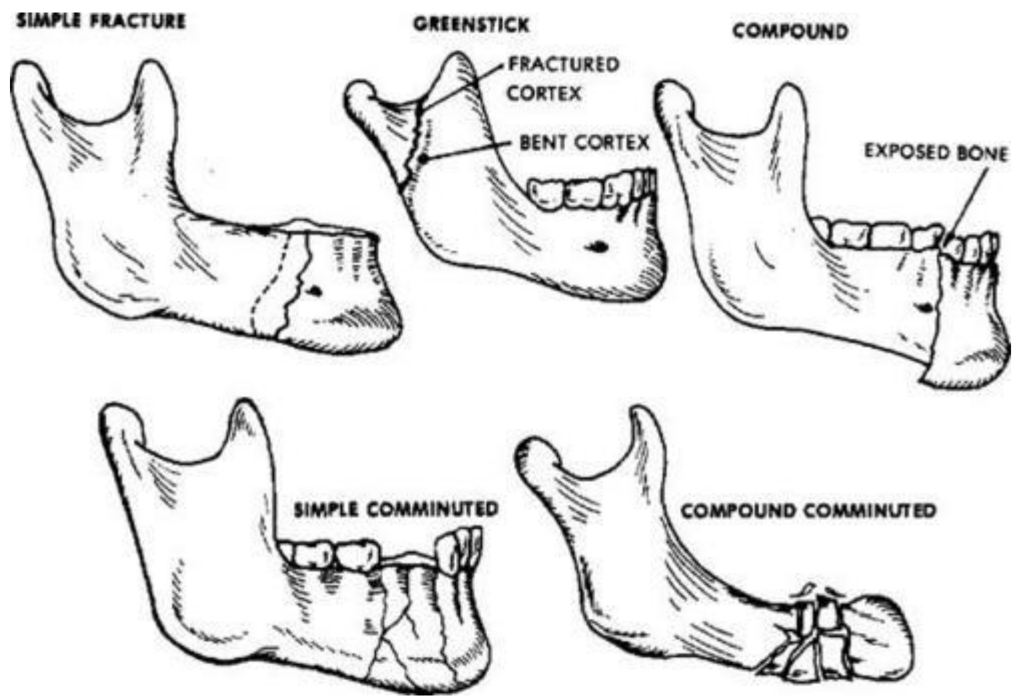


Fig. 1

3.2 According to the displacement of fracture fragments due to muscle pull, the fracture can be classified as: When viewed from superior aspect:

3.2.1. Vertically favorable: When the fracture line is passing from buccal cortical plate to the lingual cortical plate with the buccal end lying mesially and the lingual end of the line lying distally. In such situation the distal fragment will be drawn closer to the proximal fragment due to the pull of the medial pterygoid muscle, and the fracture segments will come closer rather than getting separated in buccolingual plane, and thus the fracture is called as vertically favorable

3.2.2. Vertically unfavorable: In this case, the fracture line passes buccolingually with the buccal end lying mesially. The distal fragment in this case will be easily viewed from superior border. The distal fragment in this case will easily get drifted **(Dinoman et al , 1964).**

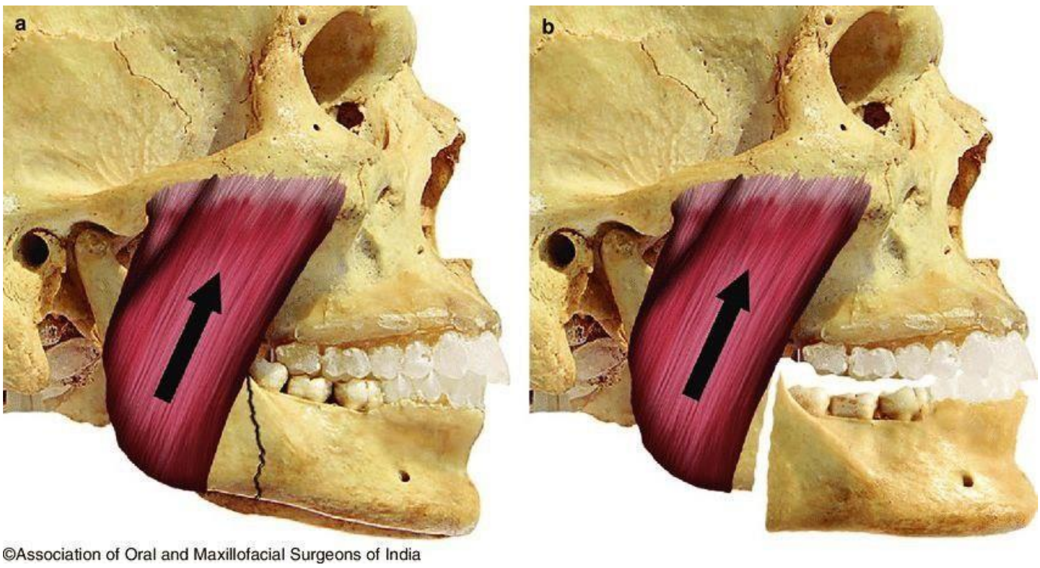


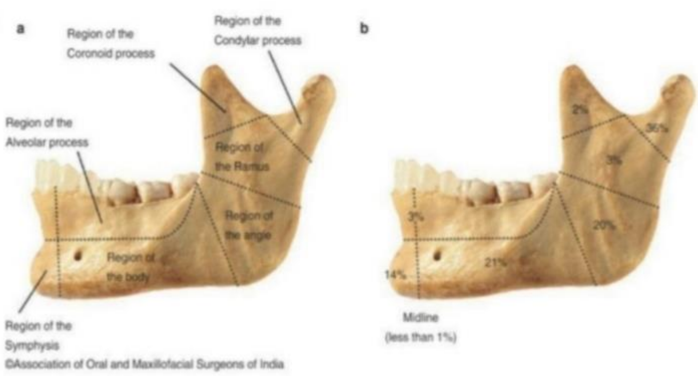
Fig. 2

3.3Classification by Anatomic Region

Mandibular fractures are also classified by the anatomic areas involved, as follows: symphysis, body, angle, ramus, condylar process, coronoid process, and alveolar process.

1. Midline: Fractures between central incisors
2. Parasymphyseal: Fractures occurring within the area of the symphysis
3. Symphysis: Bounded by vertical lines distal to the canine teeth
4. Body: From the distal symphysis to a line coinciding with the alveolar border of the masseter muscle (usually including the third molar)
5. Angle: Triangular region bounded by the anterior border of the masseter muscle to the posterosuperior attachment of the masseter muscle (usually distal to the third molar)
6. Ramus: Bounded by the superior aspect of the angle to two lines forming an apex at the sigmoid notch
7. Condylar process: Area of the condylar process superior to the ramus region
8. Coronoid process: Includes the coronoid process of the mandible superior to the ramus region
9. Alveolar process: The region that would normally contain teeth **(Dingman ,2015)**

Fig. 3



(a, b) Highlights the mandibular fracture according to site of fracture with its incidence

Bonanthaya, K., Panneerselvam, E., Manuel, S., Kumar, V. V., & Rai, A. (Eds.). (2021). Oral and Maxillofacial Surgery for the Clinician. Doi:10.1007/978-981-15-1346-6

3.3.1 The condylar fracture is among the most frequent facial fractures. Despite all the published studies, its treatment remains controversial. The aim of this retrospective study was to evaluate the epidemiology and complications of mandibular condyle fractures managed by surgical and conservative treatments, over a period of twenty years **(Marcelo S monnazzi et al , 2017).**

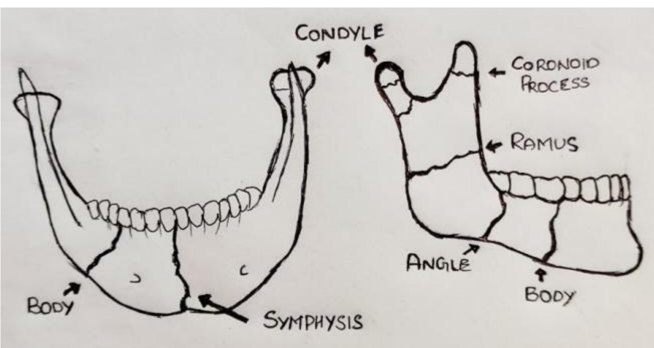
3.3.2 Mandibular body :- Fractures of the mandibular body include fractures of the symphysis/parasymphysis and horizontal branches. The symphysis/parasymphysis area corresponds to the region between the two canines To simplify our analysis, the generic term symphysis refers to both the symphysis and parasymphysis areas **(Cornelius et al, 2019)**

3.3.3 Angle fractures occur in a triangular region between the anterior border of the masseter and the posterosuperior insertion of the masseter. These fractures are distal to the third molar **(Grimme et al, 2002)**

3.3.4 Mandibular ramus fracture is usually minimally displaced as it is surrounded by the medial pterygoid medially, masseter laterally, and the pterygomasseteric sling inferiorly. They are commonly caused either by road traffic accidents or interpersonal violence **(Cureus et al, 2022).**

3.3.5 Coronoid fractures are believed to occur due to a shearing force when elbow experiences excess stress. They are often the result of an associated elbow dislocation. [2] Two to fifteen percent of elbow dislocations result in fractures of the coronoid **(Garrigues GE ,et al . 2011).**

Fig. 4



4.1 Management

4.1.1-Clinical Examination

Examination should begin with inspection and palpation. The classical signs of inflammation, pain, swelling, and erythema will help guide the physician in thorough identification of potential injuries. After examining for any lacerations or sources bleeding that needs to be addressed urgently, the clinician should perform an in-depth fracture assessment. Extra- and intra-oral findings, in addition to a neurosensory examination, will help the physician in identification of fractures or fractures patterns that may be present.

Extra-oral Examination: An extra-oral assessment should begin by examining the face and mandible for any abnormal contours or step defects. Changes to the patient's facial profile and mandibular movements will cue the physician for types of fractures. For instance, a flattened facial profile may be due to a fractured mandibular body, angle, or ramus. A retruded chin may be caused by bilateral parasymphyseal fractures. An elongated face may be the result of bilateral subcondylar, angle, or body fractures. Any facial asymmetry should also signal the physician for the possibility of a mandible fracture. Trismus (Fig. 4), or limited mouth opening, and deviation on opening may be due to guarding of the muscles of mastication, non-functioning of muscles, or bony impingements. Deviation upon opening may signify a mandibular condylar fracture due to unopposed contraction of the contralateral lateral pterygoid muscle. Inability to fully open may be due to impingement of the coronoid process on the zygomatic arch when fractures of the ramus and coronoid process or depression of the zygomatic arch is present. On the other hand, inability to fully close may signify dentoalveolar process, angle, ramus, or symphysis fractures.

Inability to fully bring one's teeth together may be due to an open bite that was present pre-injury; the presence of mammelons on the incisal edges of the anterior dentition may be a clue to determining a premorbid anterior open bite (Fig. 5).

(Fig. 5)Trismus (limited mouth opening) may be a frequent exam finding in patients with mandibular fractures, particularly those involving the angle or ramus-condyle unit. This patient sustained a left-sided subcondylar fracture. Maximal incisal opening was 20 mm. The mandibular dental midline deviates toward the fracture with opening, due to the unopposed motion of the right lateral pterygoid muscle.

(Fig. 6).Assessment of premorbid occlusion is readily accomplished with careful history and, if available, dental or orthodontic records. Anterior open bites may be the result of bilateral fractures involving the condyles with posterior shortening of the rami. Anterior open bites that are premorbid may be identified by the presence of mammelons (rounded protuberances on the incisal edges) on the incisors, as seen in this orthognathic surgery patient.

Intra-oral Examination: The physician should be vigilant in intra-oral assessment. This includes assessment of the mandibular arch form and occlusion and identification of gingival lacerations, hematomas, or ecchymosis, and injuries to the teeth. The mandible is unique in that it is a continuous, U-shaped bone that crosses midline; deviations from this arch form may indicate a fracture. Any change in occlusion is highly suggestive of a mandible fracture. The mandible should be palpated bimanually to assess for fracture mobility .

The patient should be asked if their bite feels different. This can identify injuries to the teeth, dentoalveolar process, mandible, or temporomandibular joint (TMJ). Premature posterior contacts between the maxillary and mandibular dentition can result from bilateral mandible fractures of the angles or ramus-condyle units or signify the presence of a displaced maxillary fracture. Asking for premorbid photographs of the patient's premorbid occlusion can help to ensure accurate reduction of fractures based upon the occlusion.

Gingival lacerations, hematomas, or ecchymosis may indicate injury to the mandible (Fig. 7). For instance, sublingual ecchymosis is a pathognomonic sign for symphysial, parasymphyseal, or body fractures. In addition, retromolar trigone ecchymosis can signify angle fractures. Segments of fractured teeth may indicate fractures to the dentoalveolar process or mandible itself. Fractured teeth, mobile teeth, and any grossly carious teeth in the line of fracture may require extraction for reduction and to prevent aspiration. Missing teeth should that have not been accounted for should be considered swallowed, aspirated, or displaced into soft tissue. Radiography and operative exploration may help identify lost teeth and may require removal to prevent infection or airway issues.(Kanvar Panesar et al.., 2021)

(Fig. **7**). Intraoral assessment may reveal the site of the fracture. Gingival lacerations, vestibular or sublingual ecchymoses, and/or steps at the occlusal plane suggest a bony injury. Bimanual palpation across the suspected fracture site may demonstrate independent mobility of the mandibular segments. The presenting anterior open bite is likely related to the trauma, as there is evidence of wear on the incisal edges of the anterior dentition .

Bimanual Palpation

The abnormal mobility at the fracture site can be elicited by the bimanual palpation. The mandible is grasped on either side of the suspected fracture line in such a way that the index finger is on the occlusal surface of the teeth and the thumbs are on the inferior border. The proximal and distal segments are moved in supero-inferior and anteroposterior direction, to elicit abnormal mobility (Fig. 8).

(Fig. 8)Bimanual palpation

Compression Test

When there is a hairline, undisplaced fracture of the mandible especially at the symphysis or angle or in the subcondylar areas and it is not conspicuous clinically and radiologically, a compression of the mandible at the symphysis area and both the sides over the body, using both the palms by the operator, elicits tenderness which may suggest the fracture (Fig.9).

Fig.9

Compression Test

4.1.2 Radiographic evaluation

The decision to image a mandibular injury can be justified if a fracture is suspected. It is important for a fracture to be identified quickly as there can be detrimental outcomes to the patient if missed, this includes malunion, nonunion and delayed union of the fracture. In the context of trauma, the presence of malocclusion, trismus, pain with the mouth closed, broken teeth or a step deformity, are all clinical features that present with a mandibular fracture. If a patient presents with any of these features they should receive X-ray imaging.

X-ray evaluation of a mandibular fracture follows a set mandibular series, which involves three views; a posteroanterior (PA), oblique and lateral view. Imaging can be supplemented further with a reverse Towne's view or an orthopantomogram (OPG).

Several X-ray views are obtained at different projections so that you are able to identify all visible fracture lines and the displacement shown. Individual views are insufficient in detailing the mandible and each have their own advantages and limitations.

1 - Posterior-Anterior (PA) view: accurately details fractures of the ramus, angle and body. Due to superimposed anatomy, the symphysis and condyles are displayed poorly however, being obscured by the cervical spine (c-spine) and mastoid process respectively

2 - oblique view: similarly to a PA view, visualises the ramus, angle and body well. They also detail the mandibular groove, which may be mistaken for a cortical break in other projections. The disadvantages is again limited visualisation of the condylar region as well as the symphysis. This view also may lead to a false positive of a fractured condyle, due to the superimposed anterior cortex

3 – The lateral view: is particularly helpful in assessing the TMJ and any associated dislocation. A condylar fracture would also be displayed better in comparison to a PA or an oblique view, although there is limited detail in assessing any medial or lateral displacement. Another disadvantage includes the symphysis not being visualised at all in this projection.

4 – CT imaging: The indications for performing CT imaging of the mandible are several. Firstly they are performed first in all unstable patients where the suspicion of mandibular fracture is present. Secondly, they are indicated when there are ongoing concerns that a fracture is likely despite not being demonstrated on X-ray. Finally, CT imaging would be performed in all patients whom have a X-ray diagnosis of a fracture that would be amenable for either a closed or open reduction. This is due to the enhanced detail provided in the images allowing for better operative planning

5 -Magnetic resonance imaging (MRI) of a mandibular injury: is performed when assessing any associated soft tissue injuries. In particular, assessing for temporomandibular disc disruption or capsular tear which can occur with high condylar fractures .Detail of bony injury, which is what is required in an traumatic mandibular injury, is reserved for CT due to quicker scan times and typical 24-hour access. MRI does however serve the advantage of not using ionising radiation to the patient.

6 – Orthopantomography (OPG) X-rays: is another supplemented view and images the entire mandible in a one dimensional plane. They subsequently are the most informative radiograph and are more sensitive in detecting a mandibular fracture in comparison to other X-ray views

7 - Ultrasound: Ultrasonography (U/S) The overall advantages of U/S are being a fast imaging technique, relatively inexpensive and one that does not use ionising radiation. This would be particularly useful in trauma patients whom are too unstable to have a CT performed or whom are pregnant and therefore wanting to limit radiation exposure **(Hugo Gemal 2017)**

4.1.3-Signs and Symptoms

1- Bruising and swelling of the face, bleeding from the mouth.

2- Difficulty chewing.

3- Misaligned teeth or jaw, Jaw stiffness, difficulty opening the mouth widely, or problem closing the mouth.

4- Jaw moving to one side when opening.

5- Jaw tenderness or pain, worse with biting or chewing .

6- Loose or damaged teeth.

7- Lump or abnormal appearance of the cheek or jaw .

8- Numbness of the face (particularly the lower lip).

9- Ear pain **(Haughey et al,2021)**

5.1 Treatment option

Aim of fracture treatment

The purpose of fracture treatment is to return the mechanical strength of the Fracture site to its healthy state and to achieve an improvement in the masticatory Muscles' normal functions. The first stage of treatment is to return the fracture parts to their normal anatomic position (reduction). The second stage is the fixation of the parts in their normal anatomical position (fixation). If the history of the trauma does not exceed8–10 days, the fixation of the fractures can be done manually. In order to control the pain, local anesthesia can be applied **(Buket Aybar et al, 2019).**

5.1.1 Closed reduction

Anatomically restoration of the fragments without visualization the fracture line Is called closed reduction. Arch bars, IVY loops, and intermaxillary fixation screws are all well-known appliances for closed reduction methods .Closed method is still used today due to the advantage of elastic traction which helps successful repositioning of the fragments and its low cost.

Advantage

1-Closed reduction with functional therapy is a safe treatment.

2-No injury of nerves and blood vessels occur during the treatment.

3- no postoperative complications such as infection or scar occurs.

4-In particular, complications such as fracture, loss, and eruption delay of the growing teeth can be avoided in pediatric patients as no tooth germ injury occurs because of no establishment of the crown of the permanent teeth**(Kang-Young Choi et al, 2012)**

Disadvantage

1-Long-term intermaxillary fixation has disadvantages of the injury of the periodontal tissue and buccal mucosa.

2- poor oral hygiene.

3-pronunciation disorder imbalanced nutrition.

4-mouth opening disorder, and respiration disorder.

Period of Immobilization in Close Reduction

Periods depends upon whether :-

1-site of the fracture

2-Presence or otherwise of retained teeth in the fracture line

3-The age of the patient

4-Presence or absence of infection. Young adult with fracture of angle receiving early treatment in which tooth removed From fractured line: 3weeks

Different types of wiring techniques

A-Direct Interdental Wiring

- Essig's Wiring – Gilmer's Wiring – Risdon's Wiring

B-Indirect Interdental Wiring – lvy Loop Wiring- Multiple Loop Wiring – Arch Bar Fixation

Methods used to achieve close reduction

- Reduction by manipulation
- Reduction by traction :- Intraoral traction method – Extraoral traction method

Reduction by manipulation:

Reduction by manipulation is done when the fractured fragments are adequately mobile without much overriding or impaction and the patient comes for treatment immediately after trauma. Then the digital or hand manipulation for reduction can be used . Specially designed instruments for grasping the fragments are available like disimpaction forceps, bone holding forceps.

Intraoral traction method :

In this method prefabricated arch bars are attached to maxillary and mandibular dental Arches by means of interdental wiring .The fracture fragments are subjected to gradual Elastic traction by placing the elastics, from upper to lower arch bars in a definite manner & direction depending on the fracture line.

Intraoral traction method

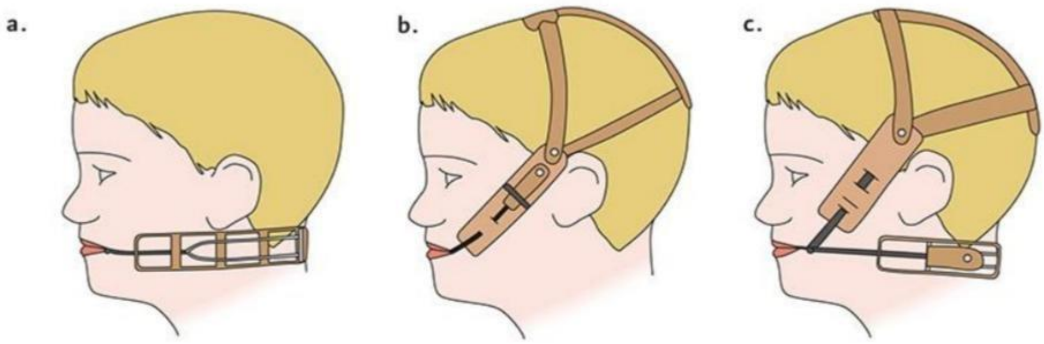
Reduction by manipulation

Fig. 10

Extraoral traction method :

In extraoral traction method, anchorage is taken usually from the intact skull of the Patient & different types of head gears are used for various attachments. Attachments Are connected to the arch bars by elastics & wires (Dr. Tshewang Gyeltshen,2017)

Fig.11



Extraoral traction method

Indications for closed reduction

- No or little displacement.
- Little or no fracture mobility.
- Possibility of regaining pre-injury occlusion.
- The absence of infection.
- The patient's cooperation can be maintained and the follow-up is possible.
- Closed reduction can also be preferred in patients whom a surgical approach is not recommended, such as patients having fractures due to medicine-related osteonecrosis of the jaws **(Buket Aybar et al, 2019)**

Contraindications to closed reduction :

1. Patients with poorly controlled seizure history.
2. Patients with compromised pulmonary function (ie, moderate-tosevere asthma, Chronic obstructive pulmonary disease).
3. Patients with psychiatric or neurologic problems.
4. Patients with eating or GI disorders.

5.1.2-Open reduction

Open reduction is preferred when closed treatment is not possible or has failed.In open reduction, there is a surgical approach to the fracture, and the fracture segments are repositioned to their anatomical positions. This stage is called reduction. This is followed by the fixation step. Fixation can be either rigid or semirigid in open reduction,Compression plates and bicortical screws are used in rigid fixation.

Advantage

1- Reduction of the displaced bony fragment to the most ideal anatomical site by a direct approach to the facture site.
2- Prevent complications such as respiration disorder, pronunciation disorder, and severe nutritional imbalance by shortening intermaxillary fixation period via rigid fixation.

Disadvantage

1- Open reduction is an invasive treatment, which may cause injury of nerves or blood vessels during operation, and postoperative complications including infection.
2- In addition, it has permanent scar though the surgery is conducted after designing the incision line considering aesthesis **(KangYoung Choi et al..,2012)**

Absolute Indications for Open Treatment

- Displacement of condyle into the middle cranial fossa (with or without fracture)
- Lateral extracapsular displacement of condyle (with or without fracture)
- Impossibility of obtaining proper occlusion by closed techniques
- Condylar fractures associated with comminuted fractures

In most adult mandibular fracture cases, intermaxillary fixation (IMF) is maintained for 4 to 6 weeks **(Edward Ellis III,2004)**

Steps in Open Reduction Internal Fixation (ORIF) of Mandible Fracture

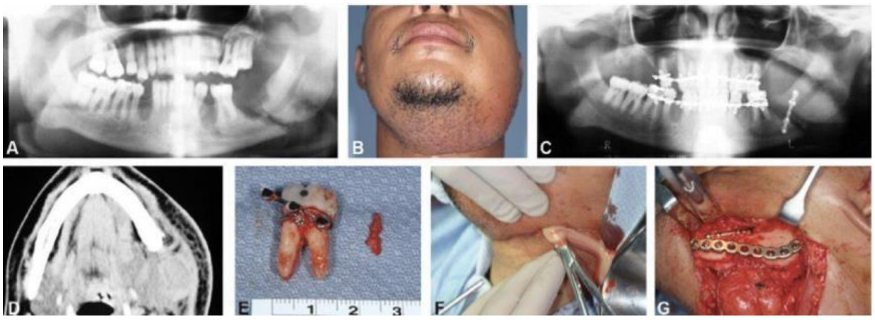
- Incision (extra-/intraoral).
- Exposure of the fracture site
- Curettage to remove the granulation tissues and irrigation with normal saline.
- Reduction of the fracture (with the help of bone-holding forceps) Chin retractor is also helpful in reduction of fracture fragments).
- Immobilization with MMF.
- Fixation with plates and screws.
- Closure of the incised site.
- Pressure bandage over the surgical site to avoid postoperative hematoma formation in required cases **(Anshul Rai,2021).**

6. Complications

6.1 Infection

Infections are one of the most common complications of mandibular fracture management, irrespective of how the fracture was treated (Fig. 12). 1 2 3 They tend to be more common when fractures are treated open, but this may be due to the more complex cases usually requiring open treatment. The oral cavity is a reservoir for bacteria that can easily colonize the surgical site or internal fixation hardware. The difference between infection and osteitis is that osteitis has no great component of bacterial cellulitis and no abscess formation or purulent discharge associated with it. Osteitis is an osteomyelitis that is localized and is due to devitalization of the bone from traumatic and/or surgical disruption of superficial blood supply. The fracture may be completely stable with osteitis or infection, but infection is more likely to be associated with fracture instability.

Fig. 12



(A) panoramic radiograph of a patient with a left angle fracture. It was treated with a single miniplate. (B) Facial photograph 6 weeks after surgery showing redness and swelling of the left angle region. (C) Panoramic radiograph showing unstable fixation and clockwise rotation of the mandibular ramus on the left side. (D) Computed tomography scan showing large abscess formation around the left angle of the mandible. The patient was taken to surgery and the left miniplate was removed. The left lower molar was also removed (E) because it was infected, and an incision and drainage was performed through a transfacial approach (F). A reconstruction bone plate was applied at the same time (G) and a drain was placed. (H) Panoramic radiograph at 12 weeks showing complete healing. Fracture instability can also lead to infection. When mobility is present during the early stages of healing, disruption of blood supply occurs, and the interference in revascularizing leads to devitalization of bone. The presence of mobility and/or devitalization of bone with microorganisms results in infection of the fracture.

Treatment of infection requires assessment of the stability of the fracture. If the fracture was treated closed and a postoperative infection occurred, one should determine whether or not the MMF provides stable fixation or not. Other causes of the infection must also be sought such as a devital tooth in the line of the fracture. If the fracture were treated open with internal fixation devices, an assessment of whether or not the hardware is continuing to provide stability to the fracture is imperative. If the fracture is stable and there is no evidence of a loose screw or plate, management of the infection is indicated without removal of the hardware. Incision and drainage and irrigations, systemic antibiotics, treatment or extraction of devital teeth, debridement of devital bone, and systemic management of the patient's general health are indicated. Any loose hardware must be removed because it tends to perpetuate infections. If removal of the hardware is necessary, the fracture must be restabilized. To provide stabilization, one has several options. One can use MMF, external pin fixation, or restabilization with internal fixation devices. If the latter course is chosen, the fracture should be stabilized by very stable means such as by using a reconstruction bone plate (load-bearing fixation) with at least four screws on each side of the fracture. The screws should be kept at least 7 mm away from the fracture. One may wish to place irrigation drains and continue irrigations until they clear.

6.2 Malunion and Malocclusion

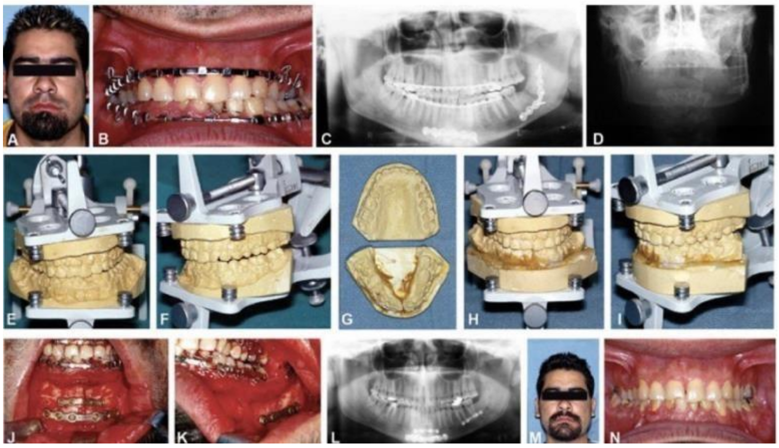
6.2 – Malunion and Malocclusion

Malunion is defined as the osseous union of a fracture in an incorrect position. The area is healed with bony continuity but there are functional and possibly esthetic problems because the reduction was inadequate. Most postoperative malocclusions are caused by malunions and are usually obvious to both the patient and the surgeon. When the degree of displacement of the healed segments is great, facial deformity may also be noted (Fig. 13) .

Fig. 13

Records of a patient who was treated elsewhere for left angle and symphysis fractures of the mandible. He complained that his bite was off and that his face looked asymmetric. Additionally, he said he had no feeling in the left lower lip and chin. (A) Facial photograph showing more fullness on the left side of his face. (B) Photo of his occlusion showing left crossbite. (C) Panoramic radiograph showing bone plates attached to the mandible in the symphysis and angle regions. Note the three lower screws through the bone plate at the angle are directly over the inferior alveolar canal. (D) Posteroanterior radiograph showing lateral displacement of the mandibular ramus. (E) Frontal and (F) left lateral photos of the patient's dental models mounted on an articulator. (G) The lower cast was segmented through the symphysis and the pretrauma occlusion was re-established (H,I). Intraoperative photographs of the symphysis (J) after an osteotomy was performed through the original fracture site and the left angle (K) after a sagittal ramus osteotomy was performed through the ramus, fragment mobilization, reestablishment of mandibulomaxillary fixation, and bone plate osteosynthesis. (L) Postoperative panoramic radiograph showing completed osteotomies. (M) Frontal photograph of the patient after healing. (N) Occlusal photograph after healing and arch-bar removal.

Fig. 13



The most common causes of malunion are inadequate dental reduction during surgery, inadequate osseous reduction during surgery, imprecise application of internal fixation devices, and/or inadequate stabilization. 16 Malunions can occur with closed treatment as well. However, the improper use of rigid internal fixation devices can very easily cause it. Improper bending of a plate, inadequate occlusal reduction due to loss of teeth, and improper application of compression techniques can very easily lead to healing in the wrong position.

One must pay special attention to assure that the lingual cortex has been adequately reduced in a symphyseal fracture because the intraoral approach usually hides the lingual cortex from the surgeon, creating a false sense of adequate reduction when evaluating the buccal cortex only. To assure this does not occur, one must use manual pressure applied to the mandibular angles until the point where the fractured buccal cortices separate a bit, assuring proper lingual adaptation. Alternatively, one can surgically expose the lingual cortex by different surgical exposure techniques.

Inadequate adaptation of a bone plate can cause malunion. The precise adaptation of a bone plate to the underlying bone is never really known with any certainty until the screws (nonlocking) have been inserted and tightened. If the plate was not properly adapted, the bone fragments will not be properly reduced, and this may cause a malocclusion. The use of locking screw/plate systems has helped eliminate this problem because the bone is not drawn toward the plate when the screws are tightened.

Failure to establish the pretrauma occlusion is another common cause of malunion and malocclusion. 16 Asking the patient or their family for a history of prior orthodontic therapy and/or the acquisition of dental models as well as pretrauma photographs can be very useful to figure out what the pretrauma occlusion was like.

A frequent cause of malocclusion is from condylar process fractures. One must understand that closed treatment of condylar process fractures accepts a malposition of the condylar fragment, resulting in a malunion. However, most of the time with proper rehabilitation, a malocclusion can be prevented. When closed treatment is not successful, a malocclusion results. Similarly, with open treatment of condylar process fractures, the condylar fragment must be properly reduced prior to application of internal fixation hardware to assure the occlusion is restored.

Treatment of malunions necessitates identification of the cause and assessment of the severity. If the malocclusion is minor, occlusal adjustments by grinding the teeth and/or orthodontic/orthopedic means can be attempted for a short period of time. Many minor occlusal irregularities will be satisfactorily treated by elastic traction between the upper and lower teeth. For more severe malunions, osteotomies may be necessary. In such instances, the old fracture site may serve as the site of osteotomy. In others, more standard osteotomy sites commonly used in orthognathic surgery can be employed. An orthognathic surgery work-up will help.

6.3 Iatrogenic Complications

The most common iatrogenic complication that can occur when rigid internal fixation of mandibular fractures is used is placement of a screw or screw hole through a normal anatomical structure such as a tooth root or the mandibular neurovascular bundle (Figs. 14 - 15). Because the mandible contains tooth roots above and the inferior alveolar neurovascular canal in the middle, the only place where bicortical bone plates can be applied safely on the lateral cortex is along the inferior border.

Fig. 15

Postoperative panoramic radiograph of a patient who was treated with bone plate fixation for a left angle and right body fracture. Both were treated through a transoral approach. Note that the posterior portion of the reconstruction bone plate applied to the right mandibular body is too high, with all screws entering the inferior alveolar canal. This can occur because visibility and access in the posterior mandible is very limited when using a transoral approach.

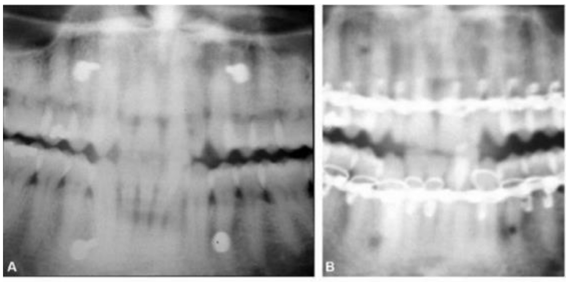


Fig. 14

Radiographs of a patient whose mandibular fracture was stabilized with mandibulomaxillary fixation screws. (**A**) Immediately after surgery. (**B**) After removal of the MMF screws. Note the hole through the root of the lower left first premolar.

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