MANDIBULAR FRACTURES

CONTENTS

ABBREVIATION LIST

MVA: Motor Vehicle Accident

TMJ : Temporomandibular Joint

SA : Sports Accident

DA: Domestic Accident

AAW: Occupational Accident

CHUO: Owendo University Hospital

CT: Computed tomography

OPT: Orthopantomogram

X-ray: X-ray

V3: Inferior alveolar nerve

INTRODUCTION

The mandible is a single, medial, symmetrical and mobile structure, representing the skeleton of the lower part of the face [1].

She is often exposed to trauma including fractures; These fractures occupy an important place in maxillofacial traumatology, because the mandible is a real bumper of the face because of its prominence. Mandibular fractures can be considered a medical emergency because of the hemorrhage, and the subsequent risk of respiratory complications. [2-4].

According to published reports, mandibular fractures are among the most common facial skeletal fractures, they account for 46-87% of facial fractures in Brazzaville for EBOUNGABEKA *et al* in 2020 [5-7], but GUALTIERI *et al* in 2021 find these fractures in 85% of facial mass fractures according to a study conducted in central Italy. However, according to FARZAN *et al*, find 36-59% in Iran in 2021.

In a study conducted in Cameroon by KEUBEU et al on etiologies, they noticed that mandibular fractures generally affect young male subjects whose etiology varies according to geographical, demographic and socioeconomic contexts. This allows DIA TINE et al to identify in a study conducted in Senegal the main etiologies: road accidents followed by assaults, work accidents, sports accidents and domestic accidents [3,8,9].

As far as the diagnosis is concerned, the clinical examination is often difficult initially, it must be meticulous to look for signs pointing to a mandibular fracture. This clinical examination will be completed by an orthopantomogram, which was once the key examination for diagnosis, still in use in some countries, revolutionized here by computed tomography which specifies certain anatomical forms of fractures and is becoming more and more the first-line morphological examination [10].

This diagnosis makes it possible to locate the location of the fractures and the type of stroke which depends on the type of shock received. Thus, condylar fractures are the most common in India according to a study by GHODKE et al, while fractures of the horizontal branch are generally the most frequent, followed by those of the angle according to a study carried out in Morocco [2,11]

Restorative treatment is surgical and currently consists of approaching the fracture sites and their retention or fixation by osteosynthesis, especially by screws and miniaturized plates.

This divergence at the level of epidemiology and clinical practice leads us to produce this book, with the aim of understanding the management and positioning ourselves on a therapeutic choice.

I. GENERAL

I.1.DEFINITION

Mandibular fractures are defined as any solution of mandibular bone continuity, which occurs on healthy or pathological bone following trauma by violent shock or spontaneously [12].

I.2. ANATOMICAL REMINDERS

I.2.1. The mandible

I.2.1.1 Situation

The mandible is the only symmetrical, medial, mobile bone of the face located on the lower and anterior level of the face. The mandible articulates with the maxilla via the dental joint and with the temporal bone at the temporomandibular joint (TMJ) and forms the lower jaw on its own. **(Figure 1)**

Figure 1: Situation of the mandible [2]

I.2.1.2 Description [2,3, 4]

It can be distinguished three parts that unite at the angle of the mandible:

-**A body** (horizontal branch) carrying teeth and depressor muscles

-**Two vertical parts**, ascending lateral branches, these are **the ascending branches** or Ramus.

I.2.1.2.1 Body

Curved in a horseshoe, it has [02] two faces, as well as [02] two edges. An upper or alveolar edge and a free lower edge. It carries the teeth of the lower jaw.

- **External surface** (cutaneous)

It is bounded on the median plane by the chin symphysis and on the lateral plane by the oblique line, it is composed of:

- The chin symphysis: it is a median vertical ridge that extends downwards, at the top of a pyramidal projection; the chin eminence, with chin tubercles running along either side of its base at its salient angles (Figure 2).

- The oblique line: having as its starting point a chin tubercle, it runs upwards and backwards to merge with the outer lip of the anterior edge of the branch of the mandible.

- The mental foramen: a real crossroads of the mandible located below the 2nd premolar, a place where the vessels and the mental nerve pass, this is of major interest in the clinic because damage to the latter can cause sensory losses.

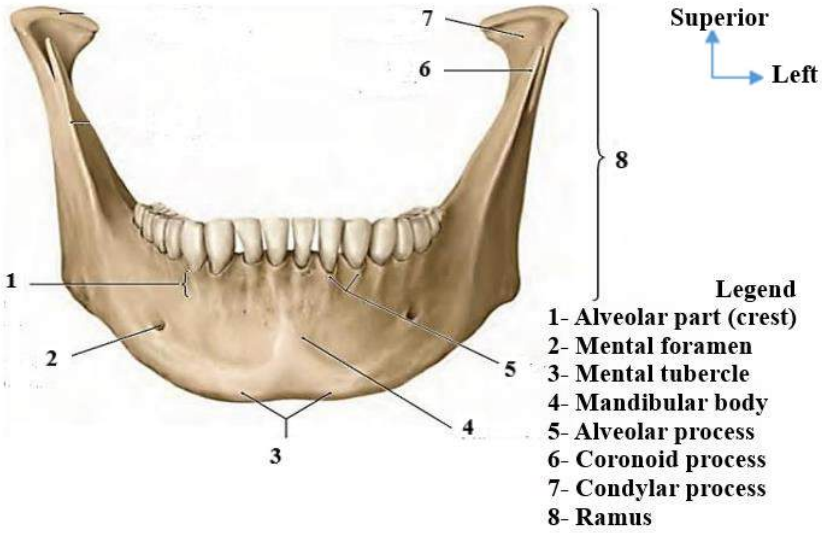
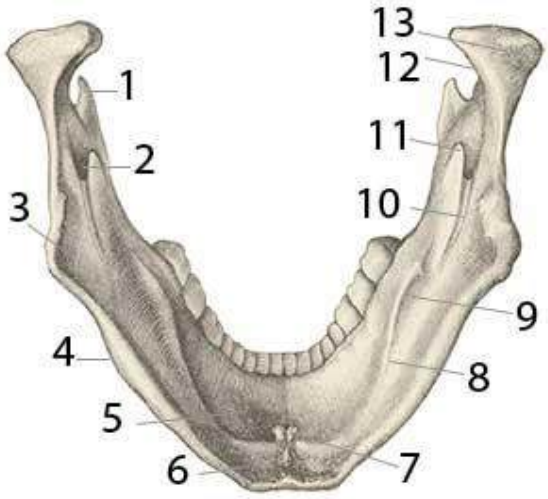


Figure 2: External surface of the mandible **[25]**

- **Internal surface (**mouth)

The inner surface is concave posteriorly, it receives on the middle part, two pairs of small superimposed protrusions at the rate of one pair on each side (left and right) which are the genio-superior and genio-inferior processes (also called superior and inferior chin spines) on which the genioglossal and genio-hyoid muscles will be inserted respectively and which during a bifocal fracture will cause respiratory distress, the internal oblique line or mylohyoid line (Figure 3) starts from the upper chin spines to extend upwards and backwards to merge with the inner lip of the mandibular ramus where the mylohyoid muscle is grafted.

Thus, the inner surface of the body of the mandible is divided into two parts by the internal oblique line. The part above this line which includes the sublingual gland8e is called the sublingual fossa and the other part below which includes the submandibular gland is called the submandibular fossa.



Superior

Left

1-Coronoid process

2-Mandibular foramen

3-Angle

4-Base of mandible

5-Sublingual fossa

6-Digastric fossa

7- Superior and inferior mental spines (genial tubercles)

8- Mylohyoid line

9-Submandibular fossa

10-Mylo-Hyoid Groove

11- Lingula

12-Condyle Neck

Figure 3: Posterior view of the mandible [2,3]

- **Superior border** or alveolar border

This edge is the seat of cavities 'the alveoli' intended for the roots of the teeth, there are eight of them on each side, the existence of this edge changes with age and the condition of the teeth << the alveolar bone is born and dies with the teeth>> It has two protrusions; one located anteriorly, which corresponds to the coronoid process, and the other posteriorly, the condylar process, both are separated from each other by the mandibular indentation. We describe:

- The coronoid process: Where the temporal muscle tendon is located;

- The condylar process: Which joins at the base of the skull by the temporomandibular joint;

- Mandibular indentation: Crossing by the masseteric vessels and nerves.

- **Inferior border**

This edge is thick, foamy, smooth. It presents, a little outside the midline, an oval surface, slightly depressed, the digastric dimple, on which the front belly of the digastric is inserted.

I.2.1.2.2 Ascending branches (Ramus)

They are connected to the temporal bone by the temporomandibular joint and allow the movement of the mandible.

Each branch has two faces, four edges which are as follows:

- **A lateral face** :

Made of rough ridges at the lower part on which the masseteric tendinous laminae are attached;

- **A medial face** :

In turn, it has rough lower ridges receiving the medial pterygoid muscle. This face communicates with the parotid gland and has in its posterior half:

-The mandibular foramen: Area of passage of the inferior alveolar vessels and nerves, it is an orifice located halfway to the inner side of the mandibular ramus near the spine of the spix (lingula);

-The mylohyoid groove: Groove that gives passage to the mylohyoid nerve and which originates at the medial aspect of the mandibular branch;

-The pterygoid tuberosity: This is a rough area for the attachment of the medial pterygoid muscle to the inner surface of the angle of the mandible;

There are four edges and they are described as follows:

- **Anterior border** :

Thin, almost sharp, slightly concave in front, continues with the anterior edge of the coronoid process.

- **Posterior border** :

Thick and rounded, very slightly concave posteriorly, widens at the top where it forms the posterior surface of the condyle.

- **Inferior border** :

Follows the lower edge of the body: it is less thick than the latter; at the point where it continues with the lower edge of the body, it sometimes bears the impression of the facial artery.

- **Superior border** :

It has two protrusions separated by a wide indentation, the coronoid process in front, the condyle behind.

I.2.1.2.3 Mandibular angle

It is defined, by convention, as the area between a vertical line tangential to the distal surface of the second molar and a horizontal line passing through the mandibular alveolar margin.

I.2.2 Temporomandibular joint [2,3,4]

The temporomandibular joint is a bicondylar diarthrosis, i.e. a paired joint that joins the mandible to the temporal bone, is an integral part of the manducatory apparatus. It is located on the lateral part of the face, behind the facial mass. It is a complex, ellipsoid-like synovial joint (Figure 4).

1. Temporomaniscal frenulum

2.Posterior articular capsule

3.Mandibular fossa of the temporal

4.Cartilaginous part of the articular disc

5.Articular tubercle of temporal bone

6.Superior synovial cavity

7.Anterior articular capsule

8.Lateral pterygoid muscle

9.Articular disc

10.External acoustic meatus

11.Fibrous membrane of the articular disc

12.Condylar process of mandible

13.Inferior synovial cavity

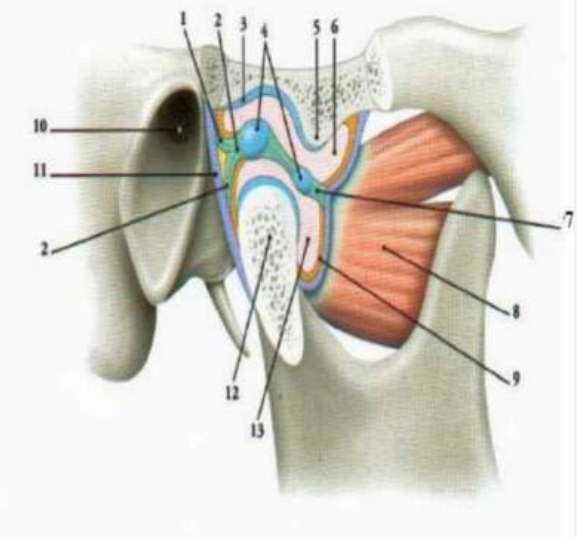


Figure 4: Sagittal section of the TMJ [4]

I. 2.2.1 Joint surfaces

The articular surfaces are formed on the one hand by the mandibular fossa and the articular tubercle of each of the temporal bones; on the other hand, of the two condylar processes of the mandible.

- **Temporal surface**

It is the infrazygomatic part of the temporal bone, it presents from front to back the articular tubercle, the glonoid fossa and the post-glenoid tubercle.

- Temporal condyle or articular tubercle: represents a true articular surface, it is convex encrusted with cartilage.

-Mandibular fossa or glenoid cavity: has the same axis of the articular tubercle. It is divided by the Glaser fissure into two parts, an anterior articular one in continuity with the posterior side of the condyle and another posterior non-articular part, merging with the anterior wall of the external acoustic meatus (Figure 4).

- **Mandibular surface**

Represented by the mandibular condyle which is an oblong projection, elongated from outside to inside and from front to back; formed by two slopes separated by a foam ridge parallel to the long axis of the condyle: an articular convex anterior side covered with cartilage and a posterior side practically vertical intra-auricular but not covered with cartilage (Figure 4).

I.2.2.2 Interarticular disc or meniscus apparatus

The articular surfaces are convex and can only fit with a biconcave disc (articular meniscus) of transversely elongated, oval shape, with a large medial end (Figure 4).

I.2.2.3 Means of union

- **Capsule**

It is a fibrous truncated conical sleeve that surrounds the TMJ. Its deep side adheres around the meniscus. It inserts into the temporal and mandibular regions through short and deep temporo-discal and mandibular discal fibers inserted on

the meniscus and superficial temporomandibular fibers and some lateral pterygoid fibers. These deep fibers thicken and become meniscal frenulums: posterior temporomeniscal, anterior temporomeniscal, medial and lateral menisco-mandibular (Figure 4).

- **Synovial**

It lines the deep surface of the capsule, is subdivided into two synoviums; one superior or suprameniscal and another inferior or submeniscal. Synovial fluid lubricates the joint and thus facilitates joint movement.

- **Ligaments**

Intrinsic ligaments

There are two of them:

-The lateral collateral ligament: thick, powerful, it inserts at the top on the lateral edge of the articular surface, covers the external surface of the joint. This ligament is in permanent tension and is a real pivot of the TMJ.

-The medial collateral ligament: less resistant, is stretched from the medial edge of the mandibular fossa of the temporal and the sphenoid spine, to the postero-medial aspect of the mandibular neck; covers the inner side of the joint.

Extrinsic ligaments

These accessory ligaments are fibrous bands; they seem to intervene only in the guidance of the mandible during opening-closing movements. There are four of them: the spheno-mandibular ligament, the stylo-mandibular ligament, the pterygo-mandibular ligament and the tympano-mandibular ligament.

I.2.3 Vascularization **[5]**

The vascularization of the mandible is mainly provided by the inferior alveolar artery, a branch of the maxillary artery, itself a dividing branch of the external carotid artery.

This vascularization is based on two distinct networks; the endosted network and the periosteal network.

I.2.3.1 Endorsed network

It is the most predominant, it is formed by the intraosseous branches of the inferior alveolar artery, itself a branch of the maxillary artery (Figure 5). After birth, at the medial aspect of the ramus, it enters the mandible at the level of the lingula before continuing its way into the mandibular canal, accompanied by the inferior alveolar nerve. Then, it sends an ascending branch intended for the vascularization of the condyle, the condylar artery; it then distributes collateral branches for the angular region, then for the body of the mandible, branches with a bone destiny downwards, with a bone and dental destiny upwards. Its terminal branches are two in number, one for bony purposes, which is the incisor artery, which vascularizes the symphysis and the other which is the chin artery which exits the mandible through the mental hole before branching out into the soft parts of the chin region.

I.2.3.2 Periosteal network

This network is dependent on the muscles and nearby arteries. The periosteal vascularization of the mandible includes:

- The symphysis: the termination of the submental artery for the anterior surface, the sublingual artery (branch of the lingual artery) for the posterior surface. Muscle insertions on the geni, and chin muscles participate in the vascularization of the symphysis.
- The body: vascularization is provided by the branches coming directly from the facial artery and the sublingual artery. The numerous muscle insertions also contribute to the blood supply to the bones.
- The angle: the periosteal vascularization is provided exclusively by the branches of muscular origin, originating from the masseter and medial pterygoid muscles.

- The ramus: the masseterin, deep temporal and pterygoid arteries participate in this vascularization through muscle insertions.

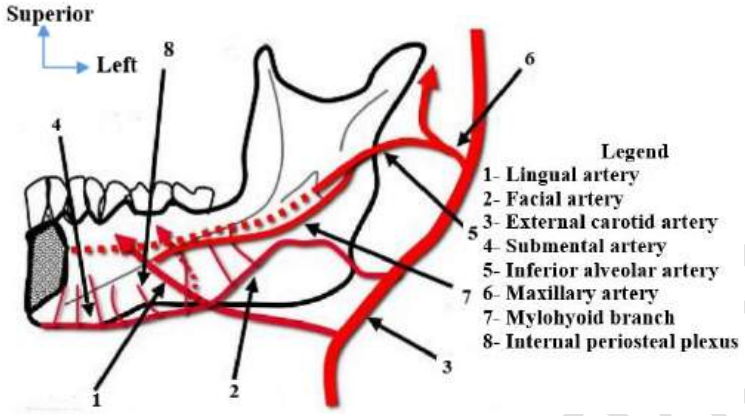


Figure 5: Vascularization of the mandible **[25]**

I.2.4 Innervation [4,5]

The innervation of the mandibular bone is mainly provided by the inferior alveolar nerve, a branch of the mandibular nerve, the third branch of the trigeminal nerve division. It provides mixed innervation: sensory and motor.

I.2.4.1 Sensory innervation

The sensory fibers of the mandibular nerve pass through the foramen ovale of the skull and reach the dura mater cranial, the external auditory meatus, the tympanic membrane and pinna of the ear, the posterior area of the temple, the TMJ, the mucosa of the cheeks of the oral floor, an anterior part of the tongue, and the teeth of the lower jaw.

I.2.4.2 Motor innervation

The motor fibers of the mandibular nerve pass through the foramen ovale and innervate the tensor muscles of the eardrum and palate, the masticatory muscles, the digastric muscle, and the mylohyoid muscle, these fibers then extend to the pterygoid muscles and the mandible. They have a role in chewing and swallowing.

I.2.5 Manducatory muscular system [4,5]

The position of the mandible depends on the degree of contraction of three main muscle groups: the levator muscles, the depressor muscles, and the propellent muscle.

I.2.5.1 Elevator muscles of the mandible

These muscles are commonly referred to as masticatory muscles. They form an autonomous group from an anatomical and physiological point of view. There are three of them, grouped together because of their main function: to lift the mandible. These are the muscles of the mouth closure. This group includes:

-The temporalis muscle

It occupies the temporal fossa, it is fan-shaped, it is thin and spread. These bundles converge towards the coronoid process. It has a role in mandibular elevation and retropulsion. It is innervated by a branch of the temporomasseterine nerve, which passes through the mandibular incisure before branching off between the two fascicles of the muscle.

- The masseter muscle

It is one of the most powerful muscles in the body. It is a muscle, short, thick, quadrilateral-shaped. It is located on the outer surface of the ascending branch of the mandible. It originates at the level of the zygomatic arch and ends at the level of the mandibular angle. It has a powerful action in the elevation of the mandible, it ensures the power of the trituration. It is innervated by a branch of the temporo-masseterine nerve.

-The medial pterygoid muscle

Quadrangular in shape. It originates in the pterygoid fossa and ends at the inner side of the angle of the mandible. When it contracts bilaterally, it will cause an elevation. Its unilateral contraction will lead to a slight deduction (side-to-side). It is innervated by a branch of the mandibular nerve.

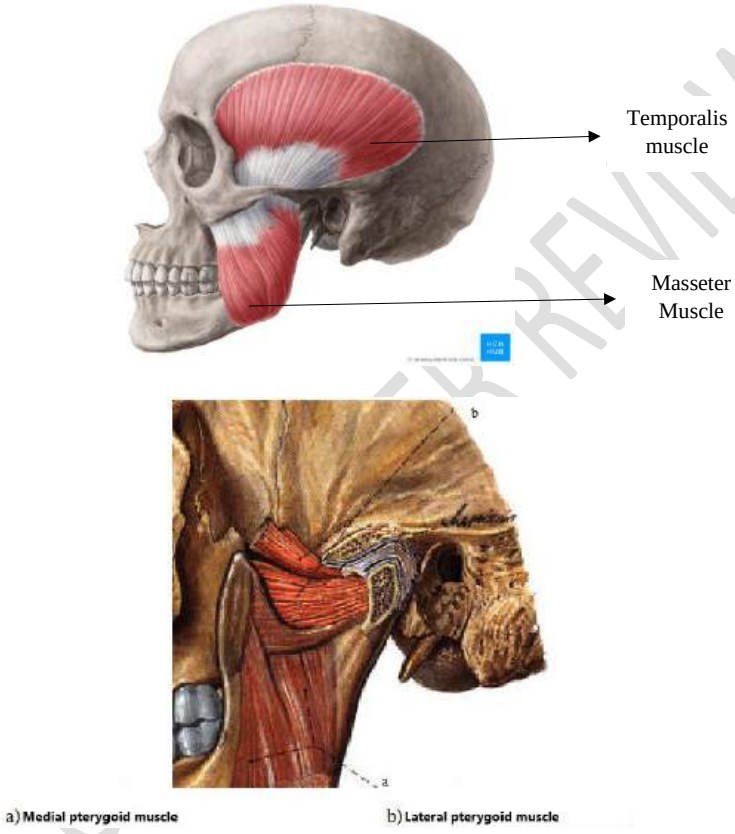


Figure 6: Ascending muscles of the mandible

I.2.5.2 Depression muscles of the mandible

They are represented by the digastric, the mylo-hyoid, the geniohyoid, which belong to the group of sus hyoid muscles.

-Digastric muscle

It is located in the upper and lateral region of the neck. It has two bellies: the hind and the anterior. It is inserted at the level of the mastoid process of the temporal bone and goes to the mandible.

-Mylohyoid muscle

Joined on the line to its counterpart, it forms a solid strap between the mandible and the hyoid bone. It is inserted into the medial aspect of the body of the mandible at the level of the mylohyoid line. Apart from being, it also participates in swallowing by placing the tongue on the roof of the mouth, and by the same action it participates in the emission of high-pitched sounds.

-Geniohyoid muscle

It participates with the mylohyoid muscle in the constitution of the oral floor. It inserts itself forward on the genial-inferior processes, when these are individualized. Cylindrical in shape, it runs backwards, resting on the mylohyoid muscle to insert itself on the anterior aspect of the body of the hyoid bone. It is a depressor of the mandible when the hyoid bone is the fixed and elevating point of the hyoid bone when the mandible is fixed. Its innervation is provided by a branch of the same name, derived from the hypoglossal nerve.

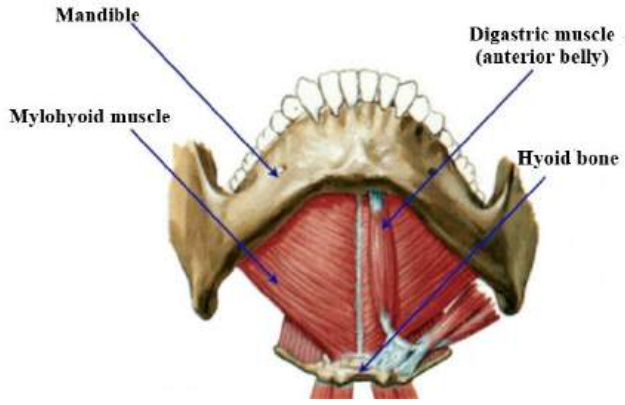


Figure 7: Lowering muscles of the mandible

I.2.5.3 Propellant muscles of the mandible

The lateral pterygoid muscle dominates this muscle group. It allows the propulsion of the mandible in association with the medial pterygoid muscle. Only it determines a contralateral diduction movement. Other muscles are incidentally involved in propulsion. These are the anterior bundle of the temporal muscle, the masseter muscle and the medial pterygoid muscle that we have presented above.

I.3. EPIDEMIOLOGY

I.3.1. Age

Mandibular fractures are more common in young adults. A study by ELLA et *al* conducted in Gabon found an average age of 22.3 ± 12 years with extremes of 2 and 72 years. Young adults (25-39 years) were the most representative with 39.2% of cases **[6].** These results are similar in Cameroon; to the study of MALA et *al*, whose average age was 30 years. This observation was the same in the work of KEUBOU *et al*, the peak frequency is between 21-30 years for an average age of 28.21 years **[7.8].** However, OMEJE *et al* observe a predominance of mandibular fractures in the third decade **[9].**

I.3.2. Gender

The work of Makungu et *al* reported a male predominance of 75.5% compared to 24.5% of women with a sex ratio of 3.1 **[13].** This is explained by the fact that men are more exposed to the various etiological factors of mandibular trauma, which are none other than road accidents, assaults, brawls, sports accidents and falls.

The majority of surveys have shown that men are more prone to maxillofacial trauma than women. Thus, these results are consistent with those of other studies; indeed, Coulibaly *et al* in Mali have regained a male predominance with a sex ratio of 4.7 **[14].** DIA TINE *et al* in Senegal also found a similar result with a sex ratio of 3.9**[3].**

I.3.3. Means of transport

Patients were transported in personal vehicles in 53% of cases, by ambulances in 31% and taxis in 13.5%, report Makungu et *al* **[13].** Another study conducted in Gabon shows that 41% of traumatized people were evacuated by taxi and 30.7% by personal transport **[9].** These means of transport are unsuitable for transporting the wounded. This demonstrates the poor communication in the care of the traumatized person at the scene of the accident and the difficulty of the population to be able to reach the rescue units in our country.

I.3.4. Mechanism

Direct shock was the most common trauma mechanism, 88% compared to 12% for indirect shock, according to a study conducted in Gabon **[9].** This denotes the exposure of the mandible to any violent contact and its role as a protective shock park for the base of the skull

I.3.5. Etiology

Accidents on public roads were the most common cause. In the study by ELLA et *al*, MVA's come in first place and they are found in 47% of cases, followed by assault and battery (brawls and assaults) in 28.9% of cases [15] (Figure). This can be related to the quality of the road network, the non-compliance with the highway code by drivers as well as the poor vigilance of pedestrians in our regions.

These results are similar to those observed in Gabon in a MAKUNGU study where PVAs accounted for 59% of cases **[13].** In Dakar in the study by DIA TINE *et al* where MVA represents the most frequent etiology with 45% of cases **[3]**; in Meknes in Morocco, FRIKEL found a frequency of MVA in 65% of cases **[16]**; similarly, MALA *et al* in a study in Yaoundé in Cameroon noted a frequency of MVA of 73% **[17].** This contradicts the studies of Razafindrabe et *al*, phamdang et *al* and Alexander et *al* where brawls and aggressions are the dominant etiologies **[18,19].**

In Europe, the number of MVA's is fundamentally decreasing, and all the efforts made in terms of road safety have borne fruit. Among these series, we have the study by RASHID *et al* performed in a teaching hospital in London, England where the most common etiology is interpersonal violence at 72% **[20].** In Vojvodina in Serbia, NALIC *et al* found a frequency of assaults of 47.3%, followed by road accidents, which accounted for 24.3% of cases **[21].** In a bicentric study carried out between Turin in Italy and Amsterdam in the Netherlands by Boffano *et al*, the main etiology is found in acts of violence as well as in the studies mentioned above **[22].**

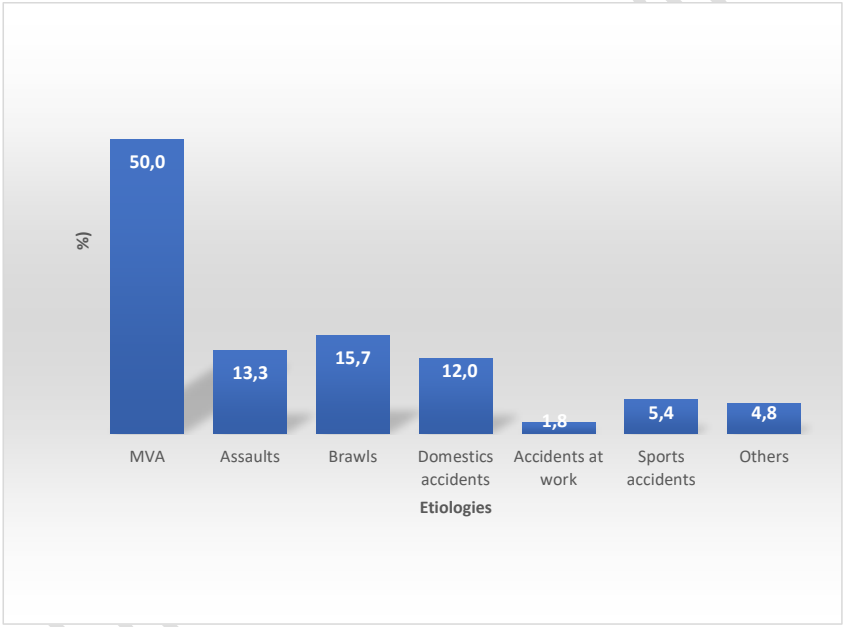


Figure 8: Distribution of mandibular fractures by etiology

I.4. PATHOPHYSIOLOGY

I.4.1 Architectonics [10,23]

Architecturally, the mandible is a cancellous corticosteroid bone. The cortical case is subject to mechanical stresses. Its upper edge is open to the dental sockets made of trabecular bone and solicited by the forces used during chewing.

In this cortical envelope, the space is occupied by the trabecular cancellous bone forming a so-called "honeycomb" structure that offers lightness and mechanical stability to the whole. The mandible has lines of reinforcement (Figure 7) in the thickness of its corticals. They were highlighted on dry bone by the method of colored cracking lines. There are five bays :

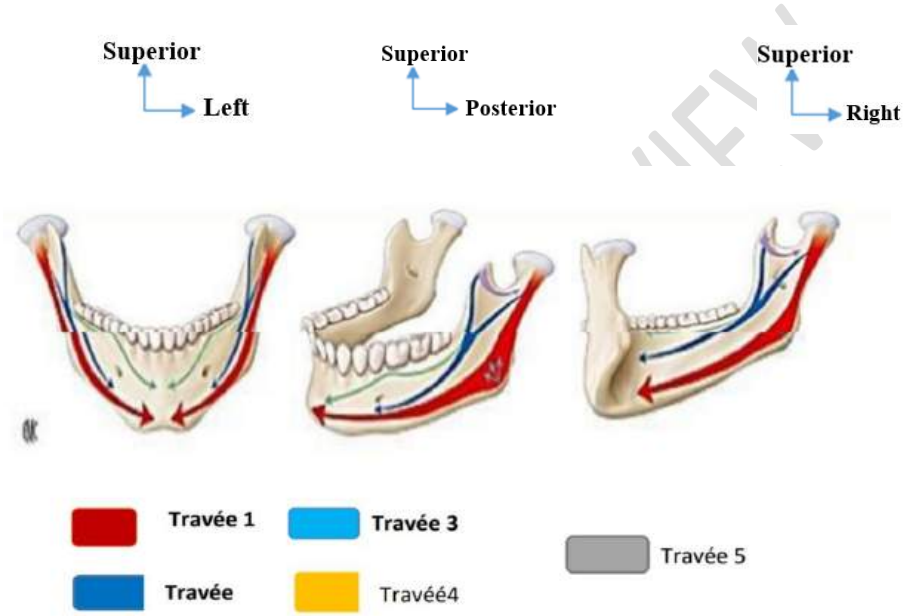


Figure 9: Mandible Reinforcement Lines [10]

- Span 1: follows the mandibular form from the condyle to the symphysis;
- Span 2: in Y, merges with span 1 on the external cortex;
- Span 3: fan-shaped in the corner, lost in span 1;
- Span 4: arciform in the sigmoid ec2hancure;
- Span 5: at the alveolar margin, bends at the level of the external cortex.

Spans 1 and 2 are related to the horseshoe-shaped mandibular morphology and compressive forces for the former, torsional forces for the latter; Spans 3 and 4 result from the muscular forces exerted on the bone (mainly by the masseter muscles for spans 4, medial pterygoid and temporal muscles for spans 3); The fifth span is related to the complex system of tooth support; It is absent in the fetus and the edentulous

I.4.2 Kinematics [2]

The mandible performs simple and complex movements in the three planes of space. During movements, the suspensory muscular system of the mandible, formed by the masseter and medial pterygoid couple, absorbs pressure and shocks.

I.4.3 Dynamics [2]

The forces exerted on the bone are compressive forces via the dentition, tensile forces via the masticatory muscles and torsion-flexion, especially in the symphyseal region. The theoretical clamping forces that can be exerted on the mandible are from 100 to 250 N. The functional forces are 29 to 66 N. They vary according to the sector with an increasing gradient from the front (incisors) to the back (molars). **(Figure 9)**

The bone structure of the mandibular dentate portion is subjected to an alveolar tension force on the one hand and to basilar compression on the other. The neutral line of force is located along the inferior alveolar nerve, protecting it from trauma.

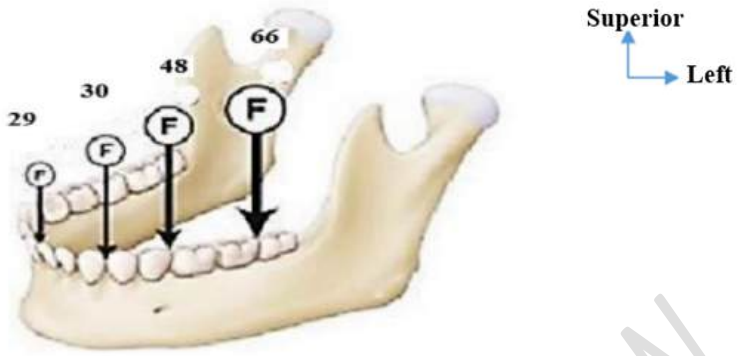


Figure 10: Masticatory forces exerted on the mandible

I.4.4 Biomechanics [24]

- **Study by the finite element method or physico-mathematical modelling**

The mandibular bone is an anisotropic living structure so its mechanical properties are not identical in the three planes of space, and viscoelastic because it deforms both in the plastic and elastic domains. Thus, the biomechanical study is complex and poses problems that have not all been solved. The study 8 by the finite element method allows a physico-mathematical approach. It consists of establishing a simpler model of the structure to be studied. The actual structure is divided into a number of simple and homogeneous geometric elements whose mechanical behavior is easy to determine.

- **Reflection photoelasticity**

It is the study of the deformations occurring in a birefringent coating. Bone deformities are inscribed on the coating in the form of luminous fringes that are studied in polarized light. It allows an analysis of the real structure by a surface examination. The photoelasticity studies carried out by Kessler find that the tensile forces are exerted at the alveolar margin and the compressive forces on the basilar edge.

➢ **Theories on the biomechanical functioning of the mandible**

The mandible can be likened to an anatomical structure with "mechanical fuses". In mechanics, when the failure of a structure is inevitable, it is predictable in specific places. The preferred fracture sites can be likened to "mechanical fuses". It is thus conceivable that a trauma to the chin leads successively to an angular, parasymphyseal and symphyseal fracture depending on its intensity. Both biomechanical studies of the dentate portion of the mandible and fracture statistics confirm the existence of selection areas for fracture sites.

I.4.5 Mechanisms [1]

Two types of trauma can lead to a fracture of the mandible depending on their mechanism:

-**Direct** trauma: the fracture occurs where the trauma occurs, when a large force is applied to a small area of the mandible it is independent of the bone and dental architecture of the site.

- **Indirect** trauma: the fracture manifests itself at a distance from the place where the trauma occurred at the level of the areas of weakness.

I.4.6 Fracture line and its location [11]

Fractures of the mandible can occur in several forms, regardless of the location of this fracture. The features are:

- Single or multiple

- in butterfly wing

- Comminuted

-Oblique

-Vertical

- Complete or incomplete

- Total or partial

- Total or partial

- Green wood and can be found in the toothed portion, the non-toothed portion and the toothed and non-toothed portion.

I.4.7 Displacement of fracture fragments [25]

Displacements are made under the influence of several factors: The mechanism of the fracture, The location and number of fracture features, their orientation, the dental joint, the action of the muscles.

There are four types of travel (Figure 10):

- angulation in the frontal plane: vestibulo-temporal

- overlap in the horizontal plane: mesio-distal

- the shift in the vertical plane: radiculo-triturating.

- torsion in the vertical plane: vestibulo-temporal

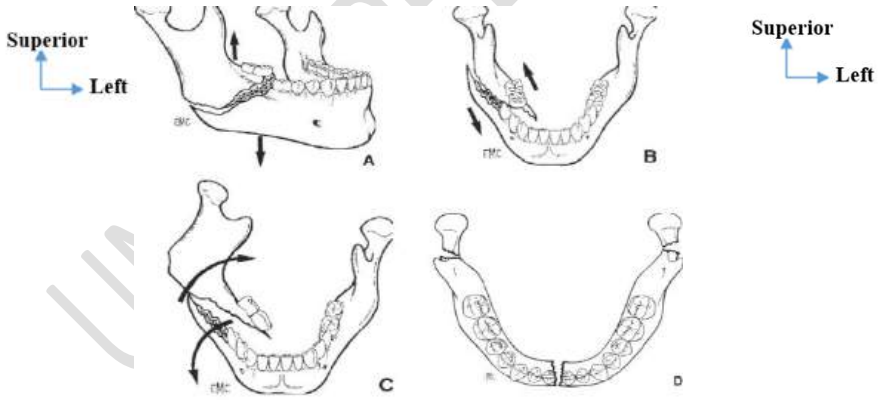


Figure 11: Types of Mandibular Fragment Displacement [25]

Thus, the depressor muscles of the mandible and protractors of the tongue that insert on the symphysis cause glossoptosis in the event of a parasymphyseal and/or bilateral symphyseal fracture by receding the symphysis and its muscle insertions. The fracture line can be favorable or unfavorable depending on the displacements induced by the resultant of muscle forces on either side of the breaking point. (Figure 12)

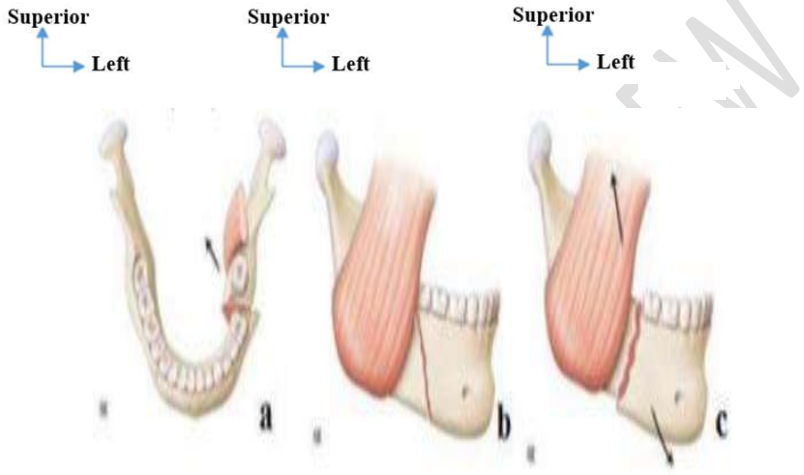


Figure 12: Displacement of fractures under the action of muscles

I.5. Classification

I.5.1Mandibular Fracture Trait [24]

Mandibular fractures can be partial or total, isolated or associated.

➢ **Unifocal**

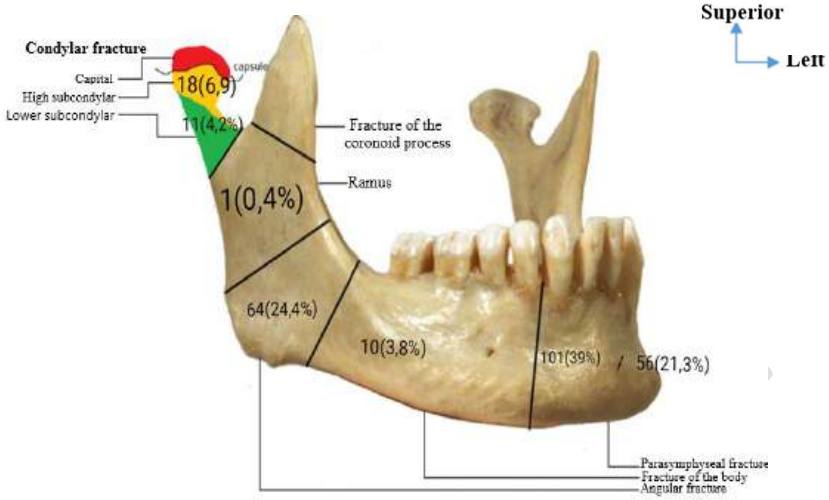


Figure 13: Mapping of mandibular fractures

In the study by ELLA et al conducted in Gabon, parasymphyseal fractures are the most common with 39% of traits, followed by angular fractures with 24.4% and symphyseal fractures with 21.3% (Table 1) **[15].** Parasymphyseal involvement is explained by the fact that it is more exposed during trauma affecting the mandible.

This predominance of parasymphyseal involvement is found by VYAS *et al* in India **[26]** where this involvement is found at 32.5%, a little less in Libya by ELARABI and BATAINEH (20%) **[27].** On the other hand, a greater involvement of other regions is found in the series of AKINBANI *et al* in Nigeria [28], ROOD *et al* in South Africa **[29],** IMAI et al in Kawasaki in Japan **[30]**, SAKR *et al* at the University Hospital of Alexandria in Egypt **[31]** and AFROOZ *et al* in the United States **[32].**

Table 1: *Location of mandibular fracture traits according to laterality*

	Right	**Left**	**Bilateral**
Toothed portion			**P=0.025**
Parasymphysis	45(17,1%)	28(10,6%)	14(5,3%)
Angle	28(10,6%)	36(13,7%)	0(0%)
Symphysis	25(9,5%)	21(8,0%)	5(1,9%)
Body	3(1,1%)	5(1,9%)	2(0,8%)
Non-toothed portion			
Upper subcondylar	7(2,7%)	7(2,7%)	2(0,8%)
Lower subcondylar	5(1,9%)	6(2,3%)	0(0%)
Ramus	1(0,4%)	0(0,0%)	0(0,0%)

- **Multifocal Line**

For their distribution, the study is dominated at 50.6% by bifocal fractures, this predominance is also found in the study of NGAGOUM **[25]** and MAKUNGU where these fractures are representative with 26.1% and 84% of cases respectively **[13].** These results contrast with the studies carried out in Cameroon by GERARD *et al* **[33]** where monofocal fractures rank first with 65.7% followed by bifocal fractures with 25.4%; 61.0% for monofocal fractures and 33.6% for bifocal fractures in Mahdia in Tunisia by HAMILA *et al* **[34]** and in South Korea by CHA *et al* **[35]** where monofocal fractures represent 51.3% compared to 45.5% for bifocals. In our study, the trifocal fractures are 3.0%, however, in the study by KEUBOU *et al* in Kumba, Cameroon **[8],** they are 4.26%; quadrifocal fractures are around 0.6%, this result is lower than those of

the MAKUNGU**[13]** and NGAGOUM **[25]** studies in Gabon, which found 2.1% each.

- Representativeness of fracture lines

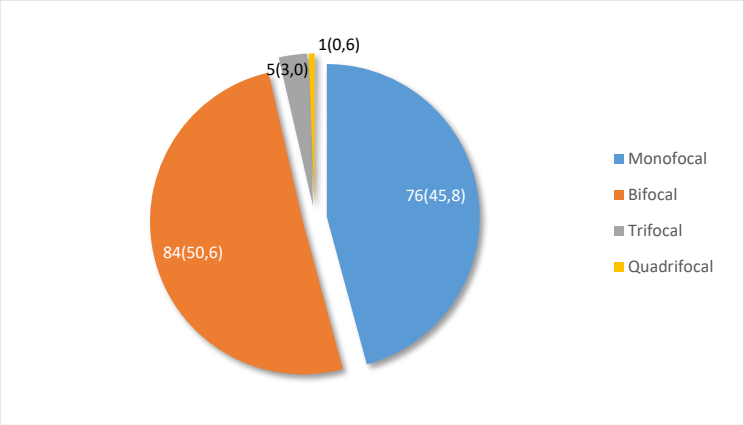


Figure 14: Number of fracture lines

I.5.2. Partial Mandibular Fractures

They affect only part of the mandible and do not interrupt its continuity. They are mainly located on the anterior dentate part, more rarely on the non-toothed part. Among these fractures, the most common are :

- Fractures of the alveolar or alveolar-dental rim.
- Fractures of the basilar margin.
- Fractures of the coronoid process.

I.5.3. Total Mandibular Fractures

Unifocal or plurifocal, they affect the entire thickness of the mandibular bone and break its continuity.

I.5.3.1 Fractures of the dentate portion: They directly affect the dental arch (symphysis, horizontal branch), the tearing of the fibromucosa is the rule. It results in a disorder of the dental joint :

- Fracture of the symphysis: between the two canines Line: vertical, bayonet-shaped or lambdoid (inverted Y-shaped). Displacement: Usually minimal.

Figure 15: Dental panning of a symphyseal fracture (Anterior view) [33]

- Fracture of the horizontal branch: are located between the medial surface of the first premolar and the distal surface of the wisdom tooth.

Stroke: is rarely vertical, most often oblique from top to bottom and front to back; Displacement: variable essentially shift by ascent of the posterior fragment and lowering of the anterior fragment.

- Angle fracture: between a vertical line passing through the distal surface of the second molar and a horizontal line passing through the alveolar margin.

Stroke: oblique from front to back and from top to bottom, or from back to front and from top to bottom;

Displacement: Variable depending on the orientation of the fracture line.

Figure 16: fracture of the angle Side view of the mandible [36]

I.5.3.2 Fractures of the non-dentate portion: These are located behind the dental arch (ascending branch, condylar region).

- Fractures of the ascending branch: these are rare fractures, exceptionally displaced due to the protective role of the pterygomassagerin muscle strap.

  Mechanism: either direct or indirect;

  Fracture line : horizontal or oblique ;

  Displacement: minimal.

- Condylar fractures: limited at the bottom by a line tangent to the lower edge of the sigmoid indentation.

Features: there are anatomical varieties, each with its own specific displacement. (Figure 17)

- Extra-articular fractures: lower subcondylar fracture

  Line: oblique at the bottom and back at the base of the neck of the condyle.

  Variable displacement: ranging from simple angulation, overlapping with ascent of the ascending branch to dislocation.

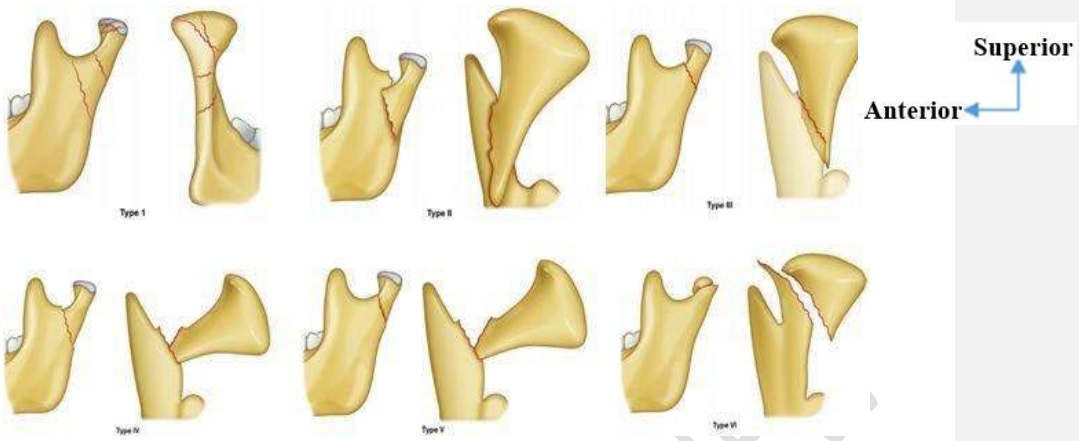


Figure 17: Different types of condyle fracture (Spiessl and Schroll classification) [37]

- Intra-articular fracture :

- High subcondylar fracture or condyle neck fracture (Figure 17)

Horizontal line passing through the anatomical neck of the condyle.

Condylar displacement often significant anteriorly and inwardly under the action of the lateral pterygoid muscle, inter dislocation of the condylar head).

- Condylar or capital head fracture

Trait: three types

  - Partial: a line detaching the inner tubercle;
  - Total (decapitation) meshed or moved;
  - Comminuted (bursting).

- Displacement: minimal

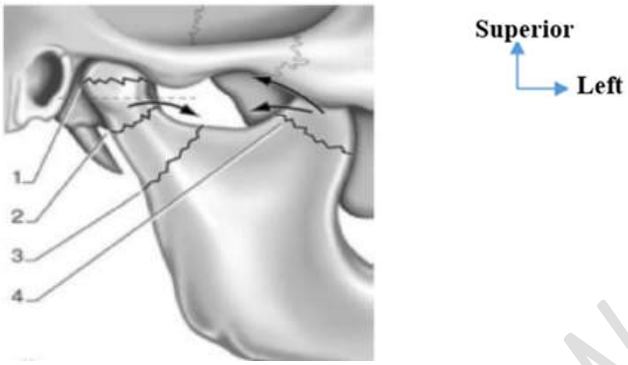


Figure 18: A fracture of the condyle and coroneum [8]

1: capital fracture; 2: high condylar fracture; 3: lower subcondylar fracture; 4: coroneal fracture

I.5.4 Green wood fracture

They are incomplete, do not completely interrupt bone continuity and are stable in the dentate sector. They are more common in children, in a study by NSA MINKO conducted in Gabon, they accounted for 5% of cases **[38].**

II. CLINICAL STUDY

II.1. Positive diagnosis

Circumstances of discovery: Following a trauma, the subject feels a sharp mandibular pain with functional impotence due to the impossibility of opening the mouth, or incidentally in a polytraumatized person.

II.1.1 Clinical signs

Before performing the actual examination of the mandibular trauma, it is necessary to situate the lesion as a whole and give priority to the associated lesions that may be life-threatening or functional. This evaluation is done in the emergency department in collaboration with other specialists, including the neurosurgeon, thoracic, visceral and trauma-orthopedic surgeons.

The examination of the facial trauma patient is done in a room provided that:

- Floor-standing light
- An adjustable suction system
- A bed or examination stretcher with a liftable backrest.

With as basic equipment:

- Single-use, non-sterile gloves
- A foam-tipped suction cannula
- Wooden tongue depressors
- A dental mirror for lighting, A headlamp provides appreciable comfort to the clinician, but this tool is rarely available.

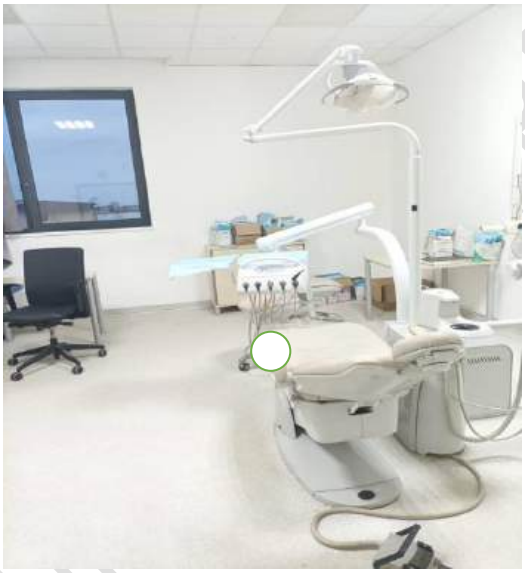


Figure 19: Examination room; source Pr MAKUNGU

II.1.1.1 Examination:

The examination provides information on:

- The age, sex, activity of the patient.

- The date, time and precise circumstances of the accident (nature of the traumatic agent, point of application, direction and energy).

-The mechanism

-Functional signs: pain, limitation of mandibular movements, difficulty in speech, swallowing, breathing, opening and closing the mouth, hemorrhage.

- Local history (malocclusion, orthodontics, prostheses, old maxillofacial trauma, etc.) and general history that can influence therapeutic modalities (alcoholism, diabetes, etc.). **[39.40]**

II.1.1.2. Physical examination

General examination

Assess general condition, consciousness, hemodynamic and respiratory status and hydration status.

II.1.1.2.1 Exobuccal examination

- **Inspection [10]**

It looks for scratches, wounds (location, depth, degree and type of soiling, pigmentation, etc.), bruises, hematomas or bone deformities, with nasal modification, widening of the intercantal distance, erasure of the cheekbone, exteriorization of an epistaxis, otorrhagia, retrogenics, deviation of the tip of the chin or a chin wound. Search for an open bite or labial occlusion.

In children, retromicrognatism can be found

In the NSA study **[38]** found genial swelling as the predominant exobuccal sign in children.

Swelling, low at 89.5%, followed by facial asymmetry at 84.2%, followed by pain on mobilization at 78.9%, and wounds under chin at 61.4%, were the most representative clinical signs. **(Figure 20).**

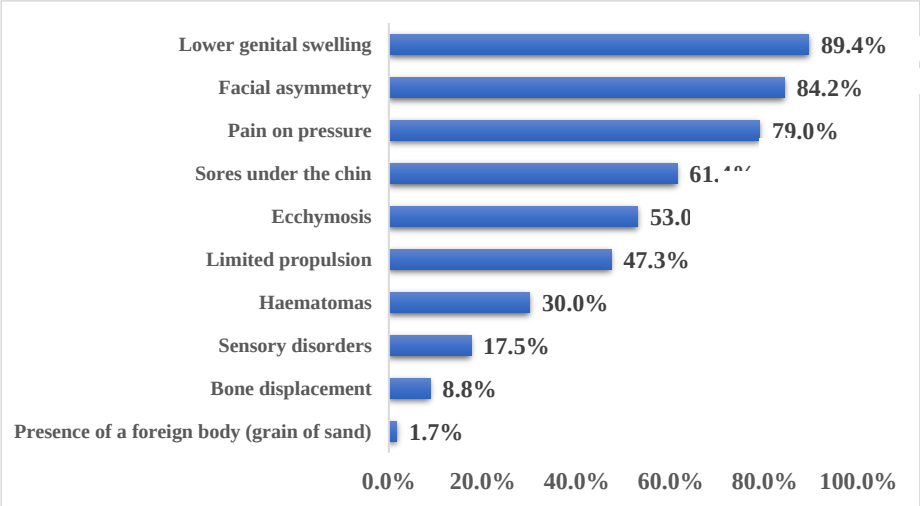


Figure 20: Distribution of exobuccal signs by population

A

Figure 21: Exobuccal signs. A-Lower right genial swelling; B-chin wound. Source: Prof. MAKUNGU

- **Palpation [10]**

It highlights pain at the fracture sites, caused by the pressure of the examiner. It looks for a painful irregularity in the contour of the dentate portion of the mandible. Symphyseal pain will be assessed by pressure on both angles at the same time, pointing to the fracture of the parasymphyseal or symphyseal region. The search for a Labio-chin sensitivity disorder is systematic.

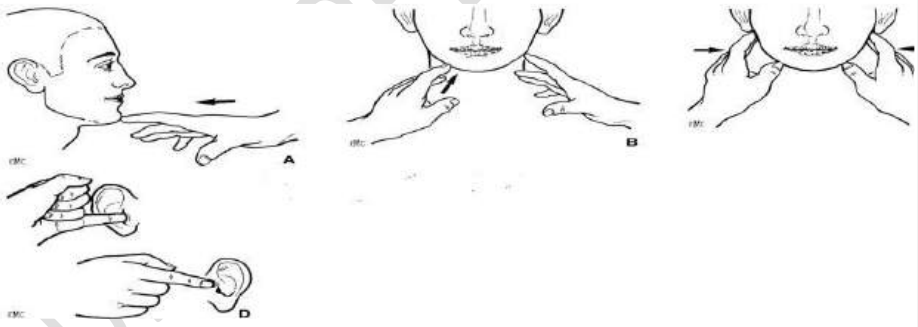


Figure 22: Facial palpation of the mandible [24]

A. Anteroposterior pressure awakens preauricular pain in the case of a condylar fracture.
B. Palpation of the basal margin.
C. Lateral pressure awakens symphyseal pain.
D. Palpation of the condylar region.

- **Sensitivity Examination**

This examination will focus on the evaluation of the third branch of the trigeminal in search of the sign of VINCENT which is a loss of lip sensitivity. This examination must be done with one's eyes closed and comparatively.

II.1.1.2 Endobuccal examination

- **Inspection [10]**

It allows you to appreciate:

- Mucous membrane lesions (gingival wounds or tears, lingual wounds, etc.).

- The type of dentition (permanent, mixed or lacteal) and lesions of the alveolar arches: Presence or absence of teeth, condition of the dental crowns, dental mobility, condition of the periodontium (gingivitis, loosening, tooth mobility), existence of fixed or mobile prostheses.

-The condition of the teeth located in or near the site of the fracture.

- Abnormalities of the occlusion (open bite, linguoversion, etc.).

- Mandibular dynamics and in particular the mouth opening (trismus essentially evoking a fracture of the retrodentate part). At the end of this inspection, it is possible to specify whether there is a fracture of the dentate part (deforming fracture) and/or a fracture of the retrodentate part (displacing fracture).

These signs are found in NKOLO's study on monofocal fractures of the mandible. Dental lesions (Figure 23) were found in 34.2% of cases, mucosal lesions in 32.9% of cases, stomatorrhagia in 27.8% of cases and dental joint disorders in 26.6% of cases **[41].**

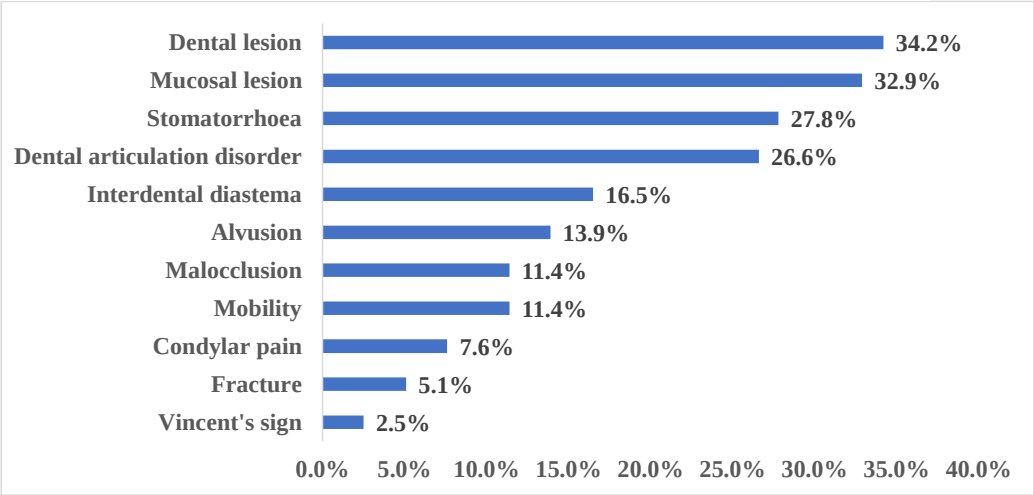
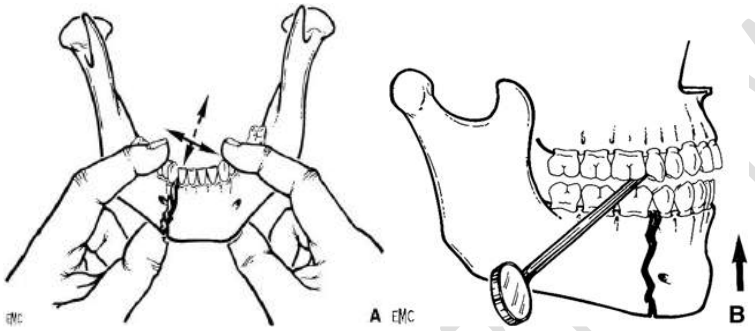


Figure 23: Distribution of patients according to endooral signs

Figure 24: Endooral examination; Labial wound, anterior open bite, dislocation of the inferior incisor block. Source : Prof. MAKUNGU

- **Palpation**

It allows the exploration of the lower vestibule in search of a painful irregularity. Manual mobilization by holding each hemi-mandible between thumb and index finger, by imposing careful movements in the opposite direction in the vertical plane, and occlusion on a wedge can highlight certain foci of fracture of the dentate portion.



A. By bimanual palpation. **B.** By biting on a hold.

Figure 25: Search for the mobility of fragments [24]

These diverse and inconsistent signs can be found in the ELLA study on the epidemiology of mandible fractures where facial edema was predominant in 90.4%; limitation of the mouth opening was found in 55.4% and hypoesthesia was reported in 14.5% **[15]**. (Table 2)

Table 2: Table summarizing clinical aspects

	Actual	Frequency (%)
Edema	150	90,4
Facial asymmetry	137	82,5
Facial Wound	103	62,0
Dental joint disorder	99	59,6
Stomatorrhagia	60	36,1
Premature molar contact	58	34,9
Vestibular bruising	47	28,3
Mouth opening		
Limitation	92	55,4
Trismus	38	22,9
Limitation + Trismus	5	3,0
Dental Injuries		
Mobility	50	30,1
Avulsion	31	18,7
Fracture + Avulsion	4	2,4
Mobility + Avulsion	3	1,8
Fracture	2	1,2
Fracture + Mobility	1	0,6
Malocclusion		
Anterolateral	40	24,1
Previous	32	19,3
Side	18	10,8
Sensory disorder		
Hypoesthesia	24	14,5
Anaesthesia	1	0,6

II.1.1.3 Examination of other devices [24]

- **General Review**

As these fractures occur in the contexts mentioned above, a general somatic examination is necessary to detect associated lesions at a distance from the lower level of the face.

We just recall the absolute necessity of checking the state of consciousness, the state of the cervical spine, which implies the search for a vicious attitude, the search for pain when palpating the spinous ones. The otological examination will look for otorrhagia indicating a fracture of the eardrum and may be related to a fracture of the mandibular condyle.

Thus, NKOLLO in his work on unifocal bills of the mandible found the unifocal mandibular fracture was isolated in 80% and associated with facial and extrafacial lesions in 20%. **[41]**

II.1.2 Paraclinical signs

The architecture of the face, and particularly that of the mandible, has led radiologists to develop multiple radiological incidences, each giving a partial or total analysis of the facial skeleton at the cost of sometimes significant distortions of the image in relation to the anatomy.

We will therefore first discuss the effects of standard radiology useful for the assessment of these mandibular fractures, then the contributions of computed tomography.

II.1.2.1. Standard Radiography [12]

II.1.2.1.1 The orthopantomogram:

This imaging was performed as a first-line treatment because of its blow, which is less than the CT scan, but is no longer relevant.

It will be requested whenever it is possible. It has certain disadvantages: at the symphyseal level, there is a superposition of bone densities; The direction and importance of the strokes and movements can sometimes be misjudged. However, when properly performed and read carefully, it allows for diagnosis (Figure 26).

Figure 26: Orthopantomogram, Mandibular Bifocal Fracture. Source: (Prof. MAKUNGU)

In the NGAGOUM study on fractures of the dentate portion of the mandible, the majority of patients who had benefited from a dental panoramic were 51.8% **[25].** And for MOUSSOUAMI on bifocal fractures, dental panoramic or orthopontomogram is performed in 66.7% and computed tomography in 50% of patients (Figure 27).**[42]**

Commented [CM1]: I suggest revising the sentence In the NGAGOUM study on mandibular dentate fractures, 51.8% of patients said that they had benefited from a dental panoramic.

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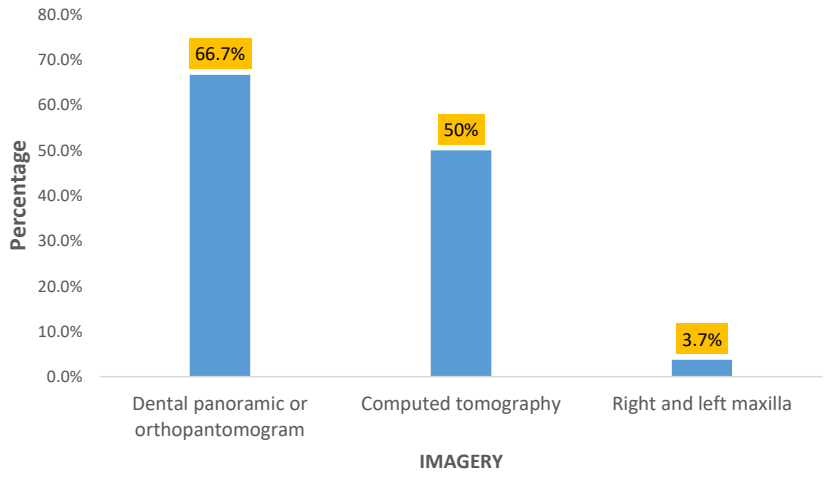

Figure 27: Distribution of patients by type of imaging

When the panoramic shot is not feasible or to complete it, other incidences are useful:

II.1.2.1.2 Incidence with the lower face open mouth (forehead - nose - plate)

Allows us to appreciate in part the condylar region, the ascending branch, the angles and the posterior part of the horizontal branch; The symphyseal region projected onto the spine is poorly visualized. It allows you to appreciate movements in a frontal plane.

II.1.2.1.3. Occlusal X-rays

Allows the identification of symphyseal or horizontal branch fractures, unicortical and "green wood" fractures.

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You can write uni cortical or uni-cortical

II.1.2.1.4. The incidence of mandibular outlet:

Two shots were taken, one right and one left, each of which revealed the corner region and the body. Visualization of the condyle and ramus may be hindered by overlays.

The multiplicity of incidences can be advantageously replaced by computed tomography, especially in polytrauma patients, which in all cases requires brain imaging.

II.1.2.2 Computed tomography: (axial incidence, coronal or even sagittal sections and three-dimensional reconstructions)

It allows the precise analysis of the ~~location of the fracture lines, the displacements of the different fragments~~, the dentition and the existence of an underlying bone anomaly (pathological fracture).

Commented [CM4]: Fracture lines location,the different fragments displacements

The study of ELLA finds CT was the most requested examination at 59.6%, dental panoramic was requested in 33.1% of cases **[15]** (Table 3)

Table 3: Number of staff at each radiological assessment carried out

	Numbers	Frequency
TDM	99	59,6
Dental Panoramic	55	33,1
Rx low face	7	4,2
Paraded Maxilla	6	3,6

For Makungu, multifocal fractures of the mandible also found computed tomography as first-line imaging **[13]**

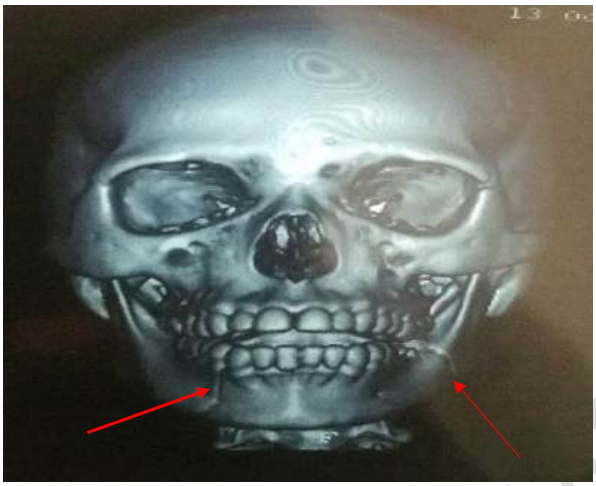

Figure 28: CT scan showing a bifocal mandibular fracture: right and left angular parasymphysis (iconography of the CHUO maxillofacial surgery department)

II.1.2.2.1 The denta scanner

Thanks to panoramic and oblique coronal curvilinear reconstructions, it allows a well-adapted exploration of the curvature of the mandibular arch and a precise study of the relationships of fracture lines with the mandibular canal and the tooth roots.

II.1.2.2.2. 3D reconstruction

Allows a global approach to both diagnostic and pre-therapeutic lesions, by offering the surgeon a 'real' view allowing a better study in space and a better choice of the operating technique. This imaging is coupled with the other incidences of the scanner allowing an overall view.

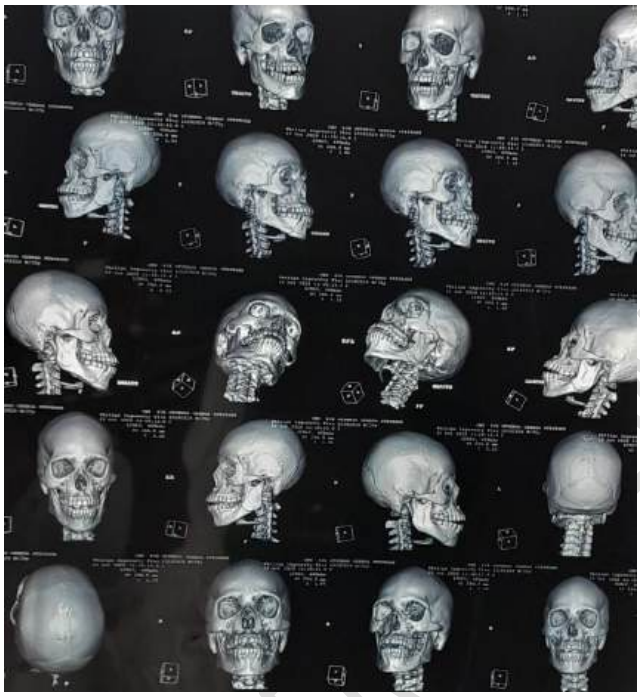

Figure 29: Three-dimensional CT of a Left Angular Fracture + Right Parasymphyseal

II.1.2.2.3 The Continuous Rotation Scanner

Allows a significant reduction in examination time in a few tens of seconds, thus reducing the risk of movement artifacts.

II.1.2.2.4. Cone beam or CBCT

Is a technique located between dental panoramic and CT scan, it allows an efficient examination of mineralized tissues, highlighting bone lesions with good precision (in the order of a millimeter).

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II.2. Topographic diagnosis

II.2.1 Bifocal Mandibular Fractures [41]

They can be of two types, symmetrical or asymmetrical. For symmetrical fractures, they concern the parasymphyseal regions, the angles, or the condyles. The muscular forces acting on the fragments are in principle balanced and the displacements symmetrical.

For asymmetric fractures, the MOUSSOUAMI study on bifocal fractures of the mandible, the most represented fractures are the fractures of the angle + parasymphyseal in 37% (Figure 30).**[42]**

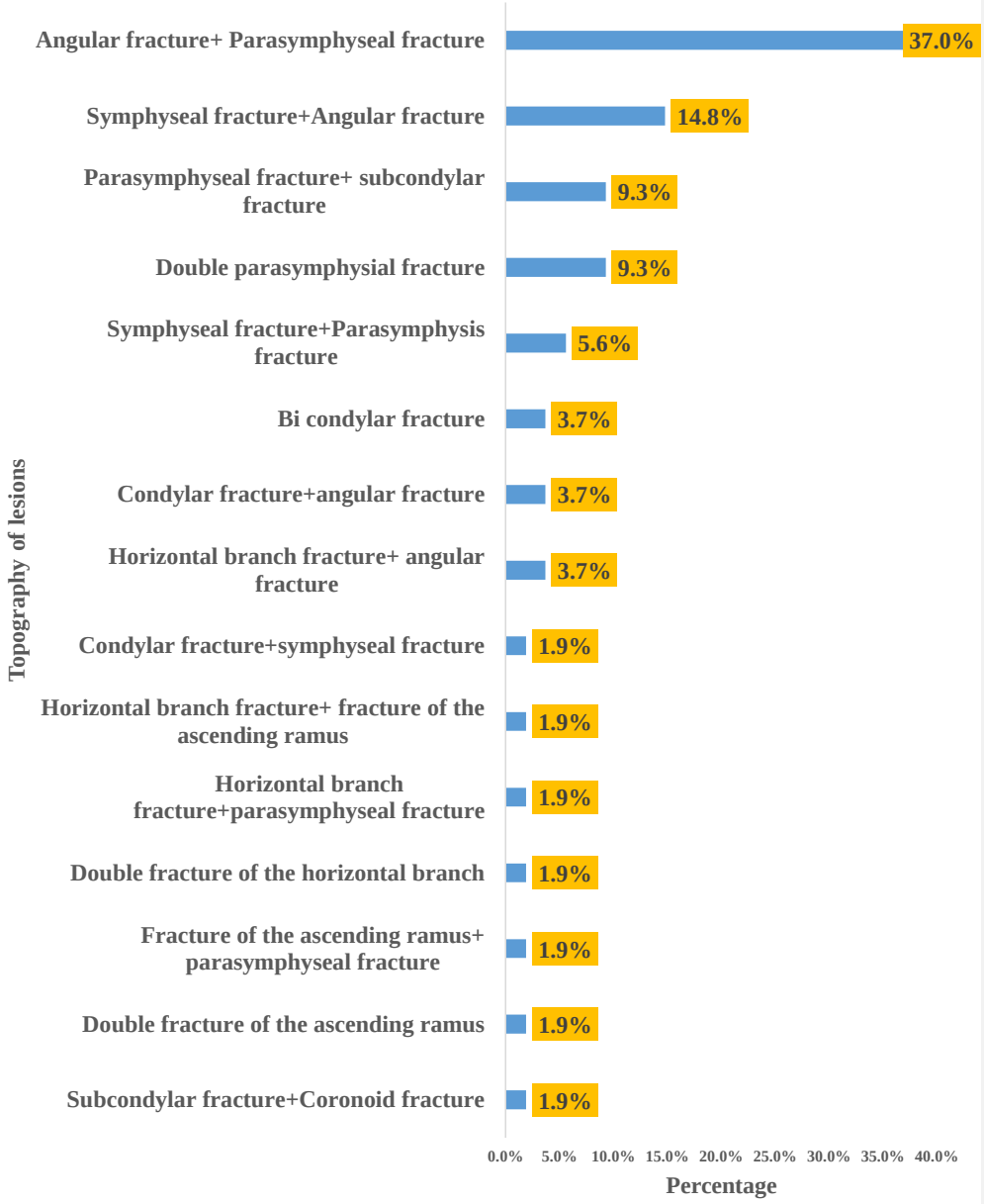

Figure 30: Distribution of patients according to lesion topography

II.2.2 Fractures of the toothed portion [10,41]

The presence of teeth and the tearing of the gingival mucosa lead to communication between the fracture site and the oral cavity. Fractures of the dentate portion of the mandible are therefore considered open fractures and should be treated as such.

II.2.2.1. Biparasymphyseal and bisymphyseal fractures [41]

They are located between the distal surfaces of the canines and can lead to downward and backward displacement of the symphyseal region, with a risk of posterior loss of the tongue. This is called glossoptosis, which can cause respiratory distress.

These fractures usually cause a direct violent impact on the chin. A fracture of one or both condyles can be classically associated with it by transmission of traumatic forces.

II.2.2.2. Fractures of the horizontal branch [41]

They are located between the medial surface of the first premolar and the distal surface of the second molar. In major displacements, damage to the inferior dental nerve is frequent, such as contusion or section, and is then responsible, depending on the case, for hypoaesthesia or anaesthesia of the labiomentonal territory.

The rupture of the inferior alveolar artery can exceptionally be the cause of a very serious haemorrhage, which can justify an emergency haemostasis, or a hematoma to be evacuated.

NGAGOUM's work on fractures of the dentate portion of the mandible allows us to summarize the fractures of the dentate portion, thus showing the most frequent site of fractures which is angular in 44,6% **[25].** (Table 4).

Table 4 : Distribution of fracture lines according to location

location of the line	number of cases	percentage
angle	29	44,6
corpus	18	27,7
symphysis and parasymphysis	11	16,9
alveolar bone	7	10,8
total	65	100

II.2.3 Fractures of the non-toothed portion [41]

II.2.3.1 Fractures of the ascending branch

These fractures are rarer and displacements are infrequent. Regardless of the orientation of the fracture line, there is usually a limitation of the mouth opening associated in displaced fractures with a premature ipsilateral molar contact due to a decrease in the length of the ascending branch.

II.2.3.2. Condylar fractures

They are mainly caused by indirect shocks, on the chin or the contralateral side of the mandible. Bilateral forms are most often high subcondylar fractures and may be accompanied by otorrhagia. In the case of significant displacement, the loss of height of the ascending branches is accompanied by a mandibular receding with premature molar contacts and anterior open bite. A distinction is made between extra-articular fractures and intra-articular fractures.

II.2.3.2.1. Extra-articular fractures:

Low subcondylar fractures. These fractures sometimes go unnoticed, the symptomatology being generally reduced to a simple pain when opening and closing the mouth.

II.2.3.2.2. Intra-articular fractures:

They are not uncommon in the event of an impact on the chin. A mandibular retreat associated with an anterior open bite is then observed. These are the high subcondylar or neck fractures and the capital fractures

As in lower subcondylar fractures, the clinical signs are usually quite discreet and may even go unnoticed. These will be confirmed or refuted by the imaging data.

II.2.3.3 Coronone Fractures

They are infrequent. Most often, the symptoms are reduced to a simple trismus.

II.2.4. Fractures combining the toothed and non-toothed portions

Different fracture associations are possible depending on the lesion mechanism and the condition of the teeth. These different fractures can be summarized by ELLA's study on the epidemiology of mandibular fractures, the right parasymphysis and the left angle were respectively the regions where the most fracture traits were noted **[15].** (Table 1) There is a significant association between laterality and the site of fracture.

II.2.5. Asymmetrical bifocal mandibular fractures

These fractures, the three fragments of which are solicited by unequal muscular actions, escape an overall description. The most common forms are symphyseal and/or parasymphyseal fractures associated with fractures of the angle or contralateral condyle. But all associations can be seen.

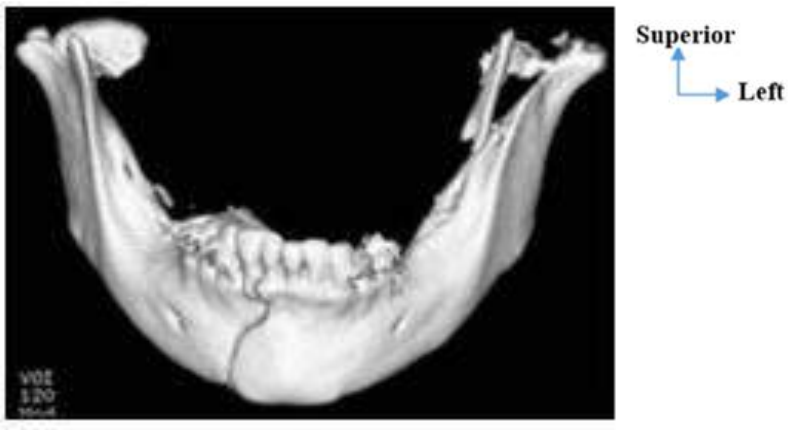

Figure 31: Computed tomography in 3D reconstruction

Right parasymphyseal fracture associated with a bicondylar fracture. Frontal impact with respect to the symphysis **[43].**

Beware of fracture lines that appear incomplete on 3D reconstructions, as they very often correspond to fractures that are not very displaced but nevertheless complete.

II.3 Diagnosis according to the field

II.3.1 Fractures in children [43]

In children, fractures are often made of green wood, after the age of twelve the fractures are similar to those in adults.

NSA MINKO finds in its study on mandibular fractures in children the parasymphyseal region as the most frequent location with 35.4% (Figure 32) **[38].**

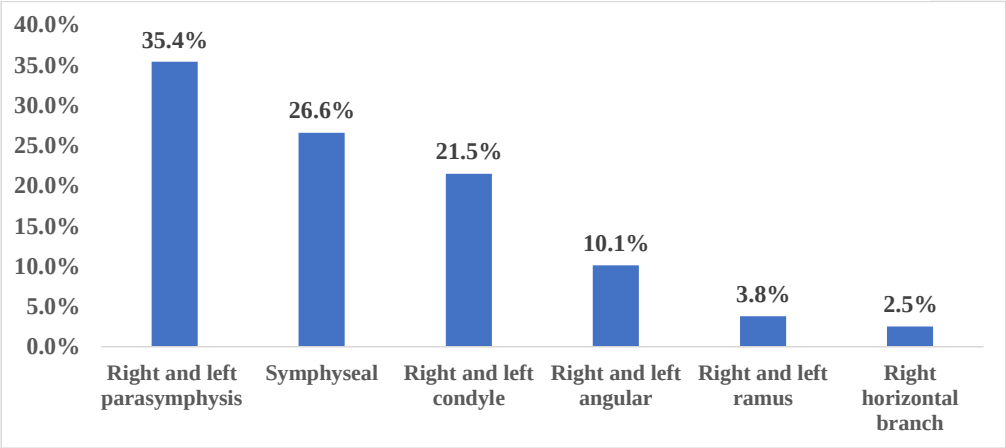

Figure 32: Distribution of the fracture site according to the frequency of fracture lines

These fractures in children are of all types with a unifocal type predominant in 58.0% of cases. (Figure 33).

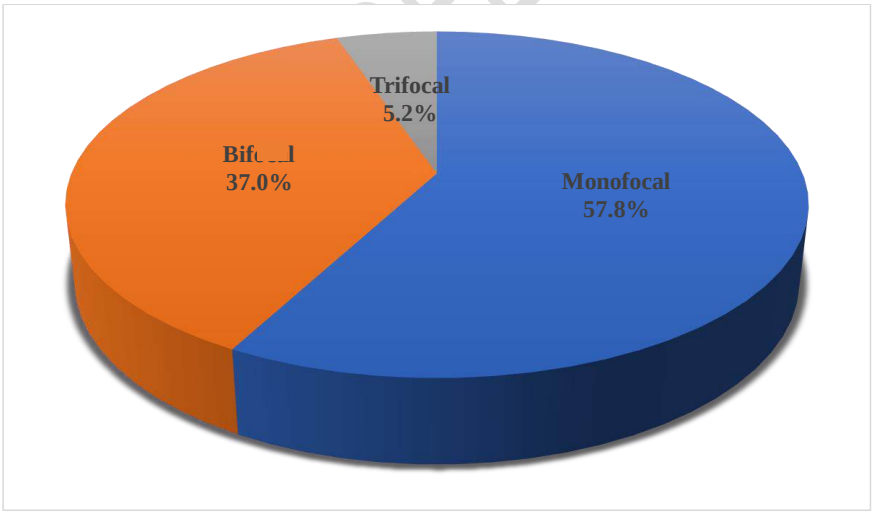

Figure 33: Distribution of fracture type by workforce

In children, displaced fractures are the most common at 65%, while green wood fractures account for only 9% of cases (Table 5)

Table 5: Distribution of fracture displacements by population

Fracture	N	(%)
Non-displaced	15	26,3%
Displaced	37	64,9%
Green-stick	5	8,7%
Total	**57**	**100%**

II.3.2 Fractures in the edentulous [44]

The most common fractures are those of the condyle and the body, while the angle resists thanks to the pterygo masseterin muscle strap. Clinically, they are often not very symptomatic.

II.3.3 Fractures in the elderly

The symptoms are poor in the case of minimal trauma and a fracture that is not very displaced.

II.4. Complications of Mandible Fractures

II.4.1 Immediate complications [44]

Respiratory distress can be due to the presence of a foreign body, tooth, prostheses, etc. or a double symphyseal fracture with glossoptosis.

Hemorrhage resulting from bleeding of soft tissue or bone is not uncommon, significant hemorrhage after a fracture of the mandible is a rare event. In the event of a significant displacement during a condylar fracture, there can be a false aneurysm of the maxillary artery and this is exceptional.

II.4.2 Secondary complications [44]

II.4.2.1 Infection

The most common complication of mandible fractures is infection. Infections of the mandibular angle are more common than those at other sites. This is due to the thinness of the bone present in this region, the biomechanical forces of distraction of the surrounding musculature, the presence of impacted teeth and the compromised vascularization of the bone segments.

II.4.2.2 Osteomyelitis

Osteomyelitis is an inflammatory condition of the bone that begins with an infection of the bone marrow and spreads to the periosteum of the affected area. Impaired vascularity can be caused by a bone injury itself, or by scarring and the formation of sclerotic bones.

II.4.3 Late complications

II.4.3.1 Delayed union (nonunion) and non-union:

Spiessl defines a non-union as any fracture that has not consolidated within 6 months, whereas delayed union is the absence of solidation of the fracture within 6 to 12 weeks. Nonunion is a type of nonunion in which a true false joint forms and includes a capsule. A delay in union can occur due to the presence of teeth located in the fracture line, which promotes the percolation of microorganisms into the fracture hindering the bone union and requiring extraction.

II.4.3.2 Vicious call:

Some specific types of fractures are prone to vicious calluses with malocclusion and loss of facial shape. These are bilateral condylar fractures (acquired retrognathia and/or open occlusion) and bilateral condylar fractures with symphyseal fracture, commonly known as "guard fracture" (enlargement of the face).

In NSA's work on mandibular fractures in children, 7 patients presented complications, 2 patients had nonunion, 2 patients had vicious calluses (Table 6).**[38]**

Table 6: Distribution of complications by workforce

	Actual	**Frequency**
Peri-fractural abscess	1	1,7%
Osteitis	1	1,7%
Delayed consolidation	1	1,7%
Pseudarthrosis	2	3,5%
Vicious Callus	2	3,5%
Total	**7**	**12,3%**

II.4.4. After-effects

Patients who had presented with temporomandibular ankylosis represented 4 cases or 7.0%, of which 2 patients had a deviation at the mouth opening (3.5% of cases).

II.4.4.1. Paraesthesia / paresis

Temporary or permanent paresis of the marginal mandibular nerve is a complication of submandibular and retromandibular surgical approaches.

II.4.4.2. Ankylosis and Other TMJ Complications

Chronic TMJ dysfunction can result from condylar fractures, joint disc injury, disc displacement, or dislocation.

Retrognathia with an open occlusion remains a formidable complication, and is usually secondary to displaced bilateral condylar fractures.

Condylar ankylosis is a rare complication, estimated to occur in 0.2 to 0.4% of all condylar fractures.

The sequelae in children are temporomandibular ankylosis represented 4 cases or 7.0% associated in 2 patients with a deviation at the mouth opening or 3.5% of cases.

III. TREATMENT

The treatment of mandibular fractures includes emergency, skeletal and complication treatments. The result depends on the quality of the skeletal restoration and the manducatory function (TMJ dental occlusion, muscles).

III.1Emergency treatment

It must ensure vital functions in polytrauma patients and severe cranio or maxillofacial trauma. Three letters summarize emergency gestures for Anglo-Saxon authors:

A (airway): clear the pharynx (blood clots from food or dental debris) manually or by suctioning. Place the injured person in the lateral decubitus position, maintaining cervical rigidity in the doubt of spinal involvement;

B (breathing): to ensure the freedom of the airways by cannula of mayo, guedel or traction on the tongue. Tracheal intubation (oro or naso). Tracheotomy

C (circulation) Initiate pulse- and tension-guided resuscitation. Stop bleeding (fracture reduction, vascular ligation, nasal tamponade). Treat the state of shock (venous route for fluid supply of macromolecules or blood after grouping). These actions, undertaken at the scene of the accident, must be continued during transport.

III.2. Skeletal treatment

III.2.1. Aims

The main objective of the treatment is to restore the functions related to the different movements of the mandible (mouth opening and closing, propulsion, retropulsion and diduction) allowing chewing.

In the event of displacement or bone loss, treatment is also aimed at restoring the bone anatomy if possible 'ad integrum'.

III.2.2. Means

They combine medical, functional and surgical means (orthopedic, bloody)

III.2.2.1. Adjuvant treatment:

Antibiotic (open fracture, oral approach), amoxicillin, clavulanic acid, metronidazole

Steroidal and non-steroidal anti-inflammatory drugs

Anti-edematous alfa amylase

Tetanus prophylaxis in case of skin wounds;

III.2.2.2. Functional treatment

This treatment is tending to disappear in some countries, with NGAGOUM regaining 1.9% of functional treatment **[25].** This treatment is reserved for condyle fractures, it is based on the dogma of joint function. It combines passive mobilization (elastic traction on hook arches) and active mobilization (voluntary movements) which favor propulsion and mandibular diduction movements. Rehabilitation, undertaken cautiously from the first days, is continued for 15 days to 2 months on average, depending on the severity of the fracture and the patient's cooperation. Recovery of a normal range of motion of the mouth opening (47+/-7mm) sometimes requires longer rehabilitation.

III.2.2.3. Orthopaedic treatment

BMM is still done in some countries, in Gabon in urban areas, this type of treatment tends to disappear; But it remains relevant in rural areas.

It is based on the dogma of dental occlusion. After manual, instrumental or progressive reduction (by elastic traction on arches), of the fracture site, the compression is ensured by the maxillomandibular blockage. This

maxillomandibular blockage BMM consists of solidarizing the dental arches together using various anchoring means (ligatures, vestibular arches, splints or aligners) that rest on the teeth. In the edentulous person, BMM is performed on prostheses previously attached to the jaws by circumferential ligatures. This blockage, maintained for 30 to 45 days, is reduced for 7 or 15 days in condyle fractures.

In children, NSA found maxillomandibular blockage, which was performed in 5.2% of cases and in 1.7% monomandibular compression was performed **[38]**

III.2.3. Surgical Methods [45-47]

III.2.3.1. Pre-operative preparation of the patient

It consists of carrying out the pre-anesthetic assessment including:

- A complete blood count (CBC),

- A haemostasis assessment, -

Fasting blood sugar levels,

- An assessment of kidney function,

- Chest X-ray and ECG

III.2.3.2. Approaches

The approach to the fracture sites can be made by various routes, such as the direct approach, through existing wounds and in the absence of these the approach will be by the inferior vestibular endooral route or by the transcutaneous route, placing straight, trapezoidal, external fixator, screw plates,

- **The endooral or inferior vestibular route**

This pathway is used in the approach of most fractures involving the dentate portion (Figure 34) of the mandible that can be adequately exposed through the mouth, thus avoiding visible external scars. At the level of the parasymphyseal

region and the horizontal branch, the emergence of the mental nerve in relation to the premolar area must be identified and managed by careful dissection and non-traumatic separation of the edges of the operative wound.

Figure 34: vestibular approach highlighting a symphyseal fracture (Source :Professor Makungu)

- **Transcutaneous or exooral approach**

Complementary to the endooral approach when it does not allow sufficient access to the fracture site, particularly at the condylar or angular level. The chin branch and the temporofacial branch of the facial nerve are dangerous, while the cutaneous approach in general represents an aesthetic disadvantage by leaving a scarring ransom that must be limited as much as possible. Finally, skin or mucous membrane wounds can also be used as an approach and enlarged if necessary. However, they should not be too dilapidated or soiled; Necrosis of a mucosal flap by ischemia could occur resulting in the discovery of the underlying osteosynthesis material with a skeptical risk requiring its removal.

Figure 35: subangulum-mandibular or Risdon approach

III.2.3.3. Intrafocal Method of Osteosynthesis

It consists of an "open" approach to the focus, most often by the inferior vestibular endooral mucosa, sometimes by the external cutaneous route. This approach makes it possible to visually control the quality of the reduction in displacements and to carry out a synthesis of the fractured fragments allowing their containment. This osteosynthesis can be achieved by steel wire, monocortical or bicortical screws and screwed metal plates. Technique It is done by compression with osteosynthesis material by:

- Miniaturized plates with unicortical screwing (immediate mobilization) They overlap the fracture site and are held in place by monocortical screws after being shaped to the shape of the bone. These plates and screws are usually made of titanium (Figure 36) and are well tolerated. Studies have shown the persistence of titanium particles in adjacent tissues without being demonstrated. The miniplates are placed in such a way as to respect the Champy lines described according to the stresses exerted on the fracture site of the mandible body. There are various shapes, most often straight with a variable number of holes. Three-dimensional (3D), rectangular or square plates are also available. The advent of these plaques makes it possible to lift the intermaxillary blockage as soon as osteosynthesis is performed, which allows the mandible to maintain freedom of movement (Figure 37). However, blockage remains an essential prerequisite to reduce displacement

by restoring the dental joint. The removal of the plaques is recommended, after consolidation.

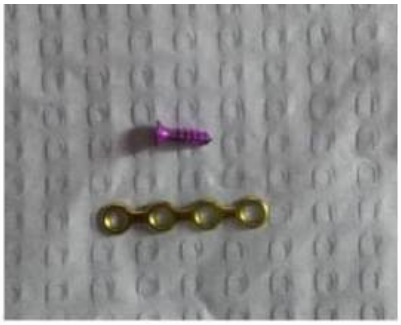

Figure 36: Titanium maxillofacial and bone compression screw with self-drilling screw. (Iconography of the department of maxillofacial surgery, CHUO, Professor MAKUNGU)

Figure 37: Osteosynthesis of a symphyseal fracture by screwed miniplates (Source: Professor MAKUNGU)

III.2.3.4. Transfocal Method of Osteosynthesis

It is a skewering through the fracture site using Kirchner-type pins placed horizontally or crosswise at the corpus level

III.2.4 Indications [48]

Stable fractures (unifocal fractures, well-toothed arches) are the responsibility of orthopaedic treatment. Unstable fractures (multifocal fractures, endentulous fractures) require surgical treatment.

III.2.4.1. Depending on the fracture trait situation

The symphyseal and parasymphyseal trait requires osteosynthesis by 2 plates to stabilize the fracture. For the anatomical portions, one plate is sufficient.

The choice of the type of plate must take into account the type of fracture to have excellent osteosynthesis.

III.2.4.2. Bilateral displaced fractures

- ✓ **Bilateral parasymphyseal fracture :**

Treatment is preferably surgical with osteosynthesis by two miniaturized plates screwed straight because of the risk of instability of the intermediate bone segment. A maxillomandibular blockage can also be performed or a combination of the two procedures.

- ✓ **Bilateral angle fracture :**

This is a particularly unstable fracture. Treatment is orthopedic by maxillomandibular blockage or osteosynthesis by a mini straight plate or maxi plates on each focus.

- ✓ **Bilateral condylar fracture :**

Primary treatment is orthopedic (blockage on the posterior wedge) or surgical by osteosynthesis by mini trapezoidal plate or screw. It must be quickly supplemented by passive and then active functional treatment, which is particularly important here to avoid an anterior open bite and the harmful repercussions of this type of fracture on joint kinetics.

Figure 38: Osteosynthesis using a trapezoidal plate with screwing with a 6-minute titanium screw (Iconography of the Department of Stomatology and Maxillofacial Surgery, CHUO, Professor Makungu)

III.2.4.3. Depending on the terrain

- ✓ **Pediatric Fracture**

An acrylic splint may be helpful in managing mandibular fractures in children. Fractures of the condylar process in children under 12 years of age should be treated by closed methods.

- ✓ **Fracture in the edentulous**

These fractures can be treated with open or closed reduction methods.

- ✓ **Pathological fracture**

Resection is the only alternative to treatment. In this case, BMM is preferred as a therapeutic means.

III.2.5 RESULTS

Complications were 3.1% with a 95.4% success rate for the NGAGOUM study **[25].** This result is similar to that of SOUKEYE [27] who had obtained in his study a cure without sequelae in 91.4% of patients. This is contrary to a study by MOUSSOUAMI where 40.7% of patients presented immediate to late complications from the sequelae. These sequelae, i.e. 9.4%, are of the type of dental joint disorder. The occurrence of these complications in our series can be explained by the late management of pupils and students, because of their low socio-economic level and the complexity of the angle fracture + parasymphyseal fracture which is the most frequent **[42].**

CONCLUSION

Mandible fractures are common fractures in maxillofacial traumatology. They are mainly found in adolescent males. Medical transport is still less used. The mechanism is direct in most cases and MVA's and brawls are the main etiologies. Mandibular swelling, facial edema, labia-mental hypoesthesia, trismus, premature molar contact, interincisal open bite and dental joint disorder are the most common physical signs on examination.

Dental panoramic is the basic examination, requested as a first-line examination, but CT, although a second-line examination, is becoming the reference examination.

The parasymphysis is the most commonly found anatomopathological form. Treatment is based on osteosynthesis by screwed plate and its management must be early in order to avoid the occurrence of complications.

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