



A Study on the Management of Mandible Fracture in a Tertiary Care Hospital in Odisha

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I. INTRODUCTION

Face is the most admirable part of our body. Facial injury is the most common cause of disfigurement and affects the personality of the individual very much.

The most frequently injured facial bone is mandible after nasal bone because it is the most mobile and prominent facial bone. The mandibular fractures outnumber zygomatic and maxillary fractures by a ratio of 6:2:1 respectively.

Fractures of mandible invariably produce malocclusion if not treated properly. Knowledge of the dentition is thus an absolute prerequisite for the proper treatment of jaw fractures.

Various techniques that are advocated in the literature to manage mandibular fractures vary ranging from bandages and external appliances, extra oral and intraoral appliances, mono maxillary wiring, intermaxillary wiring, plates and screws.

Restoration of the occlusion usually indicates anatomic reduction and proper positioning of the mandible and facial bones. Our goal should be restoration of the function without any morbidity at the earliest.

AIM

To analyze the outcome of mandibular fracture fixation with eyelets, arch bars, miniplates and screws and assess the

1. Stability of the fixation
2. Occlusion after fixation
3. Comparing the jaw dysfunction (chewing ability) before and after treatment.
4. Post operative sequelae – such as post operative pain, bony and soft tissue infections, nonunion, nerve injury, osteomyelitis, malocclusion, and malunion, .

II. REVIEW OF LITERATURE

HISTORY

The first description of mandibular fracture was as early as 1650 BC, when an **Egyptian papyrus** described the examination, diagnosis, and treatment of mandible fractures.

Hippocrates describe circumdental wires and external bandaging for reapproximation and immobilization.

Sushruta recommended complicated bandaging, manual manipulation and heat to treat fractures of mandible

Maxillomandibular fixation was first described in 1492, in an edition of the book **Cirugia** printed in Lyons.

Dental prosthetic devices were used to immobilize fracture fragments.⁷⁷by

Chopart and Desault.

Until 19th century fracture mandible was treated with wrap, external bandages and sometimes with bridle wire.

Gilmer reformed the treatment of fracture mandible by using fixed full arch bars on the maxilla and the mandible.

Numerous splints were devised in the 19th century, the most important was **Gunning (1866)** and **Bean (1865)**. This period was known as “**Prosthetic era**” in fracture management.

AO reconstruction plates has created an impact in the management of infected and comminuted mandibular fractures. There was 7.5% infection rate in treatment of mandibular angle fractures with an AO reconstruction plate without intermaxillary fixation (IMF) as reported by **Ellis**.

During the same time **Spiessl** was expounding the AO doctrine, **Champy et al in France**¹⁵ were developing the concept of adaptive osteosynthesis.

Champy in 1978 advocated transoral placement of small, malleable, thin, stainless steel miniplates with monocortical screws along an ideal line of osteosynthesis.

Champy believed that compression plates were unnecessary because of masticatory forces produce a natural strain of compression along the inferior border.

These 2 changes of AO rigid internal fixation and the Champy method of monocortical miniplates revolutionized the treatment approach to



mandibular fractures. Many fractures previously treated with closed reduction or open reduction with wire osteosynthesis are now commonly treated with open reduction with plate and screw fixation.

Wagner W F et al⁷⁹ (1979) studied the extraoral open reduction of mandibular fracture and the associated morbidity and concluded that open reduction of mandibular angle fracture associated with removal of teeth from fracture line resulted in the greatest incidence of complication.

Smith.W.P⁷² (1991) did a retrospective study on delay in surgery beyond 24 hours with miniplate osteosynthesis and surgery within 24 hours showed no difference and he demonstrated that the incision lines were more important in preventing wound infection and dehiscence rather than the implants. Stainless steel appears effective in short term use.

Jeffrey.C.Posnick et al⁴¹ (1991) in their retrospective analysis of pediatric facial fractures reviewed 137 patients and found that mandibular (34%) and orbital (23%) fractures predominated. Fewer mid face fractures (7%) were sustained than would be expected in similar adult patients. Most fractures resulted from traffic related accidents(50%), falls (23%) and sports (15%) Closed reduction with Maxillomandibular fixation was frequently chosen for children with Condyle fractures and open reduction (35%) for other regions of face.

R.A. Loukota et al⁶⁰ (1995) in their mechanical analysis of maxillofacial miniplates and found the by repeated bending the plate will result in decrease in stiffness .

Jl Cawood¹³(1995) compared 50 cases of mandibular fractures treated by mini plate osteosynthesis with Maxillomandibular fixation. He concluded that the plates have good recovery rate of normal jaw function and body weight when compared with Maxillomandibular fixation.

T. Kawai et al⁴⁵ (1997) undertook radiological follow up to remove fixation materials after treatment of mandible fractures. They observed union in 85% of case in 3 months. So they recommended follow up radiological examination during the 5th week in patients less than 18 years and 9th week for older patients and recommended

that fixation materials can be removed after 5 months after injury.

Robert A.Rudman et al⁶⁶ (1997) conducted a study to reassess Champy's findings which were instrumental in justifying the theory of tension band plating for mandibular Angle fracture. They used mandible which were fabricated with photo elastic resin for their study. They found that stress fringes were present surrounding the outer screws, indicating that these screws were subjected to pull out forces. They concluded that there is greater force on the outer screws that may contribute to fixation failure, and that the theory of tension band plating for mandibular angle fracture is accurate but Champy's model is over simplified.

Bjorn et al¹¹ (1998) in their study on miniplate osteosynthesis in infected mandibular fractures, found that, by using miniplates the surgical trauma could be kept minimal and the periosteal blood supply could also be preserved by using an intraoral approach.

James.W.Sikes et al⁴⁰ (1998) compared the fixation strengths of locking head and conventional screws in fracture and reconstruction model. Due to the increased resistance to displacement with the locking head screws only two screws per segment were used in the reconstruction model. When four screws were used there was no significant difference between locking head and conventional screw types.

Alan S. Herford et al (1998) analyzed the use of a locking reconstruction plate system for fractures of mandible with defects and found them to be simple and advantageous over conventional bone plates by not requiring the plate to be compressed to the bone to provide additional stability.

ANATOMY

Mandible bone is U shaped and it is composed of two hemi mandible which fuse to form a single bone at the age of two years. It is a first pharyngeal arch derivative.

Parts of mandible

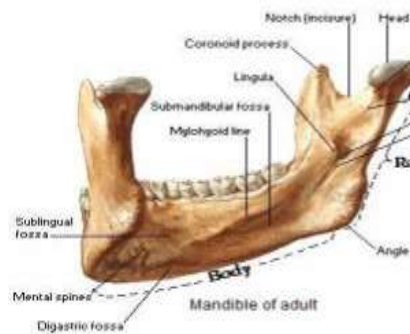
Hemi mandible consist of Parasymphysis, body, angle, Ramus, Condyle and Coronoid process united in the midline by Symphysis.(Fig.1,2).

Fig. 1



Fig. 2

Mandible left posterior view



Parasymphysis

It extends from midline to canine region.

Body of the mandible

It has upper and lower border and an inner and outer surface .

Outer surface of body

Symphysis menti - a ridge where the two body meet.

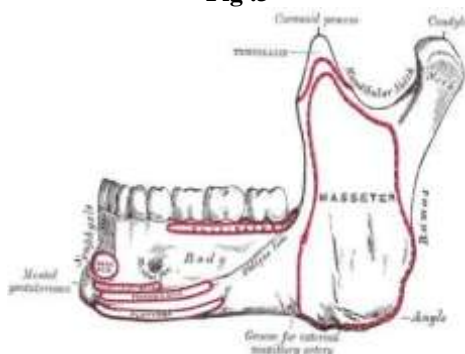
Mental protuberance - triangular projecting area in the lower part of midline.

Mental foramen - it lies in the interval between the premolar teeth which transmits mental nerve and vessels.

Oblique line - continuation of sharp anterior border of Ramus. Buccinator, depressor labii inferioris and depressor anguli oris arise from the line.

OUTER SURFACE OF MANDIBLE

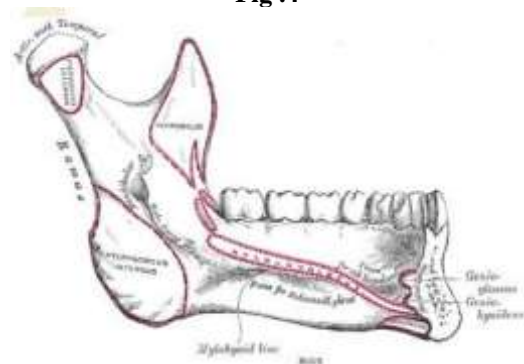
Fig.3



Incisive fossa - it is a depression which lies just below the incisor teeth, gives origin to mentalis and mental slips of the orbicularis oris.(Fig.3)

Inner surface of mandible

Fig.4



Mylohyoid line - prominent ridge running obliquely downwards and forwards from below the third molar tooth to the median area below genial tubercles. It gives origin to the Mylohyoid muscle, Superior constrictor muscle and Pterygomandibular raphe.(Fig.4)

Ramus of the mandible

Quadrilateral in shape and has upper, lower, anterior and posterior borders, lateral and medial surfaces.

Lateral surface

It is flat and having number of oblique ridges, Masseter inserted into it.

Medial surface Mandibular foramen

It lies above the centre of Ramus leads to mandibular canal and descends into body of mandible and opens at mental foramen. Mandibular



canal gives entry to Inferior alveolar nerve and vessels through mandibular foramen.(Fig.4)

Lingula - anterior margin of mandibular foramen. It gives attachment to Sphenomandibular ligament.

Mylohyoid groove - it lies below the mandibular foramen. Medial pterygoid muscle is inserted into the groove . In this groove, Mylohyoid nerve and vessels lie.

Coronoid process - flat triangular projection in the anterosuperior part of Ramus. Temporalis is inserted into it.

Condyle - an upward projection from poster superior part of Ramus. Fibro cartilage covers the head and articulates with temporal bone forming temporomandibular joint. Neck is the constriction below the head.

A depression in the anterior surface is called pterygoid fossa where lateral pterygoid muscle is inserted.

BLOOD SUPPLY

Inferior alveolar artery supplies the mandible. The artery arises from maxillary artery and descends between and Ramus and sphenomandibular ligament of the mandible. The inferior alveolar artery and nerve via mandibular foramen enters the body and exit via the mental foramen. The artery lies posterior to the nerve . Mandible also receives blood supply from its muscle attachments.(Fig.5)

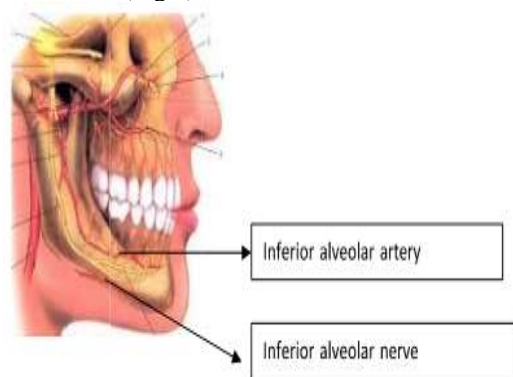


Fig. 5

NERVE SUPPLY

Inferior alveolar nerve supplies the mandible .

Uniqueness of the mandible

Thick cortical bone with single vessel for endosteal blood supply. It varies with patient's age and

amount of dentition. As the mandible atrophies ,the endosteal blood supply is decreased and periosteal blood supply is the dominant.

Mandible elevators

1. Masseter
2. Temporalis
3. Medial pterygoid

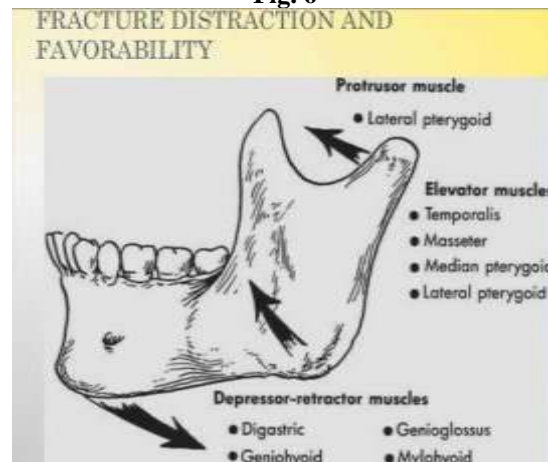
Mandible depressors

1. Lateral pterygoid
2. Mylohyoid
3. Digastric
4. Geniohyoid

All the muscles of mastication are supplied by mandibular branch (V3) of trigeminal nerve .

MUSCLE ATTACHMENTS AND DISPLACEMENT OF FRACTURES

Fig. 6



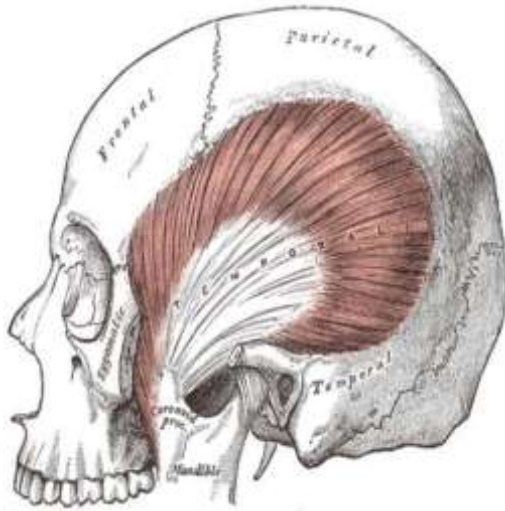
Masseter

It arises from the zygomatic arch and maxillary process of zygomatic bone. Inserted into the lateral surface of Ramus of mandible. Action - Elevation of mandible.

Temporalis

It arises from the temporal fossa. It is inserted into the Coronoid process and anterior margin of Ramus of mandible .(Fig.7) Action -Upper and anterior fibers elevate the mandible, posterior fibers retract the mandible.

Fig. 7

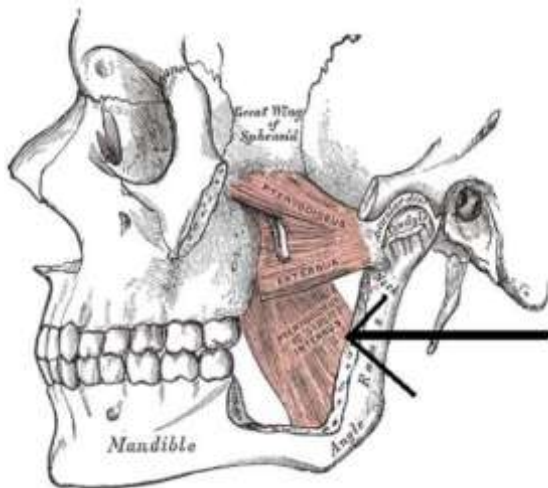


Medial Pterygoid

It has two heads superficial and deep. Deep head is larger and it arises from the medial surface of the lateral pterygoid plate the pyramidal process of the palatine bones. Superficial head arises from the tuberosity and pyramidal process of maxilla It is inserted into the medial surface of mandible near angle .

Action - Elevation and side to side movements of mandible.

Fig. 8



Lateral pterygoid

It has two heads. Superior head arises from the infratemporal fossa. Inferior head arises from the lateral surface of the lateral pterygoid plate and both fuse into a short thick tendon that inserts into pterygoid fovea in the neck of mandible

and to the capsule of temporomandibular joint.(Fig.8)

Action - Side to side movement and protrusion of mandible.

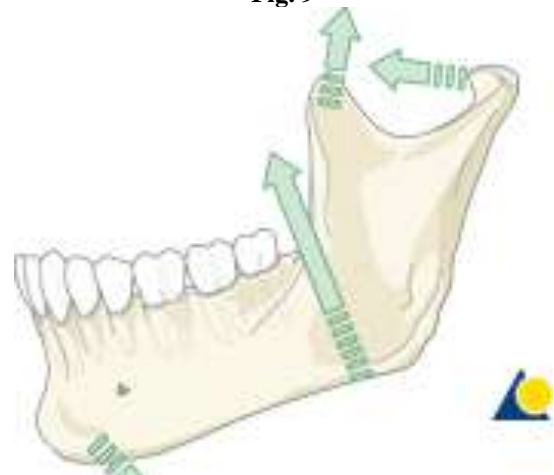
BIOMECHANICS OF MANDIBLE

Biomechanics of Mandible is a complex one. The forces applied to the mandible cause varying zones of tension and compression depending on where the bite force is located.

Muscle forces

Mandible is a hoop of bone that deforms with movement based on the origin and insertion of the muscles of mastication.

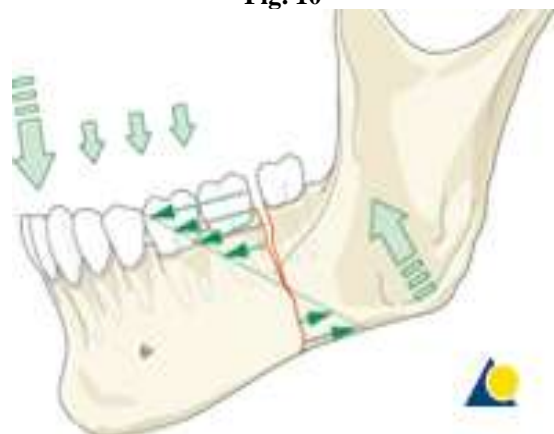
Fig. 9



Tensions and compression zones

Superior border of the mandible is the tension zone and the inferior border is the compression zone.

Fig. 10



Hunting bow concept

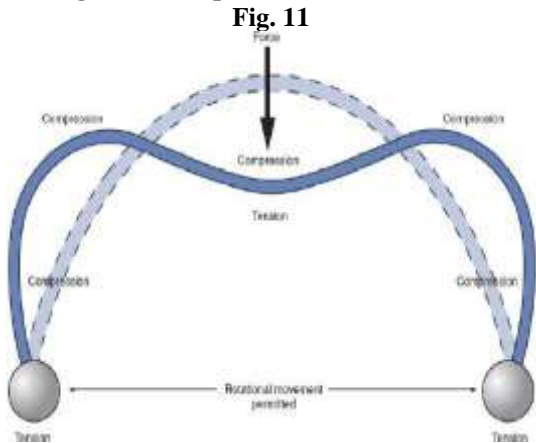


Fig. 11

The mandible is similar to a hunting bow in shape, strongest in the midline (Symphysis) and weakest at both ends (condyles). The most common area of fracture in the mandible is therefore the condylar region. A blow to the anterior mandibular body is the most common reason for condylar fracture. The force is transmitted from the body of the mandible to the Condyle. The Condyle is trapped in the glenoid fossa. Commonly, a blow to the ipsilateral mandible causes a contra lateral fracture in the condylar region. (Fig.11)

If the impact is in the midline of the mandible, fractures of the bilateral condylar region are very common. With a condylar fracture, there is very often shortening of the Ramus on the affected side. This will result in an ipsilateral premature contact of the teeth. In case of bilateral fractures, the patient may present an anterior open bite. The condylar fragment may be displaced (most often laterally) based on the angulation of the fracture and predominant muscle pull.¹⁷

AO Principles of fixation

Superior border plate should be positioned on the ideal line of osteosynthesis. Inferior border plate should be located at the base of the mandibular body below the course of the mandibular canal in a longitudinal field.¹⁷

Ideal line of osteosynthesis

In the body region, it runs at the vertical height of the tooth apices from the canine region to the oblique line. This carries into the oblique ridge which turns into the anterior outer rim of the Ramus. According to Champy¹⁵ in the transition to the Symphysis (anterior mandibular body) the insertion of two plates along the upper and lower border is mandatory because there may be rotational forces that have to be neutralized. In the

posterior transition to the angle and Ramus a second plate just below the oblique ridge may be advantageous in a reduced bone stock due to impacted wisdom tooth or in major dislocations.

Fig. 12

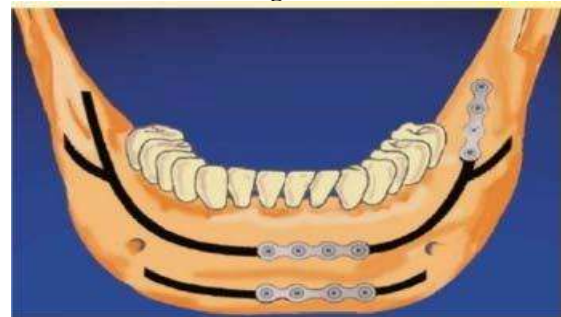
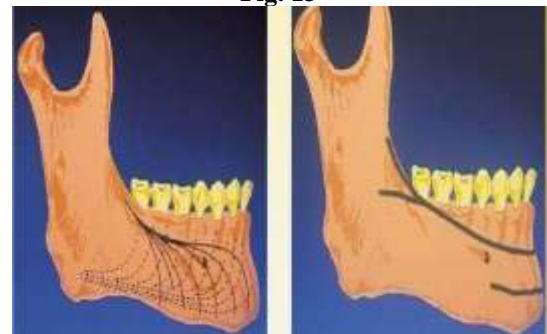


Fig. 13



Two point fixation (two plates) provide more stability than a single plate.

Addition of a second plate provides more rigidity.

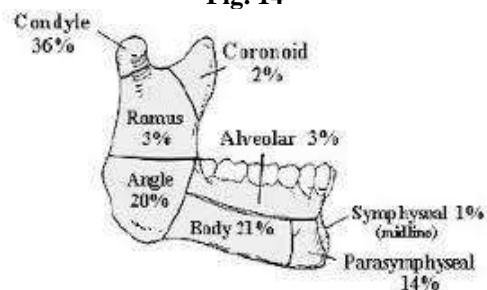
Sequence of plate insertion

Superior plate is inserted first in order to achieve preliminary fixation. This will prevent inadvertent displacement of the fragments during subsequent contouring and insertion of inferior border plate.

CLASSIFICATION

1. **Dingman and Natvig classification** according to the anatomical location site

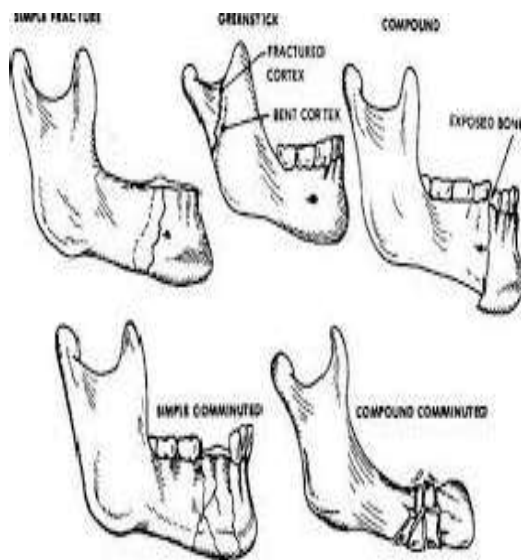
Fig. 14



2. KRUGER'S General classification

- a. Simple fracture / closed
- b. Compound fracture / open
- c. Communitated fracture
- d. Complex or complicated fracture
- e. Green stick fracture
- f. Impacted fracture
- g. Pathological fracture

Fig. 15



3. ROW AND KILLEY'S anatomical Classification

- a. Fracture not involving basal bone
 - (e.g) Dento alveolar fracture
- b. Fracture involving basal bone
 1. Single unilateral fracture
 2. Double unilateral fracture
 3. Bilateral fracture
 4. Multiple
4. **Completeness of fracture** Complete fracture
Incomplete fracture
5. **According to the presence or absent of tooth in relation to fracture line Kazanjian and Converse**

Class I - when the teeth are present on both sides of the fracture line
Class II - when the teeth are present on one side of the fracture line
Class III - when teeth are absent on both sides of the fracture line

6. Favorable and unfavorable fractures

Fig. 16

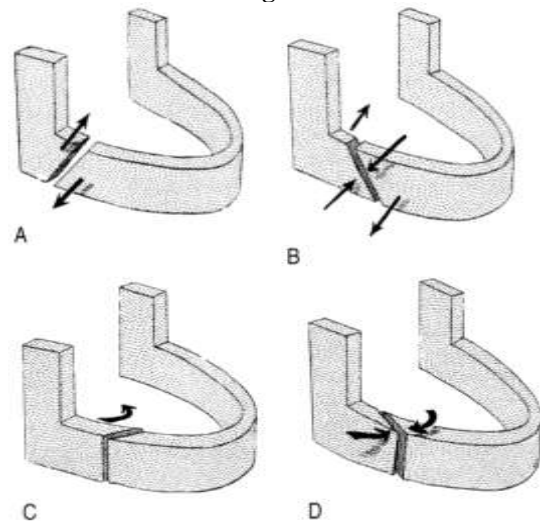
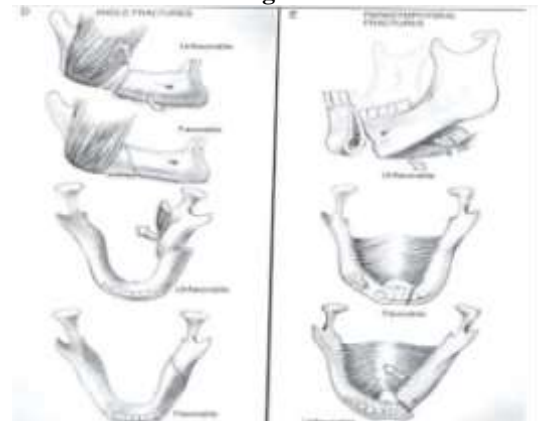


Fig. 17



- a. Horizontally unfavorable, b. Horizontally favorable,
- c. Vertically unfavorable, d. Vertically favorable

Mode of injury

1. RTA
2. Interpersonal violence
3. sports injury
4. Fall
5. Industrial trauma

Mechanism of injury

1. Direct violence
2. Indirect violence
3. Excessive muscular contracture - fracture of the Coronoid process because of sudden reflex contracture of the temporalis muscle.

METHOD OF FIXATION

Closed reduction

Indications

1. Non displaced favorable fractures
2. Fractures in children with developing dentition
3. Coronoid and high condylar fractures
4. Grossly comminuted fractures
5. Edentulous fractures with the use of prosthesis and circum mandibular wires

Splints

1. Gunning splints
2. Lingual splints

Wiring techniques

1. Glimmer method

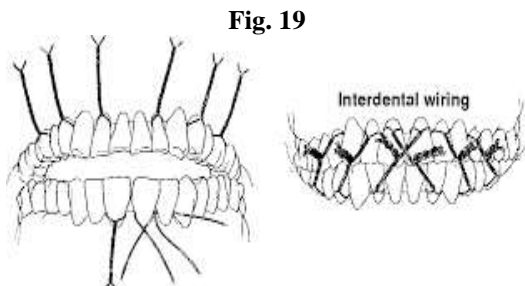
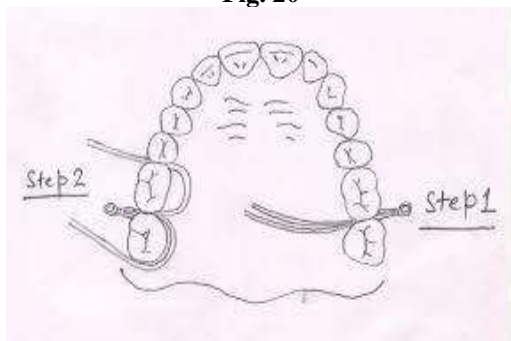


Fig. 19

2. Eyelet method

Fig. 20



3. Erich arch bar method

Fig. 21



4. Orthodontic bands
5. Acrylic splints

Maxillomandibular fixation

Maxillomandibular fixation refers to fixation of maxillary and mandibular teeth together with wiring

. Three to four weeks of fixation is needed. Weight loss has been reported due to MMF.

1. Eyelet method
2. Arch bar method
3. Intermaxillary fixation screws (Fig. 22)

Fig. 22



4. Circumferential wiring
5. External pin fixation

Open reduction

Indications

1. Displaced unfavorable angle, body and parasymphiseal fractures
2. Patients with multiple facial fractures that require a stable mandible for basing reconstruction.
3. Bilateral displaced condylar fractures
4. Fractures of an edentulous mandible with severe displacement
5. Medically compromised patients
6. Comminuted fractures

Contraindications

1. Severely comminuted fractures
2. Grossly infected fractures
3. Patients with healing problems (radiation, chronic steroid use, transplant patients)

Methods of fixation

1. Dynamic compression plates

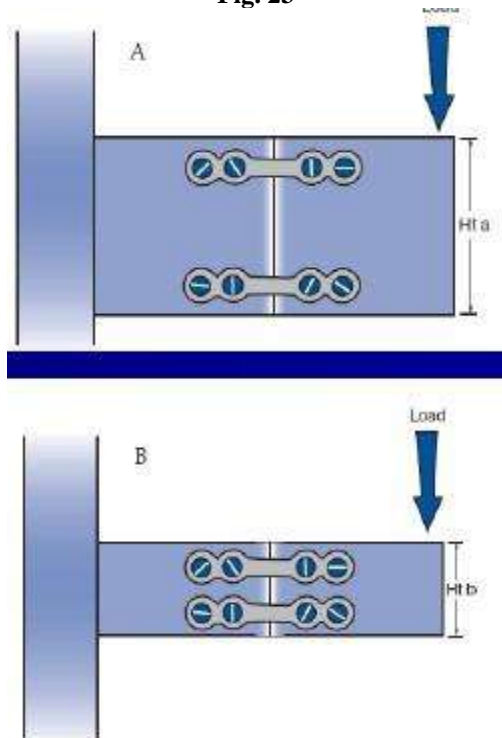
In plates with compression holes, as the screw is tightened the screw-bone unit is moved towards the fracture site impacting against the bone on the

opposite side of the fracture. Screws inserted bicortically This promotes primary bone healing.

2. Miniplates

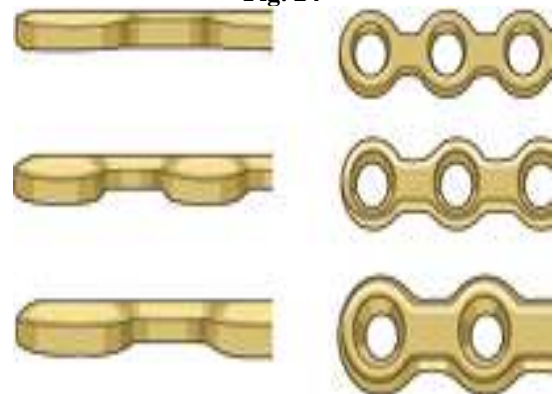
The term “miniplate” refers to a plate thickness of 1.3 mm or less.(Fig.23). Mandibular miniplates are designed to be used with monocortical screws. Bicortical screws may be used for additional stability in some cases (with plate thickness being the limiting factor)

Fig. 23



by a second thread under the head of the screw.(Fig.24) These plates function as internal fixators achieving stability by locking the screw to the plate. The advantage of this system is that it is unnecessary for the plate to have intimate contact with the underlying bone, making plate adaption easier leading to lesser alteration in the alignment of the segments and changes in the occlusal relationship upon screw tightening. It does not disrupt the underlying cortical bone blood supply. The screws are unlikely to loosen from the bone plate.

Fig. 24



3. Locking plates

In locking plate system the hole in the plate is engineered to accept screws that lock to it

4. Lag screws

The principle is to place one or more screws through fragments so that the threads of screws take hold only in the far or deep cortical bone. This is effective in oblique fractures. The screw has to be placed perpendicular to the fracture. Since a single lag screw cannot resist rotation, at least two lag screws are required to resist the rotation.

Fig. 25

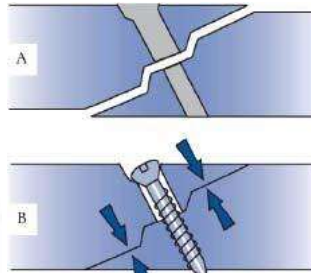
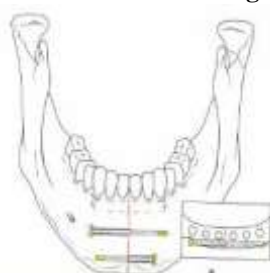
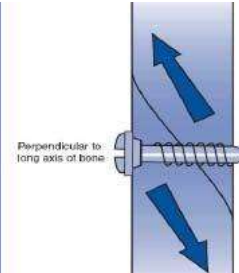


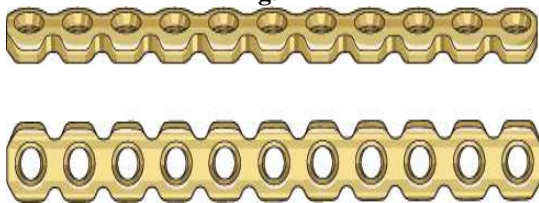
Fig. 26



5. Reconstruction plate

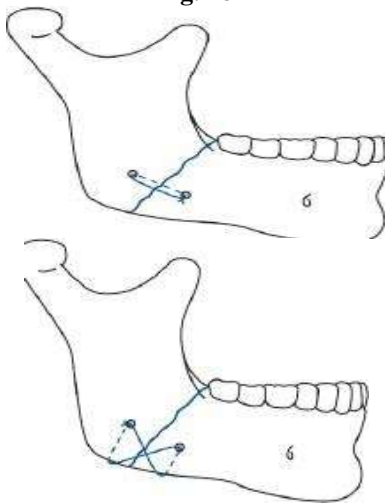
These plates are used for load bearing osteosynthesis of mandibular fractures.

Fig. 27



6. Intraosseous wire fixation

Fig. 28



ACCESS TO THE MANDIBLE

Good exposure of the fracture site is an absolute prerequisite for good surgical outcome. In face importance should be given for future scar and care should taken to avoid injury to nerves and muscles of facial expression.

INTRA ORAL ACCESS

1. TRANS ORAL LOWER BUCCAL SULCUS INCISION

Incision to be made in buccal mucosa in a U shaped manner(Fig.29) and not over gingiva. This incision gives a wide exposure of symphyseal, parasymphyseal and body fractures. Periosteal attachment should be retained whenever possible as the periosteal blood supply is the only remaining circulation. Hardware should be covered with well vascularized soft tissue two layers closure with muscle and mucosa is always effective . Mentalis should be repaired to avoid postoperative lip ptosis and lip ectropion.

Fig. 29

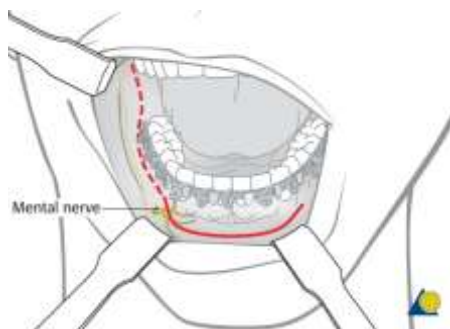
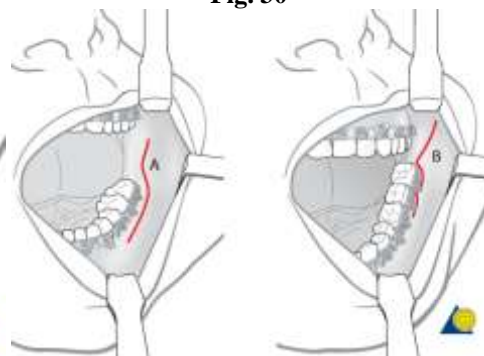


Fig. 30



Advantage

1. Occlusion status can be assessed continuously
2. Rapid approach
3. Avoids external scar

Disadvantage

1. Only labial cortex of the mandible is visualized. It is possible to have a significant gap in the lingual cortex.

2. Contracture of the vestibule

Complications

1. Mental nerve damage.
2. Lip ptosis and lip ectropion

2. TRANSBUCCAL ACCESS (TROCAR TECHNIQUE)



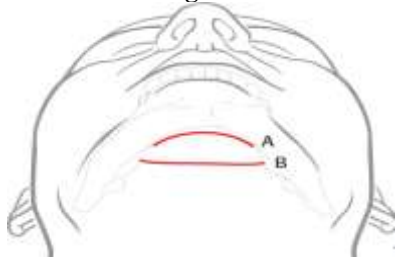
It is a combination of both intraoral and extra oral access. Trocar and specific instruments are used to place the screw. This access is used for body and angle fractures.

EXTRA ORAL ACCESS

A. SUB MENTAL APPROACH

This approach gives good exposure of symphyseal, parasymphyseal and anterior body regions.

Fig. 31



Advantage

1. Mentalis muscle is not divided.
2. Mental nerve is well protected.

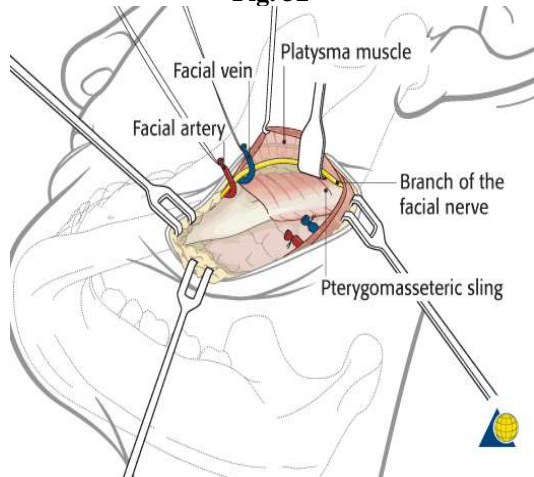
Disadvantage

External scar is present

B. SUB MANDIBULAR APPROACH (RISDON)

It is a 2 to 4 cm curved incision placed 2 cm below the inferior border of the mandible. Marginal mandibular nerve should be identified and protected. Attachment of the masseter muscle at the inferior border is divided and elevated. It gives good exposure to angle, ramus, mid body and particularly in comminuted fractures. This approach is also used in subcondylar fractures.

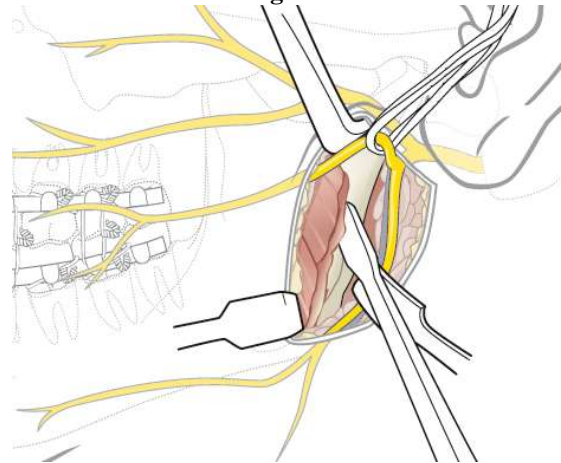
Fig. 32



C. RETRO MANDIBULAR APPROACH

An incision is made 1-2 cm posterior to the border of mandible. It gives exposure to angle, ramus and posterior body regions. Injury to Greater auricular nerve should be avoided.

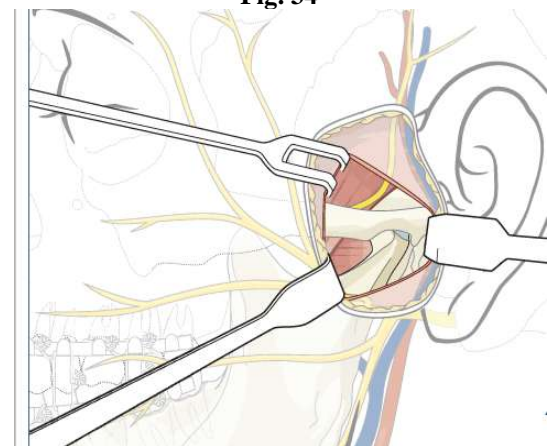
Fig. 33



D. PRE AURICULAR APPROACH

Used to expose condylar head and temporo mandibular joint. Facial nerve should be protected.

Fig. 34



E. POST AURICULAR APPROACH

Used for high condylar fractures

F. TRANS PAROTID APPROACH

This has been described for subcondylar exposure with dissection in the direction of facial nerve fibers to expose the bone through the parotid gland.

Advantage - It is directly over the fracture site.



Complications

1. Parotid fistula
2. Facial nerve injury

MANAGEMENT OF TEETH IN THE FRACTURE LINE

The problem in mandibular fracture management is dealing with teeth in the line of fracture. Commonly, there are impacted third molar associated with mandibular angle fractures. However, any fracture involving the dentate areas of the mandible has the chance to involve erupted teeth in the fracture line.

The surgeon can either remove the involved tooth or leave it in place if it is thought not to compromise the result of fracture management.

Indications for removing the teeth in the line of fracture

1. Tooth subluxated from its socket and interfering with reduction of the fracture.
2. Fractured tooth .
3. Tooth with advanced dental caries carrying a significant risk of abscess during treatment.
4. Tooth with advanced periodontal disease with mobility which could not contribute to the establishment of stable occlusion.
5. Tooth with existing pathology such as cyst or pericoronitis.

Indications for leaving the teeth in the line of fracture

1. Tooth not interfering with the reduction and fixation of fracture.
2. If tooth removal requiring removal of excessive amount of bone, it will lead to compromise in the fracture fixation.
3. Tooth that is in good condition and assists in establishing occlusion and reducing the fracture.

COMPLICATIONS

1. MALOCCLUSION

Malocclusion is the most common complication and functional problem.

Causes of malocclusion are

1. Inaccurate alignment in initial reduction (poorly applied MMF)
2. severe comminution
3. Patient's non compliance.

Minor malocclusion can be corrected with occlusal

splints. Severe malocclusion has to be corrected by refracturing or osteotomy and plates osteosynthesis with MMF.

2. DELAYED OR NON UNION

Delayed union is more commonly due to inadequate reduction and fixation. If a fibrous union is present , the fracture will heal with bony consolidation over a period of time .

Non union occurs due to

1. Infection
2. Inadequate opposition of bone.
3. Severe comminution with gap
4. teeth in the fracture line

It has to be treated by re exploration and fixation with bone grafts.

3. MALUNION

Bone heels in abnormal position due to inadequate reduction and fixation.

Malunion has to be treated with osteotomy and re fixation with bone graft.

4. INFECTION

Infection is seen in compound fractures, excessive periosteal stripping, unstable fracture fixation and poor oral hygiene. It is treated with culture specific antibiotic, re exploration, removal of devitalized bony fragments and if the fixation is loose do a stable rigid fixation and bone grafting of mandible. If the primary fixation is stable allow it till fracture union.

5. EXPOSED OR LOOSE HARDWARE

Hardware get exposed when there is infection, wound contracture and when a dental prosthesis is worn over hardware. Minor exposure is managed conservatively till fracture union whereas major exposure requires hardware removal and more stable fixation.

6. SENSORIMOTOR DISTURBANCES

Sensory disturbances of inferior alveolar nerve and mental nerve can occur. Motor disturbances due to injury to marginal mandibular nerve and facial nerve have been reported.

7. EXACERBATION OF DENTAL DISEASE

If oral hygiene is not maintained there can be exacerbation of existing dental disease like caries .

8. TEMPOROMANDIBULAR JOINT DYSFUNCTION



Prolonged immobilization with MMF can lead to TMJ dysfunction. Simple jaw exercises and mechanical exercises can improve the condition. Myositis ossificans can occur when hematoma in the muscle organises and ossifies. The myositis has to be excised, but there is a chance of recurrence.

9. SCARS

Unightly scar can occur in compound fractures. It can be managed initially with scar massaging followed by scar revision .

III. MATERIALS AND METHODS

This study was conducted in the Department of Plastic and Reconstructive Surgery, Hi-Tech Medical college and Hospital ,Bhubaneswar on 67 patients who reported to the trauma ward and the department of plastic and reconstructive surgery for the treatment of fracture mandible from December 2019 to December 2021.

The mandibular fractures were classified according to the sites such as ramus, Condyle, Coronoid Symphysis, body, Parasymphysis and angle.

INCLUSION CRITERIA

1. All adult patients between 25 to 55 years.
2. Patients reporting within first 7-10 days from the day of trauma.
3. Dentulous / partially dentulous patients
4. Patients giving consent for a follow up period of 3 months post operatively.

EXCLUSION CRITERIA

1. Compound fractures
2. Patients with other facial bone fractures.
3. Patients with systemic / debilitating diseases
4. Patients with head injury

CLINICAL EVALUATION

1. History of incident
2. Inspection- swelling , laceration ,malocclusion, sublingual hematoma, deformity and trismus
3. Palpation-step deformity/tenderness
4. Paresthesia / dysaesthesia/ anesthesia of mental nerve.
5. TMJ examination- to find any Condyle fracture.

All patients with suspected mandible fracture were subjected to OPG (Orthopantomogram) & CT facial bones .The mandibular fractures were classified according to the site such as Ramus, Condyle, Symphysis, Body, Parasymphysis and Angle. All these patients were transferred to the Plastic surgery ward.

Out of 67 patients ,15 patients who had undisplaced fractures , Condylar & Subcondylar fractures were treated conservatively with arch bars , eyelets and Maxillomandibular fixation (MMF) for 4 -6weeks .They were done under mandibular nerve block in our ward within 24-48 hours. Post MMF OPG was taken to assess the reduction .These patients were started on liquid diet soon after the MMF and encouraged to maintain oral hygiene The remaining 52 displaced ,unfavorable and Communited fractures were treated surgically .

Arch bars and MMF were done preoperatively for all the cases to achieve conclusion. Extra oral approach (Risdon) was used for the angle fracture . Intra oral approach (gingivobuccal sulcal approach) was used for the Symphysis, Parasymphysis and body the fractures.

Surgical technique

All the 52 patients who were taken up for surgery were treated according to the principles outlined by Champy. Conventional non locking miniplates and screws were used.

Taking into account the anatomy of the mandible, with the location of the dental apices and the thickness of the cortical layer, Champy et al determined an ideal line of osteosynthesis which corresponds to the course of a line of tension at the base of the alveolar process.^{15,16}

As Champy recommended , one plate was applied behind the mental foramen, just below the dental roots and above the inferior alveolar nerve, in order to neutralize the higher torsion forces between the canines. A second plate was applied near the lower border of the mandible in addition to the sub- apical plate. In the miniplate system unicortical fixation was done.

INSTRUMENTS

Fig. 35





Fig. 36



ANESTHESIA AND PREPARATION OF SURGICAL SITE

All cases were treated under general anesthesia with nasotracheal intubation in supine position. Extra-oral scrubbing was done with povidone-iodine. The oral cavity was prepared with diluted povidone-iodine. Towels and drapes were applied to expose the mouth and neck. 2% Lignocaine with 1: 1,00,000 adrenaline was used for infiltration.

SURGICAL PROCEDURE INCISION:

The fractures of the Parasymphysis, Symphysis and body were exposed using lower gingivobuccal sulcus approach. A low level vestibular incision was made just near the fracture site and a mucoperiosteal flap was raised to expose the fracture site till the lower border of the mandible. Great care was taken not to damage the mental nerve. For angle fractures Risdon approach was used. Marginal mandibular nerve was identified and protected.

REDUCTION

All single fractures, a preinjury occlusion was achieved with preoperative Maxillomandibular fixation (MMF) and then the fracture was fixed. In cases of comminuted fractures, fracture site was exposed intraoperative fracture reduction was done and occlusion was maintained with MMF and then fracture was fixed with plate and screws.

We used 2mm conventional miniplates and 2x8 mm screws for fixation.

In placing the hole, the drill was made perpendicular to bone surface and plate within the centre of the screw hole, with 701 or 702 bur, so that the screw gets fitted into bone plate.

Two four hole conventional miniplates were used in the Symphysis and Parasymphysis fractures between the mental foramina according to Champy's line of osteosynthesis.

These lines corresponds to the

1. Course of a line of tension at the base of alveolar process and
2. Another line near the lower border of the mandible in order to neutralize torsion forces.

A gap of 4-5mm and parallelism were maintained between the two plates. The upper plate was fixed first and then the lower plate with 2x8 mm screws on either side of the fracture. Care was taken not to injure the nerve in the mandibular canal. Marginal mandibular nerve was protected during the Risdon approach. The occlusion was checked and the screws were tightened finally. Maxillomandibular fixation was released depending on the stability of the fixation.

In cases where 2 miniplates were used, MMF was removed soon after the surgery. In cases where single plate was used, MMF retained for 2 wks. Arch bars maintained for 4 more wks. In fractures with combinations like Parasymphysis and Subcondyle, plating was done only for the Parasymphysis and the Subcondyle treated conservatively with MMF for 2-3 weeks.

CLOSURE

The fracture site was irrigated and soft tissues closed with 2-0 vicryl in two layers. Post operative OPG was taken to assess the stability of fixation.

POSTOPERATIVE CARE

All patients were kept under antibiotic cover for 5 days. Those for whom MMF was removed they were advised to take liquid diet for 2days and thereafter on a soft diet for 4to 6 weeks. Those who were advised to maintain MMF, continued liquid diet for 2-3 weeks.

The patients were asked to maintain oral hygiene with mouth wash. Sutures were removed on the 5th postoperative day for patients who had underwent extra oral approach.

At the end of second post operative week they were started on gentle physiotherapy. Follow up was performed weekly during the first 6 weeks and thereafter monthly for 4 to 6 months.

FOLLOW UP

During the immediate follow up the following parameters were recorded.



1. Resolution of facial edema.
2. Healing of surgical sites.
3. Sensory , motor disturbances.
4. Visual analog score for pain
5. Visual analog score for chewing ability
6. Angle criteria for occlusion
7. Mouth opening
8. Weight loss

- 0 – No pain
- 2 – Annoying pain
- 4 – Uncomfortable pain
- 6 – Dreadful pain
- 8 – Horrible pain
- 10 – Agonizing pain (most intense pain imaginable).

Data in the form of two Visual Analogue Scales (VAS) related to the degree of pain and dysfunction in terms of chewing capabilities were collected.⁶⁸

VISUAL ANALOGUE SCALES

Pain is a subjective experience reported by the patients . In clinical pain research, pain is usually measured in rating scales . There are various rating scales have been used like visual, verbal and numerical in clinical setting. The visual analogue scale (VAS) for pain assessment was studied by Huskisson .

A commonly used visual analogue pain scale consists of a 100mm line, anchored at each end with terms describing the amount of pain felt (for example: “No pain” to “worst pain possible”). The subject makes a mark on the line corresponding to the amount of pain felt, and the distance from the “No pain” end of the scale to the marked point is measured in millimeters (mm). Thus visual analogue scale provides data on pain in the form of a continuous variable. The other rating scale uses the verbal descriptor as ‘none’ , ‘mild’ , ‘moderate’ and ‘severe’.

In our study we used the following:

VAS I was used to assess the level of pain (ranging from 0 to 10). VAS II was used to assess the level of disturbance in jaw function (ranging from 0 to 10).

Patient were given a chart with numerical marked from 0 to 10 making it more simpler for the patient to express their subjective ratings of pain and dysfunction (chewing capability).

VISUAL ANALOGUE SCALE – I (FOR PAIN)

VISUAL ANALOGUE SCALE – II (FOR CHEWING ABILITY)

- 0 – No impairment
- 2 – Mild impairment
- 4 – Moderate impairment
- 6 – Severe impairment
- 8 – Very severe impairment but able to chew
- 10 – Total inability to chew.

Patients were explained about the chart and were asked to mark the level of their rating in both the scales.

IV. OBSERVATION AND RESULTS

The total number of patients who underwent treatment for both conservative and surgically treated patients were sixty seven. The number of patients in the conservative group was fifteen and surgically treated was fifty two.

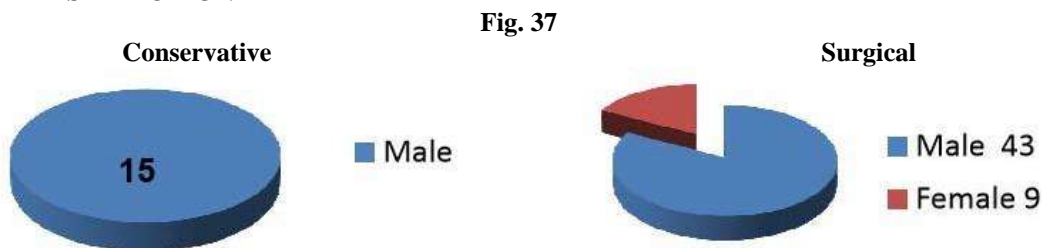
TABLE - 1. AGE DISTRIBUTION OF MANDIBLE FRACTURES

Age	Conservative	Surgical
25-30	6	25
31-35	1	10
36-40	3	10
41-45	0	3
46-50	4	3
51-55	1	1
Total	15	52

In this study both in conservative and surgical majority of the injured patients were in the age group between 25-30 (42.6%). The youngest patient was 25 years and the oldest was 54 years. About 55 patients (82%) were in the age group of 25-40 years .

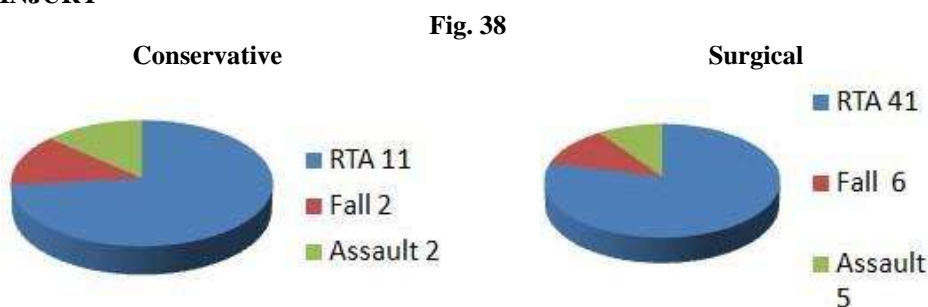


GENDER DISTRIBUTION



Of the 15 patients treated conservatively all were male and in the 52 patients treated surgically 43 were male (82.6%) and 9 were female .

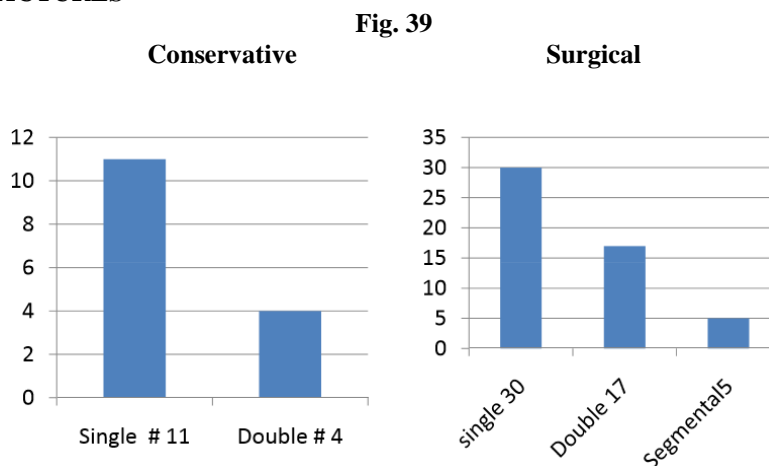
MODE OF INJURY



Road traffic accident (RTA) was the most common mode of injury in both conservative and surgically treated patients, which was followed by

fall and assault . Road traffic accident was about 76.6% in both the groups (67 patients) .

NUMBER OF FRACTURES

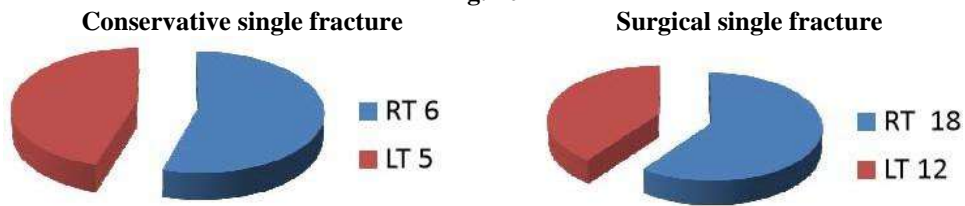


Of the 15 patients treated conservatively 11 (73.3%) had single fracture and 4 (26.6%) had double fractures. In the surgically treated patients

30 (57.6%) had single fracture , 17 (32.6%) had double fractures and 15 (28.8%) had segmental fractures.

SIDE OF INJURY

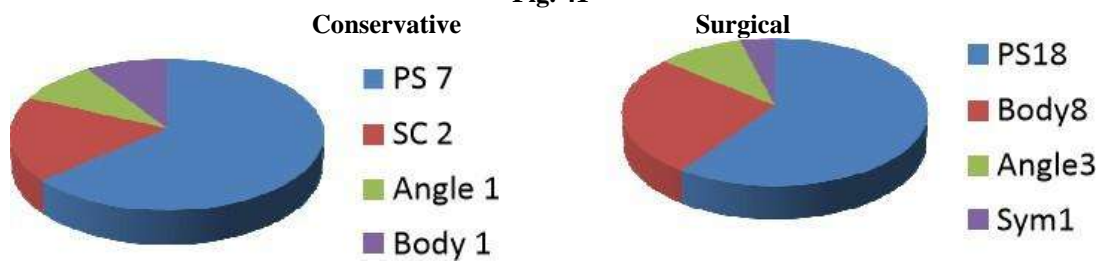
Fig. 40



In single fracture right side (58.5%) was the most frequently involved.

FRATURE DISTRIBUTION IN SINGLE FRACTURE

Fig. 41

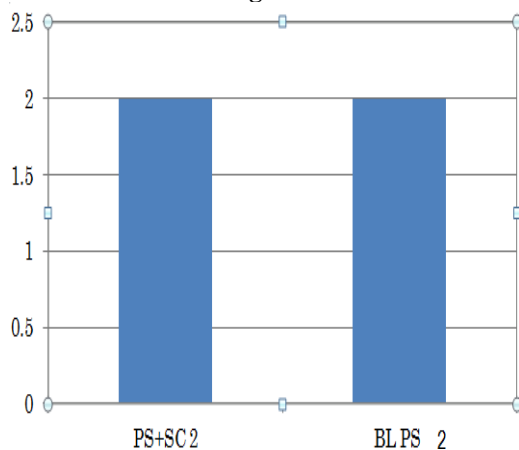


PS-Parasymphysis SC-Sub condyle Sym-Symphysis

In both the groups Parasymphysis (48%) was the most common site of involvement in single fracture.

CONSERVATIVE DOUBLE FRACTURE

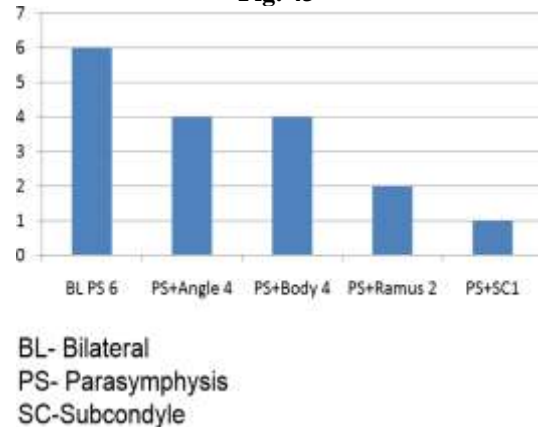
Fig. 42



PS-Parasymphysis SC-Sub condyle BL-Bilateral
 The combinations in conservative double fractures were Parasymphysis with subcondylar and bilateral Parasymphysis fracture.

DOUBLE FRACTURE SURGICAL

Fig. 43



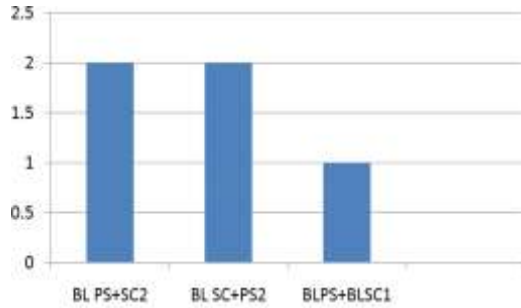
In surgically treated double fractures the following were the combinations .

Bilateral Parasymphysis -6,
 Parasymphysis with Angle - 4, Parasymphysis with Body - 4, Parasymphysis with Ramus - 2 and Parasymphysis with subcondylar -1. Bilateral Parasymphysis was the most common fracture . All the combinations had Parasymphysis fracture.



SEGMENTAL FRACTURE SURGICAL

Fig. 44



BL-Bilateral
 PS-Parasymphysis
 SC-Subcondyle

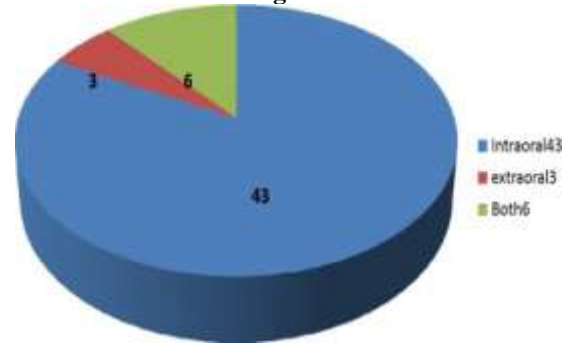
There were five cases of segmental fracture. Of which bilateral Parasymphysis with Subcondylar-2, bilateral subcondylar with Parasymphysis -2 and bilateral Parasymphysis with bilateral subcondylar fracture-1.

TIME INTERVAL BETWEEN INJURY AND PROCEDURE

In the patients treated conservatively, Maxillomandibular fixation (MMF) done within 24-48 hours. In the surgically treated patients, operated in an average period of 7 days.

SURGICAL APPROACH

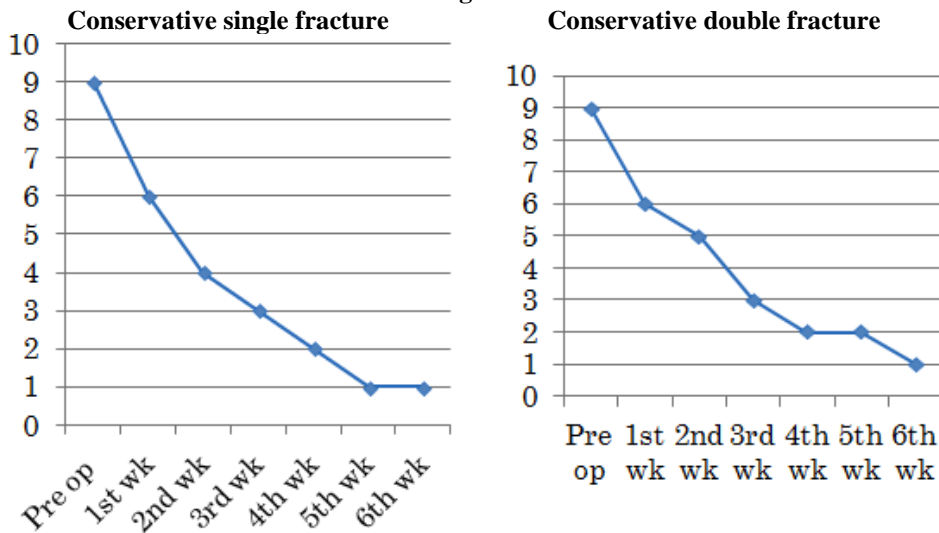
Fig. 45



Out of the 52 patients treated surgically, 43 patients underwent intraoral approach, 3 patients underwent extra oral approach (Risdon approach) and 6 patients underwent both the approaches.

VISUAL ANALOG SCORE FOR PAIN

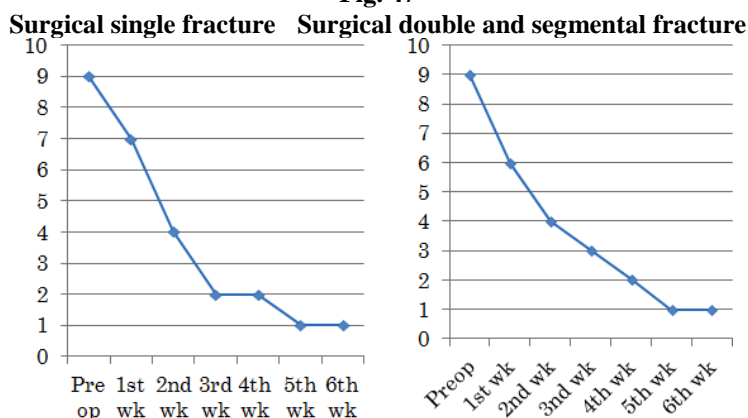
Fig. 46



In both single and double fractures treated conservatively the prefixation score of 9 improved to 1 by the end of five weeks in single fractures but it took one more week in double fracture.



Fig. 47

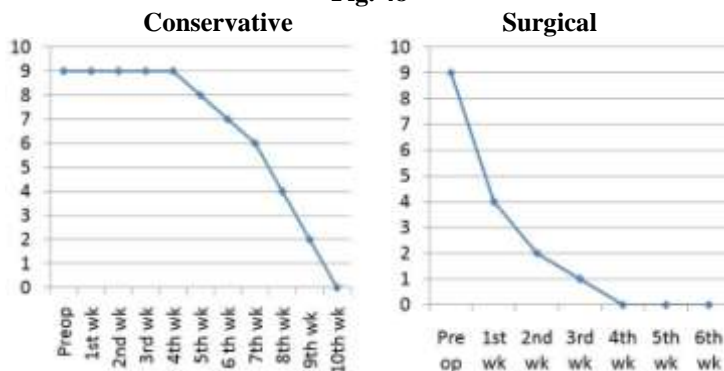


In surgically treated patients (single, double and segmental fractures) the results were same as conservatively treated single and double

fractures, but the pain score was remaining high in the second and the third weeks.

VISUAL ANALOG SCALE FOR CHEWING

Fig. 48



In the conservative group the visual analog score for chewing improved from 9 to 6 in 6 weeks time and in the surgical group the score improved in 4 weeks time, since we removed Maxillomandibular fixation (MMF) soon after surgery

The mouth opening become near normal(45-50mm) in single fractures both in conservative and surgical groups. In double fractures of both the group the mouth opening was 40-45mm in six weeks time

MOUTH OPENING

Table. 2

Conservative	Surgical
Single fracture - 45-50 mm	Single fracture - 45-50mm
Double fracture - 40-45mm	Double fracture- 40-45mm
	Segmental fracture - 40-45mm

OCCLUSION

Angle Class I occlusion was achieved in 13 patients (86.6%) in conservatively treated patients and 49 patients (94.2%) in surgically treated patients. There were 2 cases of open bite (13.3%) in conservatively treated patients and 3 cases of open bite (5.7%) in surgically treated patients .



COMPLICATIONS

Table.3

S.no	Complications	Conservative	Surgical
1	Mal occlusion	2 (13.3%)	4 (7.6%)
2	Infection	0	5 (9.6%)
3	Non union	0	0
4	Mal union	1% (6.6%)	0
5	Paresthesia-Mental nerve involvement	2 (13.3%)	4 (7.6%)
	Marginal mandibular nerve involvement	-	0
6	Hard ware exposure	0	0

V. DISCUSSION

The mandible although considered the heaviest and the strongest facial bone, is more prone for fractures because it is an open arch, located in the lower portion of the face and atrophies with age. Facial injuries not only involves soft tissues but also damages the bone, leading to fractures. Mandible is connected by strong muscles for various functions. They act as a splint and give protection to the mandible, on the other hand these powerful muscles can cause massive displacement of the fracture fragments.⁶⁸

The human face constitutes the first contact point in several human interactions thus, injuries and mutilation of the facial structures may have a disastrous influence on the affected person.⁸⁴ Knowledge of the dentition is thus an absolute prerequisite for the proper treatment of mandible fractures. Fractures of the mandible invariably produce malocclusion if not treated properly.

The most common facial fractures were the mandible (61%), followed by the maxilla (46%), the zygoma (27%) and the nasal bones (19.5%).^{57,58}

Road traffic injury was the most common mode of injury in our study (76.6%) followed by fall and assault. Adekeye has reported that 74% of mandibular fractures were due to road traffic accidents.^{1,58} This was also reported by Subhashraj et al in a study done in South Indian city.⁷¹ The mechanism of hyperextension and hyper flexion of the head in traffic accidents makes it more vulnerable to fracture³⁴.

Males are predominantly involved in mandibular fractures^{43,52,74}. This male predominance may be due to the greater mobility of the male and their aggressive behavior. In our study we found that the age group between 25-30 years was the most commonly involved. This was supported by Ajmal et al³ and Wimon Sirimaharaj et al⁷⁰.

There were 61.6% of single mandibular fractures and 40.6% of multiple mandibular fractures, with an average of 1.34 fractures per person. This is similar to that of Sirimaharaj et al.⁷⁰ who reported 1.4 fractures per person. Ajmal et al³ reported 1.5 fractures per person.

Parasympyseal fractures were the most common fractures in our study followed by body and angle.⁵² Among double fractures the most common combination is bilateral Parasympysis. In segmental fractures, bilateral Parasympysis fracture was the most common one. Right side involvement was common. Ajmal et al³ also reported Parasympyseal fractures were the most frequently involved followed by body and angle. This was also supported by Mittal et al⁵² study.

Deranged occlusion followed by bony deformity was the commonest mode of clinical presentation. This finding was supported by Laurentjoye M et al.⁴⁶

All the Parasympysis, Symphysis and body fractures were approached intra orally. Extra oral approach was used for angle fractures. Care was taken not to injure the mental nerve during intraoral and marginal mandibular nerve during Risdon approach.

In our study, undisplaced fractures, condylar and subcondylar fractures were treated with Maxillomandibular fixation (MMF). with good functional results as comparable with Ghodke et al.³¹

Out of 67 patients 15 (22.3%) underwent conservative treatment with eyelets, arch bars and Maxillomandibular fixation (MMF). The duration of MMF was 4-6 weeks in adults, 2-3 weeks in condylar fractures⁴. Benjamin et al¹⁰ study from Nigeria have also reported the usage of arch bars and eyelets with same results.



The average recommended period of immobilization of fractured mandible is 4-6 weeks.^{27,43,57} Although this is only empirical, it is usually influenced by several factors such as age of patient, type, number and severity of fracture, presence or otherwise of retained teeth in fracture line, and presence or absence of infection amongst others.⁵²

In both the conservative & surgical single fracture patients, the visual analog score - pre operative pain score of 9 has come down to 1 during 5th week.

In surgical group the pain score was remaining high in the 1st week due to surgical trauma, then it has reduced to 2 during 3rd week due to stability of fixation. In surgical double fracture the pre operative pain score of 9 has come down to 1 in 5 weeks. But it took 1 more week for the conservative double fracture to come down to one.

There was weight loss, air way related problem, difficulty in phonation and poor oral hygiene in the conservatively treated group. Weight gain and good oral hygiene was seen in the surgically treated patients. This study was similar to that of **Brown.J.S. et al.**¹² who demonstrated the advantages of miniplate osteosynthesis over intermaxillary fixation in management of fractured mandible. The post operative function is improved and there was weight gain. Patient treated with intermaxillary fixation have restricted airway.

There was weight loss during the first postoperative week in surgically treated patients. This was probably due to the poor intake of proper diet due to surgical trauma.

Complications

Two patients (13.3%) had **malocclusion** in the conservative group, which was noticed in the first review and they were subjected to open reduction. There was malocclusion in four patients (7.6%) who were treated surgically which were less when compared with the **Benjamin et al**¹⁰ study. All the four patients were subjected to redo and occlusion was achieved.

There were five cases of **infection** (9.6%) in the operated group which were treated with higher antibiotics and the implant was retained till the fracture union. Implant removal was done in all these five patients after the fracture union. The infection rate was little higher when compared to **Ugboko et al.**⁵⁷ who had 8.1%. One patient who was treated conservatively developed **malunion** and it was corrected with osteotomy, bone graft and plate osteosynthesis.

The **neurological deficit** in the operated group was 4 (7.6%) and the conservative group was 2 which was comparable to the study done by **Okoturo and Benjamin et al.**¹⁰ (7.1%) and **Cawood**¹³ (8%) which improved in 6-8 weeks time. This deficit was not due to the surgical procedure but related to the nature of injury.

VI. CONCLUSION

The treatment of mandible fractures requires adequate fracture reduction and stabilization through a closed or open technique. Success relies on the restoration of normal dental occlusion and bony union. The treatment chosen may differ as there are many factors like cost of treatment, affordability by the patient, feasibility in the hospital, doctor's decision and skill, and patient's willingness to avail the treatment advised; all of which may vary from one country to another.

This study is not comparing the results of closed reduction and open reduction techniques. It is an analysis of the mandibular fracture demographic variables and outcome of the management adopted in patients presented to our department. The results of the patients treated both closed and open methods were same as reported in the literature.

In single fracture, the results both in the surgical and conservative groups are equal.

Conservative group took longer time for improvement than surgical group, since we maintain MMF for 4-6 Weeks.

In double and segmental fracture, surgical management had good outcome with double plate fixation.

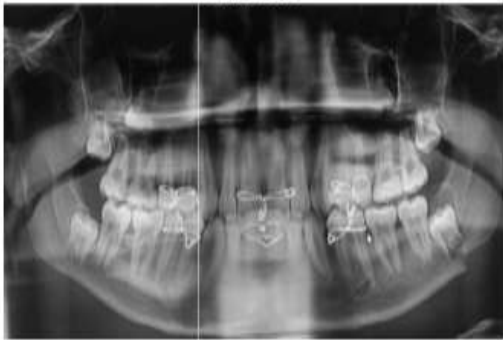
Intra osseous wiring prevented distraction; however, it does not provide sustained inter fragmentary compression.⁶⁹ This has led to increased preference for open reduction and internal fixation with miniplates. This has helped reduce malocclusion, nonunion, improved mouth opening, speech, decreased weight loss, and increased the ability for patients to return to work earlier.⁶⁹

High levels of success can still be achieved using available materials in the form of arch bars, eyelets and wire osteosynthesis in the treatment of mandibular fractures using either the closed or open reduction technique in resource poor settings despite the advent of miniplate osteosynthesis.



SURGICAL CASE No.42 LEFT ANGLE FRACTURE

**PRE OP
PRE OP**



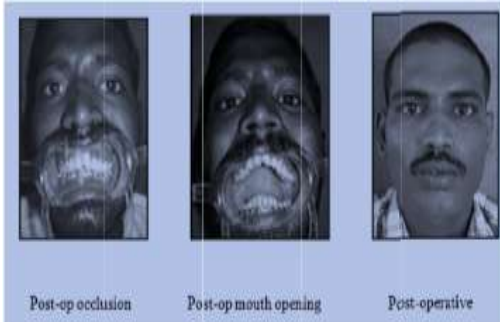
POST OP



PER OP



POST OP CLINICAL PICTURE



SURGICAL CASE No. 13 BILATERAL PARASYMPHYSIS FRACTURE

PRE OP



PER OP



POST OP



**SURGICAL CASE No. 6
LEFT PARASYMPHYSIS FRACTURE
PRE OP**



**SURGICAL CASE No. 8
RIGHT BODY FRACTURE
PRE OP**



PER OP



POST OP





**COMPLICATIONS
SURGICAL CASE No. 40
INFECTED IMPLANT**



POST OP (AFTER METAL EXIT)



**MALUNION
CONSERVATIVE CASE No. 14
LEFT BODY FRACTURE – went into
malunion – osteotomy, plating and bone grafting**

PRE OP



POST OP



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