

Complimentary Online  Videos

Textbook of **SURGERY** for Dental Students



Sanjay Marwah

3rd
Edition




Contents

1. Introduction of Surgery 1

 Sanjay Marwah

- History of Surgery 1
- Recent Advances 2
- Dealing with a Surgical Patient 3
- History Taking 3
- Examination 4
- Investigations 7
- Management of Unfit Patient 8
- Risk Assessment of the Surgery 8

2. Inflammation 9

 Nisha Marwah

- Definition 9
- Types of Inflammation 9
- Chemical Mediators of Inflammation 10
- Systemic Inflammatory Response 10
- The Inflammatory Cells 12
- Morphological Types of Acute Inflammation 13
- Chronic Inflammation 14

3. Acute Infections 16

 Sanjay Marwah

- Definition 16
- Pathophysiology 16
- Wound Infection (Surgical Site Infection) 17
- Types of Infection 17
- Vincent's Angina 23

4. Chronic Specific Infections and Viral Infections 24

 Varinder Saini, Sanjay Marwah, Kranti Garg,
Surabhi Jaggi

- Tuberculosis 24
- Syphilis 29
- Gonorrhea 30
- Anthrax 31
- Actinomycosis 31
- Tetanus 32
- Leprosy (Hansen's Disease) 33
- Viral Infections 35

5. Sinus, Ulcer and Fistula 39

 Sanjay Marwah

- Sinus 39
- Fistula 40
- Examination of Sinus/Fistula 41
- Ulcer 42
- Clinical Features of Various Ulcers 45

6. Wounds 49

 Sanjay Marwah


- Definition 49
- Types of Wound 49
- Wound Healing 53
- Examination of Wounds 54
- Treatment of Wounds 55
- Management of Facial Wounds 56
- Medicolegal Aspects of Wounds 57
- Complications of Wound Healing 57

7. Surgical Asepsis and Antiseptic Measures 60

 Sanjay Marwah

- Operation Theater Discipline 60
- Sterilization 62

8. Hemorrhage, Blood Transfusion and Bleeding Disorders 65









 Nisha Marwah

- Classification of Hemorrhage 65
- Methods for Determining the Blood Loss 67
- Treatment of Hemorrhage 67
- Blood Transfusion 68
- Bleeding Disorders 71

9. Shock, Syncope and Circulatory Collapse 73

 Sanjay Marwah, Jasbinder Kaur

- Shock 73
- Syncope 76
- Circulatory Collapse 77

10. Care of the Acutely Injured 78	14. Diseases of Oral Cavity 139
 <i>Sanjay Marwah</i>	 <i>Sanjay Marwah</i>
<ul style="list-style-type: none"> • Prehospital Management and First Aid of Trauma Patients 78 • In Hospital Management of Trauma Patients 79 	<ul style="list-style-type: none"> • Non-neoplastic Lesions of Oral Cavity 139 • Diseases of the Tongue 142 • Diseases of the Lips 144 • Diseases of the Palate 144 • Diseases of the Tonsils 145 • Neoplastic Lesions of Oral Cavity 147 • Clinical Features of Oral Cancers 150 • Investigations for Oral Cancers 152 • Staging of Oral Cancers 152 • Treatment of Oral Cancers 152 • Clinical Examination of Oral Cavity 157
11. Tumors 86	15. Diseases of Salivary Glands 160
 <i>Sanjay Marwah, Sandeep Chauhan</i>	 <i>Sanjay Marwah</i>
<ul style="list-style-type: none"> • Benign Tumors 86 • Malignant Tumors 94 	<ul style="list-style-type: none"> • Surgical Anatomy 160 • Salivary Gland Disorders 161 • Inflammatory Disorders 162 • Salivary Gland Tumors 165 • Parotid Gland Tumors 166 • Submandibular Gland Tumors 168 • Minor Salivary Gland Tumors 168 • Sjögren's Syndrome 172 • Clinical Examination of Salivary Glands 172
12. Cysts and Neck Swellings 105	16. Diseases of Larynx and Nasopharynx 174
 <i>Sham Singla, Sanjay Marwah</i>	 <i>Sanjay Marwah</i>
Cyst 105 <ul style="list-style-type: none"> • Symptoms 105 • Signs 106 • Complications in a Cyst 108 • Dermoid Cyst 108 • Sebaceous Cyst 111 • Cystic Swellings from Blood Vessels 112 • Carotid Body Tumor (Chemodectoma) (Solid Swelling) 116 • Sternomastoid Tumor (Solid Swelling) 117 • Secondaries Neck (Solid Swelling) 117 • Cystic Swelling from Lymphatics 117 • Branchial Cyst 119 • Branchial Fistula 120 • Pharyngeal Pouch 120 • Laryngocele 122 • Subhyoid Bursal Cyst 123 • Cysticercosis 123 • Meningocele 124 • Myelocele 124 • Odontogenic and Nonodontogenic Cysts 124 • Parotid Abscess 124 • Retention Cyst 124 • Ranula 125 • Cold Abscess 125 Neck Swelling 125 <ul style="list-style-type: none"> • Clinical Examination and Differential Diagnosis of a Neck Swelling 125 	Larynx 174 <ul style="list-style-type: none"> • Surgical Anatomy 174 • Physiology 174 • Stridor 174 • Epiglottitis 175 • Laryngitis 175 • Vocal Cord Palsy 176 • Tumors of the Larynx 177 • Tracheostomy 179 Nasopharynx 181 <ul style="list-style-type: none"> • Surgical Anatomy 181 • Enlarged Adenoids 182 • Tumors of the Nasopharynx 182
13. Diseases of Lymph Nodes and Lymphatics 126	17. Head and Cranial Nerves Injury 184
 <i>Sanjay Marwah</i>	 <i>Ishwar Singh, Sanjay Marwah</i>
<ul style="list-style-type: none"> • Cervical Lymph Nodes 126 • Leukemia 134 • Diseases of Lymphatic System 135 	<ul style="list-style-type: none"> • Pathophysiology of Head Injury 184 • Mechanisms of Head Injury 184 • Classification of Head Injury 184 • Scalp Laceration 184 • Skull Fractures 185 • Brain Injury 187

- Injury to Blood Vessels 188
- Management of Head Injury Patient 190
- Cavernous Sinus Thrombosis 193
- Cranial Nerves 194
- Trigeminal Neuralgia (Tic Douloureux) 196
- Facial Nerve Paralysis 197

18. Gangrene and Diseases of Arterial System200

 Sanjay Marwah

- Gangrene 200

Individual Causes of Gangrene202

- Atherosclerotic Arterial Thrombosis 202
- Surgery for Chronic Lower Limb Ischemia 207
- Embolism 208
- Buerger's Disease 209
- Raynaud's Disease 211
- Raynaud's Syndrome 212
- Cervical Rib and Thoracic Outlet Syndrome 212
- Drugs Causing Gangrene 213
- Venous Gangrene 214
- Traumatic Gangrene 214
- Physical Gangrene 216
- Chemical Gangrene 216
- Infective Gangrene 216
- Diabetic Gangrene 218

19. Diseases of Venous System221

 Sanjay Marwah

- Surgical Anatomy of the Lower Limb Venous System 221
- Surgical Physiology 222
- Varicose Veins 222
- Deep Vein Thrombosis 227

20. Principles of Operative Surgery, Diathermy, Radiotherapy and Anesthesia229

 Sanjay Marwah, Naveen Malhotra

- Principles of Operative Surgery 229
- Principles of Diathermy 231
- Principles of Radiotherapy 234

Principles of Anesthesia237

- General Anesthesia 238
- Local Anesthesia 242
- Regional Anesthesia 244
- Central Neuraxial Blocks 244
- Pain Management 245
- Daycare Surgery 245

21. Fractures and Maxillofacial Injuries247

 Sanjay Marwah, Virendra Singh

- Definitions 247
- Types of Bones 247
- Types of Fractures 247
- Classification of Fractures 247
- Healing of a Fracture 248
- Clinical Features and Diagnosis 249
- Management 249
- Newer Methods of Fracture Treatment 252
- Complications of Fractures 252
- Fractures of Head and Neck Region 252
- Maxillofacial Fractures 252
- Fracture of the Mandible 257
- Fracture of the Maxilla 262
- Orbital Blow-out Fracture 264
- Panfacial Fractures 264
- Complications of Maxillofacial Fractures 264

22. Cleft Lip and Cleft Palate266









 Sanjay Marwah

- Embryology of Lip and Palate 266
- Anatomy of Lip and Palate 266
- Cleft Lip 267
- Cleft Palate 267
- Common Syndromes Associated with Cleft Lip and Cleft Palate 271

23. Thyroid Gland273

 Sham Singla, Sanjay Marwah

- Surgical Anatomy 273
- Physiology 275
- Hypothalamic-Pituitary Thyroid Axis 275
- Thyroid Function Tests 275
- Thyroid Imaging 275
- Fine Needle Aspiration Cytology 276
- Thyroid Autoantibodies 277
- Core Biopsy 277
- Frozen Section Biopsy 277
- Hypothyroidism 277
- Goiter 278
- Thyrotoxicosis 282
- Thyroid Neoplasms 285
- Differentiated Thyroid Carcinoma 286
- Anaplastic Carcinoma 289
- Medullary Carcinoma 290
- Malignant Lymphoma 291
- Discrete Thyroid Swellings 291
- Thyroiditis 292
- Thyroidectomy 293

• Ectopic Thyroid 294	
• Thyroglossal Cyst 295	
• Thyroid Eye Disease 295	
• Clinical Examination of Thyroid Gland 297	
24. Parathyroid Gland300	
 Sanjay Marwah, Nisha Marwah	
• Surgical Anatomy 300	
• Physiology 300	
• Hypoparathyroidism 300	
• Hyperparathyroidism 301	
• Hypercalcemia 303	
25. Swellings of the Jaw304	
 Sanjay Marwah, Virendra Singh	
• Epulis 304	
• Odontomes 305	
• Swellings Caused by Jaw Tumors 308	
• Inflammatory Swellings 315	
• Clinical Examination of the Jaws 318	
26. Principles of Tissue Biopsy319	
 Nisha Marwah, Sanjay Marwah	
• Types of Biopsy 319	
• Frozen Section 323	
• Sentinel Lymph Node Biopsy 324	
27. Burns and Principles of Tissue Replacement.....325	
 Sanjay Marwah, Kuldeep Singh	
• Burns 325	
• Principles of Tissue Replacement 332	
• Skin Substitutes 339	
• Tissue Expansion 340	
28. Surgical Suturing341	
 Sanjay Marwah	
• Surgical Needles 341	
• Suture Materials 342	
• Suturing Techniques 344	
• Removal of Skin Sutures 347	
• Alternatives to Sutures 347	
29. Surgical Instruments.....349	
 Sanjay Marwah	
• Instruments used for Cleaning and Draping 349	
• Dissecting Forceps 350	
• Tissue Holding Forceps 350	
• Forceps used for Hemostasis 351	
• Suturing Instruments 353	
• Instruments used for Making Incision 354	
• Scissors 354	
• Retractors 355	
• Miscellaneous Instruments 357	
• Tracheostomy Instruments 359	
• Drains 360	
• Plastic and Rubber Instruments 361	
• Catheters 364	
30. Wound Dressings and Bandages.....367	
 Sanjay Marwah, Sandeep Chauhan	
• Dressing 367	
• Bandages 367	
31. Surgical Specimens.....374	
 Nisha Marwah, Sanjay Marwah	
• Pathological Specimens of Head and Neck 374	
Index.....379	

Fractures and Maxillofacial Injuries

 Sanjay Marwah, Virendra Singh

CHAPTER OUTLINE

- Definitions
- Types of Bones
- Types of Fractures
- Classification of Fractures
- Healing of a Fracture
- Clinical Features and Diagnosis
- Management
- Newer Methods of Fracture Treatment
- Complications of Fractures
- Fractures of Head and Neck Region
- Maxillofacial Fractures
- Fracture of the Mandible
- Fracture of the Maxilla
- Orbital Blow-Out Fracture
- Panfacial Fractures
- Complications of Maxillofacial Fractures

DEFINITIONS

Fracture

It is the structural break in normal continuity of bone.

Dislocation

It is a complete disruption of a joint with no remaining contact between articular surfaces.

Subluxation

It is a partial disruption of a joint with some contact remaining between articular surfaces.

Sprain

It is a painful condition due to tearing of a ligament and soft-tissue injury.

TYPES OF BONES

Tubular Bones

These are long bones with marrow in the medullary canal, e.g., femur.

Cancellous Bones

These are flat bones that have uniform spongy texture with no medullary canal, e.g., sternum.

TYPES OF FRACTURES

Simple Fracture

A fracture is called simple or closed when there is no communication between site of fracture and exterior of body.

Compound Fracture

A fracture is called compound or open when there is a wound on the skin surface leading down to the site of fracture. However, it must be stressed that the presence of a skin wound and fracture of underlying bone without any communication between the two is not a compound fracture.

In compound fracture, there is a risk of contamination of fractured bone by outside organisms while a closed fracture is free from this risk.

CLASSIFICATION OF FRACTURES

Classification Based on Etiology of Fractures

Traumatic Fracture

It forms the largest group, and the term “fracture” generally means traumatic fracture.

It occurs in bones with normal strength. It may be caused by *direct violence*, e.g., fracture mandible due to blow on face or by *indirect violence*, e.g., condylar fracture due to trauma over chin region.

Stress Fracture (Fatigue Fracture)

It occurs due to repeated injury occurring at the same site.

It occurs in bones with normal strength. The mechanical structure of the bone gets fatigued due to repeated trauma and then bone breaks, e.g., fracture second metatarsal bone due to prolonged marching in soldiers (march fracture).

Pathological Fracture

It occurs in a bone already weakened by disease. The bone gets fractured due to trivial injury or even spontaneously. The causes of pathological fracture are given in **Box 21.1**.

Classification of Patterns of Fracture (Fig. 21.1)

Transverse Fracture

It is due to bending of bone along its long axis. It is unlikely to become redisplaced after reduction.

Box 21.1: Causes of pathological fracture.

Local diseases of bone

- **Infections:** Pyogenic osteomyelitis
- **Benign tumors:** Osteoclastoma
- **Malignant tumors:** Osteogenic sarcoma, Ewing's tumor and metastatic carcinoma (from breast, lung and thyroid)
- **Miscellaneous:** Simple bone cyst, bone atrophy (in polio) and tabes dorsalis.

Generalized diseases of bone

- **Congenital:** Osteogenesis imperfecta
- **Diffuse rarefaction of bone:** Hyperparathyroidism, senile osteoporosis, rickets and osteomalacia
- **Disseminated tumors:** Multiple myeloma
- **Miscellaneous:** Paget's disease, fibrous dysplasia



Fig. 21.1: Patterns of fracture.

Spiral Fracture

It is caused by twisting of long bone along its axis. It is prone to redisplacement after reduction.

Comminuted Fracture

It is due to severe injury that breaks the bone into fragments.

Compression Fracture

It is caused by force applied along the length of a bone and the bone collapses into itself, e.g., compression fracture of vertebral body due to fall from a height. As the spongy bone is crushed so it cannot be restored to its original form.

Avulsion Fracture

It is caused by severe traction on a ligament that breaks the bone on which it is inserted. It is commonly seen in small bones attached with strong muscles, e.g., patella (attached to quadriceps muscle).

Greenstick Fracture

It is seen in children whose bones are flexible. An angulation force bends the bone at one cortex and breaks it at the other thus producing an incomplete fracture.

HEALING OF A FRACTURE

As soon as the bone breaks, the fracture begins to heal.

Various stages in **healing of fracture in a tubular bone** are (Fig. 21.2A):

- **Stage of hematoma:** The torn vessels form a hematoma between and around the fracture surfaces. The ring of bone immediately adjacent to each side of the fracture becomes ischemic and undergoes necrosis.
- **Stage of subperiosteal and endosteal cellular proliferation:** These cells are precursors of osteoblasts. They form a collar of active tissue that grows towards the other fragment. The blood clot is pushed aside by the proliferating tissue and gets absorbed.
- **Stage of callus:** The proliferating cells give rise to osteoblasts that form the immature woven bone of fracture callus. This mass of callus is visible in radiographs and can be felt as a hard mass surrounding the fracture site in superficial bones.
- **Stage of consolidation:** The woven bone gradually transforms into mature bone that has typical lamellar structure.
- **Stage of remodeling:** The bone is gradually strengthened along the lines of stress and surplus bone is resorbed outside the lines of stress. Thus, the bone is restored to more or less of its original form.

In **cancellous bone**, as the bone has uniform spongy texture and no medullary canal, there is broad area of contact at fracture site. So, healing occurs without medium of callus.

However, pathological events are similar to that of fracture tubular bone.

CLINICAL FEATURES AND DIAGNOSIS

History

- Mostly there is history of injury except in pathological or stress fracture.
- The patient complains of pain at the site of fracture.
- There is loss of function in the injured area, e.g., in limb fracture, patient is reluctant to move it.
- The patient may complain of weakness in the limb or loss of sensation due to neurological damage.

Examination

- Swelling and bruising at the site of injury.
- There may be external wound suggesting compound fracture.
- Localized tenderness at the site of fracture.
- Local temperature is raised due to inflammatory response.
- In fracture mandible, on jaw movement, abnormal mobility or crepitation may be elicited. However, vigorous efforts should not be made to elicit this sign as it causes severe pain and further soft tissue damage and blood loss.
- Examine for neurovascular damage in the injured jaw by checking distal circulation and any neurological deficit.

Radiological Examination

- While getting X-ray for suspected fracture, rule of 2s should be remembered (**Box 21.2A**).
- The information provided by X-ray is shown in **Box 21.2B**.
- Some fractures may not be visible on X-ray such as stress fracture, fracture in skeletally immature children.
- In such cases, CT scan, MRI and bone scintigraphy may be required to diagnose the fracture (**Box 21.2C**).

Box 21.2A: "Rule of 2s" for X-rays.

- *Two views*: At right angle to each other [anteroposterior (AP) and lateral].
- *Two joints*: One above and one below the site of fracture
- *Two occasions*: Sometimes fracture is not visible on initial X-ray, repeat X-ray should be done after 10–14 days if suspicion of bony injury persists.
- *Two sides*: In pediatric patient, an X-ray of opposite and uninjured side is taken for comparison if doubt exists.

Box 21.2B: Information provided by X-ray.

- Accurate localization of fracture site
- Demonstrates dislocation if any
- Demonstrates degree and direction of displacement
- Provides evidence of underlying bone pathology
- It may show a radiopaque foreign body
- It may reveal an unsuspected injury

Box 21.2C: Other radiological investigations for fractures.

- **Ultrasound** is useful for defining associated soft tissue injuries in a case of fracture.
- **CT scan** allows for multiplanar reconstruction of injury anatomy and provides three-dimensional information. It is very useful for periarticular injuries
- **MRI** provides three-dimensional information without the radiation. It also gives information about soft tissues and bone vascularity
- **Nuclear scintigraphy** technetium-99 scan picks up osteoblastic activity and demonstrates occult fractures

MANAGEMENT

First Aid

At the site of accident, the aim of management is to keep the patient alive and to minimize the chances of further damage. The measures include:

- Maintenance of adequate airway and breathing.
- Maintenance of circulation by control of bleeding. The external bleeding is controlled by application of pressure dressing (using cloth, bandage, handkerchief or manual pressure).
- The use of tourniquet should be avoided as it may only impair venous return causing increased bleeding. Moreover, if it is kept for too long, it may cause ischemic limb damage.
- The limb should be splinted with whatever method is available (piece of wood, plastic, umbrella, etc.).
- If spinal injury is suspected, the patient should be moved without rotating and flexing the spine (log roll).

Definitive Management

It is done in the hospital. It has two components:

1. *General management of the patient*:
 - Treatment of shock due to blood loss initially by intravenous crystalloids and colloids followed by blood transfusion.
 - Pain control by parenteral analgesics (diclofenac sodium, tramadol).
 - Broad-spectrum antibiotics are given parenterally especially in compound fractures to prevent wound infection.
 - Prophylaxis against tetanus with tetanus toxoid injection.
 - Management of associated injuries.
2. *Local management of the fracture*: The aims of local treatment of fracture are:
 - Pain relief.
 - Reduction of fracture.
 - Immobilization to promote fracture healing.
 - Preservation and restoration of function.

Treatment varies from individual to individual and should not be guided by X-ray findings alone. The aim is "to treat the patient, not the radiograph".

Treatment of Uncomplicated Closed Fractures

The treatment includes:

- **Reduction:** Fracture reduction is done only if it is necessary. Not all fractures need reduction even if displaced because there is no change in final outcome. However, the fractures involving articular joint surface need to be reduced perfectly to restore normal joint movement in the short term and avoid degenerative changes in joint in long term.

“Intra-articular fracture = anatomical reduction”

The reduction can be achieved by:

- *Closed manipulation under anesthesia:* The fragments are grasped, disimpacted and then adjusted to near normal position.
- *Reduction by mechanical traction:* The traction is applied by weights (**Fig. 21.2B**).
- *Operative reduction:* During operation, the fragments are reduced under vision and fixed internally to maintain the position.

- **Immobilization:** The aims of immobilization are:

- To prevent movement
- To prevent displacement
- To relieve pain.

The methods of immobilization are:

- *Plaster of Paris cast or splint:* For fracture long bone (**Box 21.2D**).
- *Immobilization by continuous traction:* It is required in spiral fracture of long bone to prevent overlap of the fragments due to muscle pull (**Fig. 21.2B and Box 21.2E**).
- *Immobilization by internal fixation (Box 21.2F):* It is done when plaster of Paris (POP) cast or traction is unable to give immobilization. Also, it is used in case fracture requires open reduction. For internal fixation, the bone on either side of fracture site is exposed by dissecting soft tissues and immobilization is achieved by one of the following ways:
 - » Plate held with screws (**Fig. 21.2C**).
 - » Transfixation screws (**Fig. 21.2D**).
 - » Intramedullary nail (**Fig. 21.2E**)
 - » Circumferential wires (Kirschner wires) (**Fig. 21.2F and Box 21.2G**).
- *Immobilization by external fixation:* It is done in case of open fracture (**Fig. 21.2G and Box 21.2H**).

- **Rehabilitation:** The results of fracture treatment are significantly improved by rehabilitation. It should begin as soon as treatment of fracture starts.

The prolonged rest in an injured limb can lead to collection of edema fluid around fracture as well as in the whole limb. Also, there is muscle wasting and joint stiffness.

The aims of rehabilitation are:

- To preserve functions while fracture is uniting.
- To restore functions after fracture is united.

Box 21.2D: Plaster of Paris cast or splint.

Advantages

- No wound
- Cheap, adjustable
- No interference with fracture site
- No implants to remove

Disadvantages

- Limited access to the soft tissues
- Cumbersome, interferes with functions
- “Plaster disease” – joint stiffness and muscle wasting

Box 21.2E: Immobilization with continuous traction.

Advantages

- No wound in injury area
- Cheap, adjustable
- No interference with fracture site

Disadvantages

- Limited access to the soft tissues
- Skin pressure causing bedsores
- Prolonged hospital stay
- Pin site infection
- Thromboembolic complications

Box 21.2F: Immobilization by internal fixation.

Advantages

- Provides stability
- Early weight bearing
- Provides anatomical reduction

Disadvantages

- Risk of infection
- Fat embolism
- Interferes with fracture site
- Possible need for removal of implant

Box 21.2G: Kirschner wires (K-wires)—indications.

- Temporary fixation of fracture mandible (Tension band wiring)
- Definitive fixation – with small fracture fragments (non-comminuted, and comminuted mandibular fractures and those without bone loss)
- Temporary immobilization of a small joint

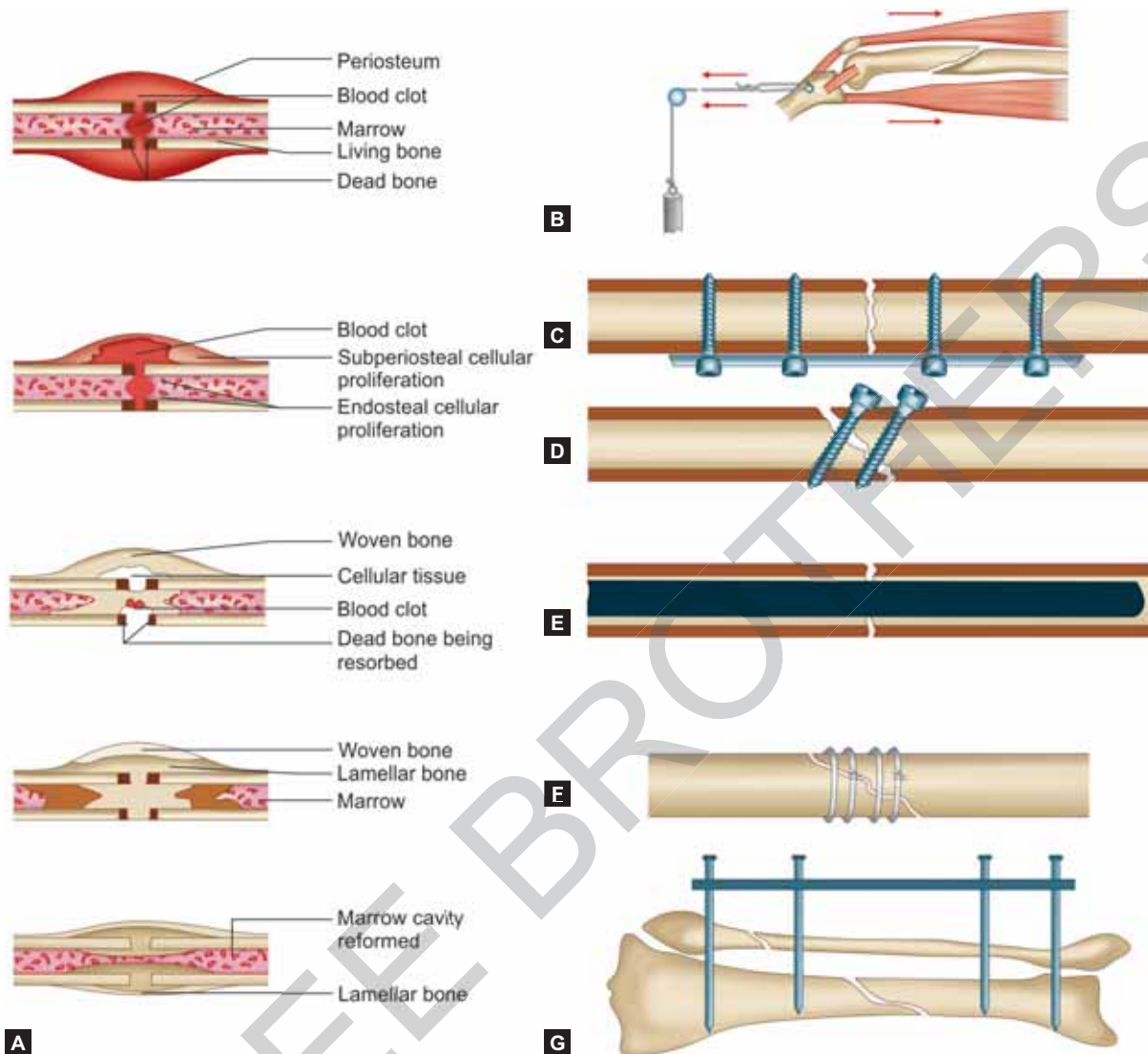
Box 21.2H: Immobilization by external fixation.

Advantages

- Rapid fracture stabilization
- Adjustable after application
- No interference with fracture site
- Easy to remove

Disadvantages

- Risk of infection at pin site
- Cumbersome
- Interferes with plastic surgical procedures



Figs. 21.2A to G: (A) Stages in healing of a fracture; (B) Continuous skeletal traction with a hanging weight counteracts muscle pull and prevents overlap of bone fragments; (C) Plate held with screws; (D) Transfixation screws; (E) Intramedullary nail; (F) Circumferential wires; (G) External fixation.

The two essential methods of rehabilitation are: (1) active use and (2) active exercises.

Active use implies that the patient should continue to use the injured part as naturally as possible. Although rest is necessary in the early days following injury, but the injured part should gradually return to activity as soon as possible.

Active exercises imply doing exercises of muscles and joints under supervision of a physiotherapist. It should be encouraged at an early stage. In case a limb is immobilized in a splint, muscle functions are preserved by static contraction of muscles without moving the joint. When splints are no longer required, active joint movements are started.

When a fracture has soundly united, physiotherapy is intensified by carrying movements against gradually increasing resistance until normal power is regained.

Treatment of Open Fractures

The open fracture demands urgent attention so as to minimize the risk of wound infection. The principles of treatment are:

- **Wound debridement:** All extraneous material is removed. The dead and devitalized tissue is excised leaving healthy and vascularized tissue.
- If the wound is clean and is dealt within few hours of injury, it should be closed primarily.
- In case of dirty, severely contaminated wound with delayed presentation (more than 8–10 hours), it should be left open and dressed regularly. Once the wound becomes clean, delayed closure is done.
- **Treatment of fracture:** Principles of management are same as for closed fractures. However, open reduction and internal fixation (ORIF) of the fracture should be avoided

to prevent the risk of infection. If fracture is unstable and unsuitable for treatment by POP alone, external fixation by pins inserted into the bone fragments and fixed to a rigid external bar should be done (**Fig. 21.2G**).

NEWER METHODS OF FRACTURE TREATMENT

The following methods of fracture treatment have come up recently, and these methods have revolutionized the treatment of fractures:

- **Biological fixation of fractures:** The internal fixation of fracture is done without opening periosteum and minimal disruption of soft tissues at fracture site. Thus, fracture hematoma is not disturbed and osteogenic potential at fracture site is maintained that helps in early union of fracture.
- **Use of image intensifier:** It is an X-ray screening device used on the operation table at the time of fracture reduction. It helps in accurate fracture reduction and precise positioning of implants that is confirmed on operation table itself. Its use has revolutionized fracture treatment. Earlier check X-rays were done after surgery in radiology suite and any improper fracture reduction required re-exploration.
- **Biodegradable implants:** The plates and screws are made of biodegradable polymers which provide strength for adequate period of time and then get metabolized within the body. Thus, long-term complications of metal implants are avoided. These are especially useful in children where future growth is a consideration.
- **Arthroscopic (key hole) surgery:** In joint injuries, endoscopes are used to visualize the site of fracture that can be reduced precisely. The tears in ligaments and cartilage are also taken care of.
- **Video-assisted surgery:** In spinal injuries, video-assisted minimal invasive surgery is performed for passing screws through fracture site for stabilization. If performed with robots, it makes the surgery precise without causing damage to adjoining nerves and spinal cord (see Chapter 1: Introduction of Surgery). It has also been found to be useful in operative management of subcondylar fracture of the mandible.
- **Lightweight plaster:** Instead of POP, polyvinyl chloride (PVC) material is used for fracture immobilization. Its advantages are that it is one-third of the weight of POP, 10 times stronger than POP, porous and comfortable.
- **Virtual reconstruction, stereolithographic modeling and intraoperative navigation:** These are especially useful in complex faciomaxillary fractures. The computed tomography (CT) data is utilized to create a stereolithographic reconstruction by “mirroring” the normal side to create a reverse or mirror image for correction of fractured site. A navigation system is used during surgery to exactly reproduce the desired position of the fractured side.

- **Distraction osteogenesis (Ilizarov):** It is a surgical-orthopedic method for lengthening bone by separating or distracting a fracture callus. In a fractured bone after formation of callus, if the two bony ends are slowly pulled apart by a screw-driven appliance, then new bone can fill in the stretched callus tissue. In orthodontics, it is used to resolve skeletal discrepancies of faciomaxillary region.

COMPLICATIONS OF FRACTURES

These can be divided into two groups:

1. Complications related to fracture itself:
 - **Infection:** Osteomyelitis, tetanus and gas gangrene.
 - Delayed union
 - Nonunion
 - Malunion
 - Shortening
 - Avascular necrosis.
2. Complications due to associated injuries:
 - Injury to blood vessels
 - Injury to nerves
 - Injury to tendons
 - Injury to joints
 - Injury to adjoining viscera
 - Fat embolism
 - Deep vein thrombosis and pulmonary embolism.

FRACTURES OF HEAD AND NECK REGION

These include:

- **Skull fractures** (see Chapter 17: Head and Cranial Nerves Injury).
- **Fracture cervical spine** (see Chapter 10: Care of the Acutely Injured).
- **Maxillofacial fractures** causes are:
 - Road traffic accidents
 - Domestic violence
 - Sports injuries.

MAXILLOFACIAL FRACTURES

Classification

Fractures of the facial skeleton can be divided into three parts:

1. **Upper third:** It involves an area of the skull above eyebrows. The fractures usually involve frontal sinuses and supraorbital ridges.
2. **Middle third:** It involves an area between eyebrows and mouth. The bones fractured are maxilla, zygomatic complex and nasal bone.
3. **Lower third:** It involves fractures of the mandible. The fractures tend to occur through weak areas like sutures, foramina and thin bony parts.

Another way of dividing fractures of facial skeleton is:

- Fractures not involving dental occlusion (nose and zygomatic bone).

Box 21.2I: Maxillofacial fractures: Classification.

- Nasal fractures
- Forehead fractures (broken frontal bone)
- Orbital fractures (eye sockets)
- Zygomatic fractures (cheek bones)
- Tripod facial fractures (eye socket, cheek bone and upper jaw)
- Maxillary fracture
- Mandibular fracture

- Fractures involving dental occlusion (maxilla and mandible).

This division is on the fact that provision and maintenance of proper dental occlusion is the mainstay of treatment of facial fractures.

Another simple way to classify maxillofacial fractures is given in **Box 21.2I**.

Early Care

- Majority of patients with maxillofacial fractures require temporary splinting by passing through a wire around the teeth adjacent to fracture line (bridal wiring).
- In case of Le Fort fracture with palatal split, transpalatal wiring is an essential step to stop the nasal bleeding along with nasal packing.
- Splinting of bilateral parasymphysis fracture prevents tongue from falling back and thereby restores the compromised airway.
- In case of unstable fracture mandible, support of barrel bandage may be used to support the mandible.
- In cases of polytrauma having multiple facial lacerations, multiple fractures of facial skeleton and head injury, there is risk of:
 - Immediate or delayed respiratory obstruction.
 - Severe uncontrolled facial hemorrhage.

The patient should be nursed in semiprone position so that bleeding and secretions fall out with gravity and aspiration is prevented. The detailed management is given in Chapter 10: Care of the Acutely Injured.

Clinical Examination

- Primary survey of the patient is done as per advanced trauma life support (ATLS) guidelines (see Chapter 10: Care of the Acutely Injured).
- Examine whole head and face visually and by palpation using gloved hands.
- Start with the facial lacerations and soft tissue injuries.
- Feel for any bony tenderness, asymmetry and step formation starting from above downwards:
 - Supraorbital and infraorbital margins
 - Nasal bridge
 - Zygomatic arches
 - Maxilla
 - Mandible
- Swelling, change of contour of nasal bridge or a new asymmetry suggests a fractured nose (**Fig. 21.3**).

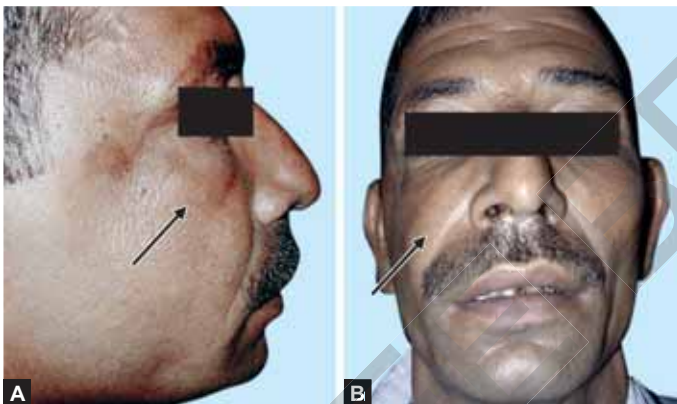


Fig. 21.3: Fracture nasal bone; see swelling and change in contour of nasal bridge (arrow).

- Examine eyes for subconjunctival hemorrhage, diplopia and visual acuity.
- Do intraoral examination under good light (soft tissue lacerations, bruising, hematoma, injury to dentition).
- Examine for the dental occlusion. In case of malocclusion of teeth, a fracture of the jaw (maxilla and mandible) is suspected.
- Examine for the relevant cranial nerves for anesthesia or paresthesia.
- There can be facial nerve palsy due to injury to branches of facial nerve or due to fracture temporal bone.
- In case of tearing of gingiva with loose tooth, fracture of alveolus is suspected.
- In *fracture of the maxilla*, findings are:
 - Face as a whole, especially middle third, is diffusely swollen with edema of cheeks and eyelids that “looks like a football”.
 - Some diagnostic signs for midface fractures are:
 - » **Guerin sign** with floating maxilla is feature of Le Fort I.
 - » **Battle sign** with panda face are features of Le Fort II and III.
 - » **Dish face appearance** is a feature of Le Fort III.
 - Cerebrospinal fluid (CSF) rhinorrhea. It differs from nasal discharge in that it does not starch the cloth whereas nasal secretions do.
 - Subconjunctival hemorrhage and black eye.
 - Orbital symptoms (diplopia, diminished vision, exophthalmos and enophthalmos).
 - Failure of occlusion of teeth.
 - Test for the mobility of maxillary complex by grasping maxilla just above incisors between finger and thumb of one hand while fingers and thumb of other hand holds the head steady at bridge of the nose (**Fig. 21.4**). If maxilla is fractured, gentle backward and forward movement of the fingers will reveal the mobility of maxilla.



Fig. 21.4: Method of testing mobility of maxillary complex in fracture maxilla.



Figs. 21.5A and B: (A) Zygomatic arch fracture showing flattening of right cheek prominence (lateral view); (B) Zygomatic arch fracture showing flattening of right cheek prominence (frontal view).

- In *fracture of the mandible*, findings are:
 - Swelling and skin discoloration in the lower part of the face (see **Figure 16.6A: Chapter 16**).
 - Hematoma of the floor of mouth (**Coleman's sign**).
 - Improper occlusion of teeth.
 - Combined intraoral and extraoral palpation reveals break in continuity of the mandible and bony crepitus.
 - In unilateral condylar fracture, there is deviation of the jaw to the affected side on opening mouth.
 - **Guardsman fracture** is feature of bilateral condylar fracture associated with symphysis fracture.
 - There may be anesthesia of lower lip due to inferior dental nerve damage.
- In *fracture of the zygomatic complex*, findings are:
 - Soft tissue swelling and bruising over the cheek bone.
 - Flattening of cheek prominence (**Figs. 21.5A and B**)
 - Subconjunctival hemorrhage.

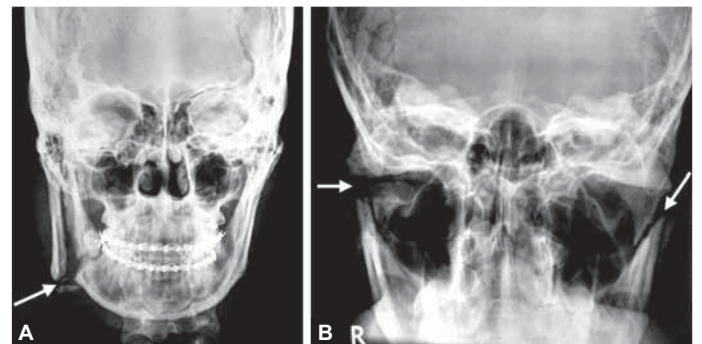
- The fracture line may be palpable in upper buccal sulcus.
- Anesthesia of upper lip and upper teeth due to damage of branches of infraorbital nerve.
- **Mongoloid slant:** Downward displacement of lateral eyebrow.
- **Hypoglobus:** Vertically downward displacement of eye globe.
- Diplopia due to fracture of orbital floor causing damage to sling mechanism of eyeball.

Radiological Investigations

These are performed only after stabilizing the general condition of the patient.

Following X-rays are done for different areas:

- *For fracture mandible:*
 - *Posteroanterior view of mandible in open mouth position:* For visualizing fracture of symphysis, lower border of the body and angle of the mandible (**Fig. 21.6A**).
 - *Anteroposterior view (Towne's view) of mandible:* For visualizing fracture of head and neck of the condyle of mandible (**Fig. 21.6B**).
 - *Right and left lateral oblique view of mandible:* For visualizing fracture of body and ramus of the mandible.
 - *Orthopantomograph:* For visualizing complete mandible from condyle to condyle (**Fig. 21.7**).



Figs. 21.6A and B: (A) X-ray facial skeleton PA view showing fracture ramus and fracture angle of mandible on right side; (B) Towne's view showing bilateral condylar fracture.

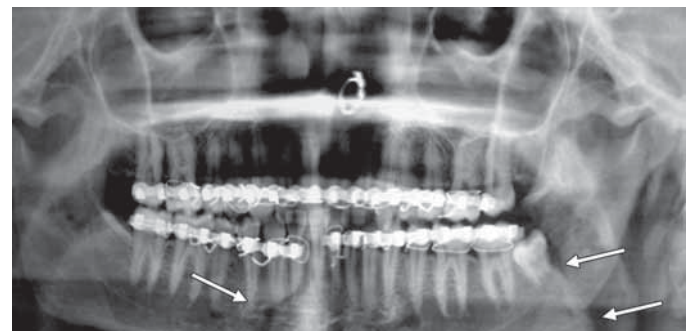


Fig. 21.7: Orthopantomograph (OPG) showing fracture right parasymphysis and displaced angle of mandible left side.

- Occlusal view of the mandible to see split fractures in body of the mandible.
- *For fracture maxilla:*
 - Posteroanterior view maxilla in Water's position—it also shows zygomatic bone and infraorbital margins.
 - 30° occipitomenal projection (sinus view) (Fig. 21.8A).
- *For fracture zygomatic arch:* Superoinferior projection (submentovertex view or jug handle view) (Figs. 21.8B and 21.8C).
- *For fracture nasal bone:* True lateral view of the skull (Fig. 21.9A).

Computed tomography (CT) scan is more useful for complex maxillofacial injuries especially middle third fractures (Fig. 21.9B). The three-dimensional reconstruction with CT scan provides invaluable information in such cases.

Treatment

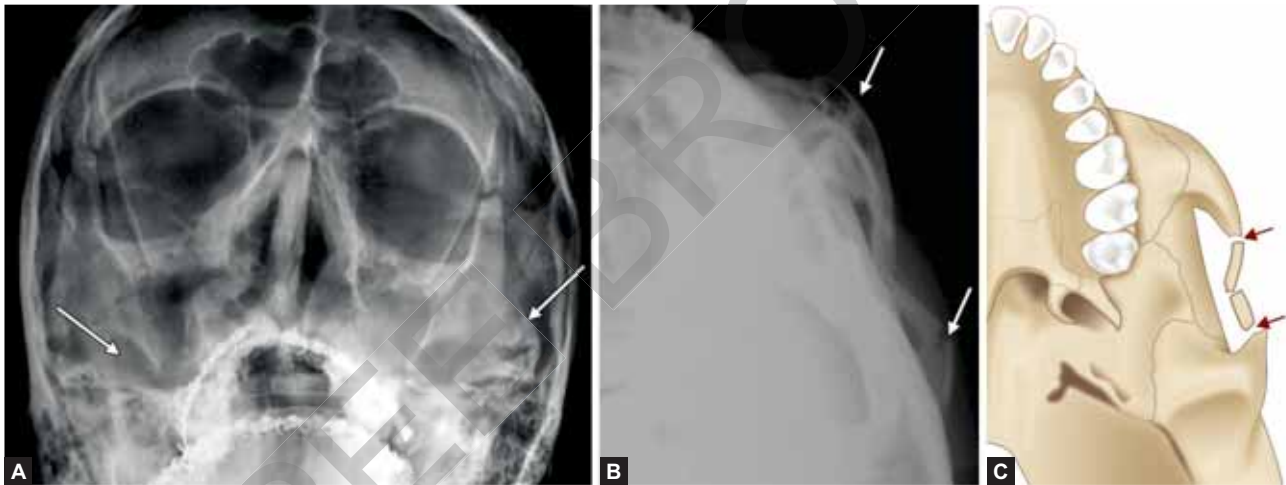
Aims of treatment are given in Box 21.3A.

Box 21.3A: Aims of treatment of faciomaxillary fractures.

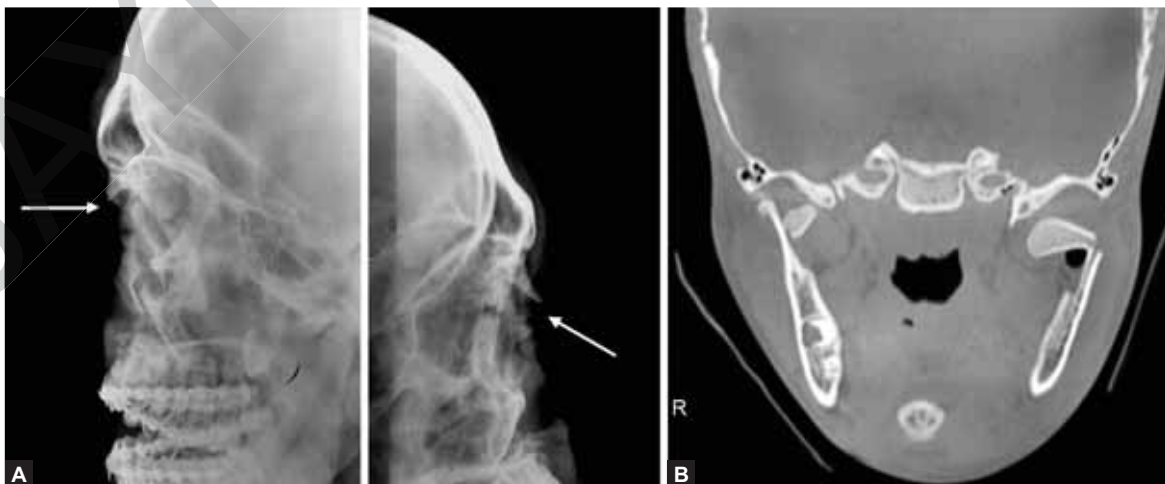
- Reduction of bony fragments
- Stable fixation of fragments
- Preservation of blood supply
- Prevention of infection
- Restoration of mastication
- Restoration of speech
- Return of ocular and nasal functions
- Acceptable facial and dental symmetry.

General Measures

- Since all faciomaxillary fractures are likely to be compound fractures, so broad-spectrum antibiotics should be given to prevent infection (coamoxiclav + metronidazole).
- For pain relief, nonsteroidal anti-inflammatory drugs are given parenterally [injection diclofenac sodium 50 mg intramuscular (IM) 8 hourly].
- Intraoperative and postoperative steroids (dexamethasone) may be added to reduce facial edema.



Figs. 21.8A to C: (A) Occipitomenal view showing fracture of right maxillary bone and left zygomatic bone; Zygomatic arch fracture (B) Submentovertex view; (C) Line diagram of the fracture seen in Figure B.



Figs. 21.9A and B: (A) X-ray facial skeleton lateral view showing fracture nasal bone; (B) CT film showing bilateral condylar fracture.

- Care of orodental hygiene by irrigation and chlorhexidine mouthwash.

Fracture of the Zygomatic Complex (Box 21.3B)

Most fractures can be reduced by *Gillies temporal approach*. This method of fracture reduction is based on the anatomical fact that while the temporal fascia is attached along the zygomatic arch, the temporalis muscle runs under it and a lever inserted between fascia and muscle can slide down deep to the arch to exert its leverage (**Fig. 21.10**). An oblique 2 cm incision is made in temporal fossa incising deep fascia and taking care to avoid injury to superficial temporal vessels. As a pathfinder for the lever, long scissors are inserted under the fascia and slid along the surface of temporalis muscle deep to the arch. A Bristow's or Row's elevator is then inserted along the path found by the scissors so that it reaches beneath the zygomatic arch. Force is then applied in the opposite direction to the displacement of fracture and fracture is reduced. If there is associated fracture of the orbital floor, then entrapment of infraorbital

soft tissues may occur during fracture reduction. It may require exploration of the floor of the orbit.

If fracture of zygomatic complex is unstable, it may require ORIF with intraosseous wires or bone plates (**Fig. 21.11**).

Postoperatively, observation should be made for development of retrobulbar hematoma. The patient presents with increasing proptosis and loss of vision requiring urgent decompression.

Fracture of Nasal Bones (Box 21.3C)

These are the most commonly fractured bones of the facial skeleton. The reduction is best done within 1 week once swelling has settled. In case of further delay, the nasal fractures tend to fix in their displaced position. Walsham's forceps are used for disimpaction of nasal bone fracture. The blades of the forceps are closed over the nasal bone which is then mobilized with a rocking movement of the forceps first laterally and then medially to disimpact it. The external blade of the forceps should be covered with rubber tubing so as to avoid damage to the skin (**Fig. 21.12**). The nasal septum is then grasped with Walsham's forceps and manipulated until it is straight.

Box 21.3B: Fracture zygomatic complex.

- Zygomatic fracture is difficult to assess initially due to significant facial swelling. So review assessment is done after one week for complete evaluation.
- Orbital fractures may occur in combination with zygomatic fracture.
- Undisplaced or minimally displaced zygomatic fractures are often treated conservatively.
- The indications for surgical intervention are:
 - Asymmetrical cheek bone prominence
 - Diplopia
 - Orbital deformity
 - Restricted mouth opening

Box 21.3C: Fracture nasal bone.

- After initial assessment, follow-up after one week should be done for accurate examination
- The indications for surgical treatment is cosmetic deformity
- Nasoethmoidal fractures occur in case of significant force of injury and present with:
 - Periorbital ecchymosis
 - Depressed nasal bridge
 - Upturned nasal tip (piggy nose)
 - Telecanthus (increased distance between the inner corners of the eyelids with a normal interpupillary distance)
- Treatment is delayed for 7–10 days post injury to allow for the swelling to subside

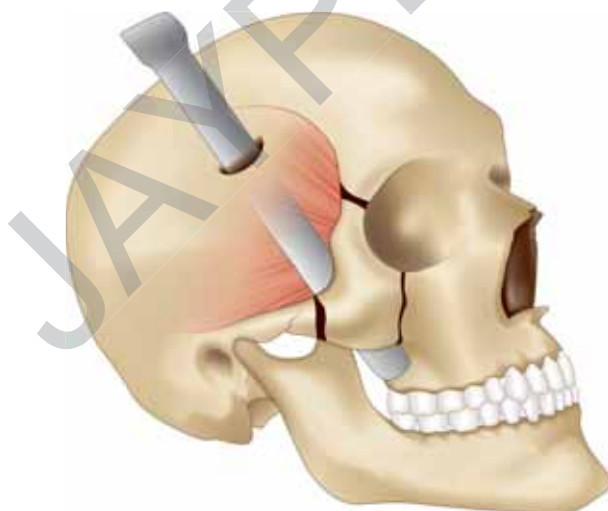


Fig. 21.10: Gillies temporal approach for reduction of zygomatic fracture.

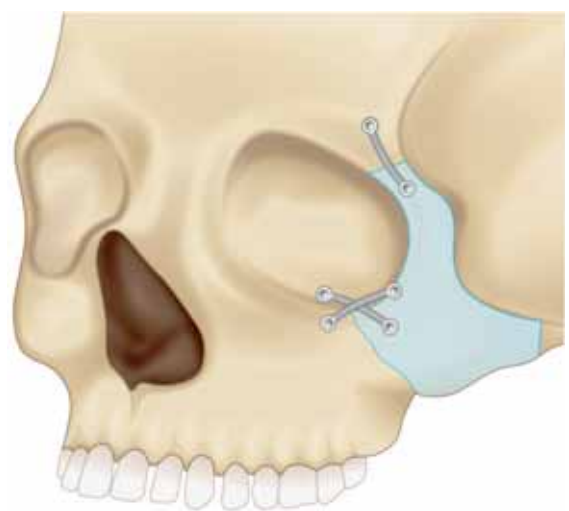


Fig. 21.11: Open reduction and internal fixation of fracture zygomatic complex.

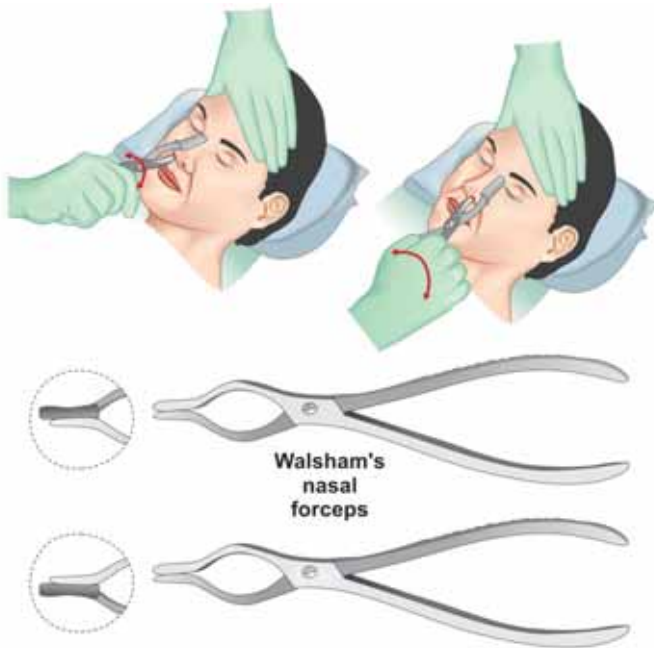


Fig. 21.12: Fracture nasal bone reduced with Walsham's forceps.

Following nasal bone reduction, nasal packing is done for 2–3 days for supporting nasal bones.

A protective nasal plaster may be required for 5–7 days.

■ FRACTURE OF THE MANDIBLE (BOX 21.3D)

Patterns of Mandible Fracture

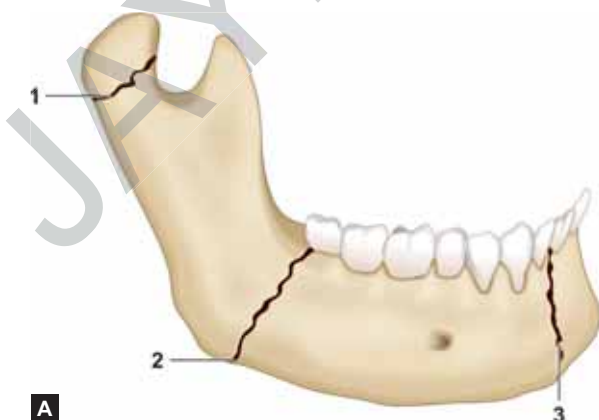
- The common sites of fracture are condylar neck, angle of the mandible and body through canine sockets (**Fig. 21.13A**). Other sites for fracture are midline, parasymphyseal, symphysis, coronoid process, alveolar process and ramus (**Fig. 21.13B**).
- Fractures may occur singly or in several combinations.
- Most fractures in the tooth-bearing portion of the mandible are compound into the mouth because the

Box 21.3D: Fracture mandible.

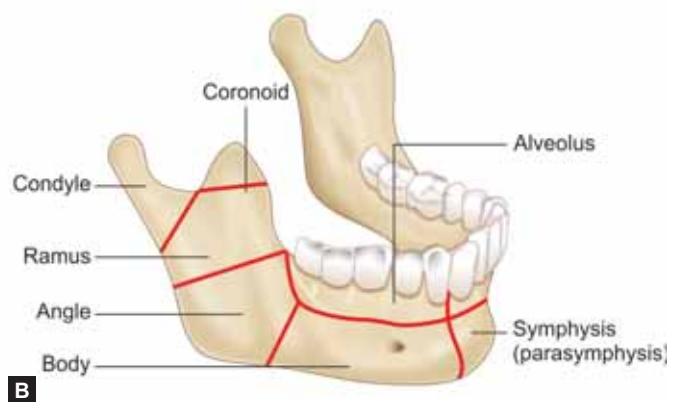
- Condylar neck is the commonest site of fracture
- Always look for a second mandibular fracture since contralateral fractures are common.
- Look for anesthesia of lower lip due to inferior dental nerve damage
- Bilateral condylar fracture leads to “open bite deformity”
- The most common X-rays required for fracture mandible are OPT and PA view mandible
- Most mandibular fractures are treated with ORIF using titanium miniplates and screw fixation, preferably within 24–48 hours of injury

mucoperiosteum is firmly attached to the bone and tears during injury.

- Displacement of fractured segments depend upon:
 - Direction of violence
 - Direction of muscle pull.
- The muscles which elevate the mandible are all inserted *behind* the first molar, viz., masseter, medial pterygoid and temporalis.
- The muscles which depress the mandible are all inserted *in front* of the first molar, viz., geniohyoid, mylohyoid and digastric.
- Thus, most common displacement of posterior fragment is upwards and of anterior fragment downward (**Fig. 21.14**).
- Another important factor deciding the displacement of angle fractures is the direction of fracture line (**Fig. 21.15**).
- The condylar neck is the weakest and most common site of fracture mandible.
- The condylar head is pulled forward by the lateral pterygoid muscle leading to lateral deviation of mandible towards the side of fracture.
- If both condyles are fractured, the displacement of both heads causes the patient to gag on his molars giving an “open bite” deformity (**Fig. 21.16**).



A



B

Figs. 21.13A and B: (A) Fracture mandible—common sites; (B) Sites of mandibular fracture.

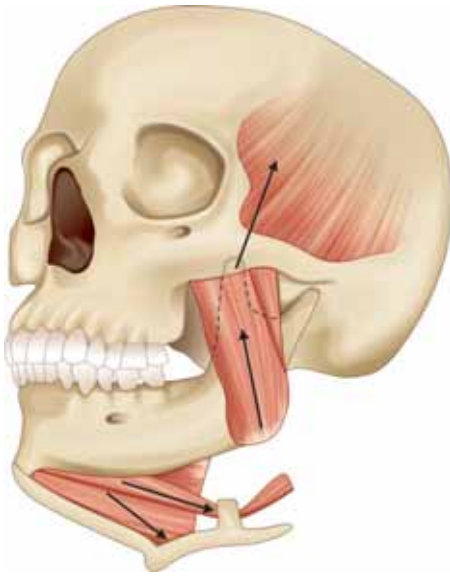


Fig. 21.14: Fracture mandible—directions of muscle pull influencing displacement of fragments.

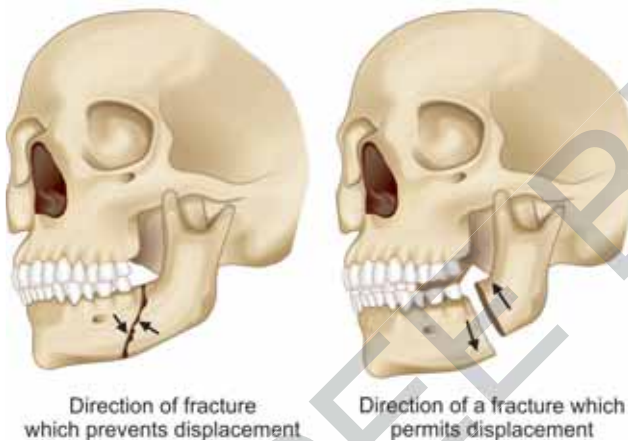


Fig. 21.15: Fracture mandible—directions of fracture lines influencing displacement of fragments.



Fig. 21.16: Fracture bilateral condyles causing "open bite" deformity.

- A bilateral fracture through canine sockets detaches a midline segment from rest of the mandible (*butterfly fracture*). This free segment will be pulled down by digastric and genioglossus muscles and tongue will fall back and occlude the airway.

Treatment of Mandible Fracture

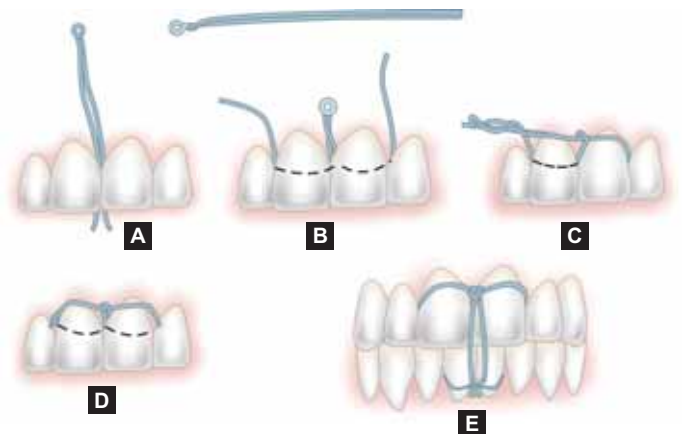
Fracture of Tooth-bearing Segment

Closed reduction with indirect fixation

- Fracture mandible is first *reduced* followed by *fixation*.
- Aim of *reduction* is to bring the teeth of the fractured segments into a normal relationship with those of unfractured counterpart so as to restore preinjury dental occlusion.
- Markedly displaced fractures require general anesthesia for the fracture reduction.
- Once correct occlusion is achieved after reduction, the **mandibular teeth** are fixed with intermaxillary fixation (IMF).

It can be achieved by:

- **Eyelet/ivy loop wiring:** The fixing device is a stainless steel wire of 0.4 mm diameter that is doubled on itself and twisted tightly 2–3 times leaving a small loop at the end. The double wire is passed inwards between the necks of two adjacent teeth, two wires separated and passed outwards through the next interspace and twisted together with one of the ends going through its own loop. Four or five eyelets are required for each dental arch. After eyelets have been applied to both upper and lower teeth, connecting wires are threaded through the loops to join the jaws together (**Figs. 21.17A to E**).
- **Arch wiring:** An arch bar (flattened soft silver bar) is molded round the alveolar arch on its outer aspect at level of neck of the teeth to which it is wired. Similarly, an arch bar is applied to the maxilla and the two arch



Figs. 21.17A to E: Steps in eyelet wiring.

Textbook of SURGERY for Dental Students

Salient Features

- The book is primarily written for the undergraduate dental students. It is also useful as a ready reference for postgraduate students and practicing surgeons as well.
- All the chapters cover the BDS curriculum of different universities and are written in a simple and easily understandable format.
- Each chapter includes the detailed clinical examination of the case related to the topics covered in the chapter.
- Incorporation of figures, boxes, tables, and flowcharts in the chapters would provide the glimpse of salient points of the subject and help the readers with quick revision.
- Interesting case summaries along with learning points have been added in many chapters that would be helpful in better understanding of the diseases.
- Recent advances in the diagnosis and management of various diseases have been updated in a comprehensive manner.
- Online content in the form of operative videos of minor surgeries and routine ward procedures are available with this edition for easy understanding by the students.

Sanjay Marwah MS FIAS Commonwealth Fellow HPB Surgery, is presently working as a Professor and Unit Head in the Department of Surgery, Pt BDS Postgraduate Institute of Medical Sciences, Rohtak, Haryana, India. He has been serving in this institute for more than three decades as a faculty member in various positions and is involved in teaching, training, research, and clinical work. He has been an undergraduate and postgraduate examiner for various universities for the last 25 years. He is a popular teacher among his students and has been twice awarded as the "Best Teacher" by the students of his institute. He has presented many scientific papers in national and international conferences. He has been conferred with gold medal in 2000 for his research presentation and the prestigious PK Sen Memorial Oration in 2023 by the Association of Surgeons of India. He has the honor of receiving prestigious Commonwealth Fellowship in the United Kingdom in 2011–12. Based on his research innovations, two of his publications have been included in the "Cochrane Review." He has contributed many chapters in international books and has 180 publications to his credit in national and international journals with 5,843 citations (Google Scholar), h-index of 30 and i10-index of 53.

Printed in India



Available at all medical bookstores
or buy online at www.ejaypee.com



JAYPEE BROTHERS
Medical Publishers (P) Ltd.
EMCA House, 23/23-B, Ansari Road,
Daryaganj, New Delhi - 110 002, INDIA
www.jaypeebrothers.com

Join us on facebook.com/JaypeeMedicalPublishers
Follow us on instagram.com/JaypeeMedicalPublishers

Shelving Recommendation
DENTISTRY

ISBN 978-93-5696-267-5

