# Principles of Orthopedic Surgical Techniques

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2- Overall Aim of Course: 2 هدف المقرر:		The purpose of this course is give both basic and applied clinical knowledge about different operative orthopedic procedures with special reference to preoperative patient preparation and post-operative patient care.		
3- Intended learning outcomes of the course (ILOs): المستهدف من تدريس المقرر			3-المستهدف من تدريس المقرر	
<ul> <li>i. Knowledge and Understanding:         <ul> <li>i. Intellectual Skills:             <ul> <li>i. Intellectual Skills:                 <ul> <li>i. Intellectual Skills:</li> <li>i. Analyze the methods of draping and different acquipment and instr</li> <li>i. State Stat</li></ul></li></ul></li></ul></li></ul>		ents should have: atient preparation pedic instruments and common techniques in patient care and follow draping , sterilization , and instruments used in		
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IV. General Transfer Skills:	and able د- المهاران العامة :	<ol> <li>Assess patient's' orthopedic p</li> <li>Work efficiently with others</li> <li>Practice independent learning technology tools.</li> <li>Evaluate information from v to improve professional skill</li> </ol>	problems. s. ng by using information various standard sources ls.	
4- Course content المقرر:	4۔ محتوی			
5- Teaching and Learning Meth التعليم والتعلم	ods: 5- أساايب	<ol> <li>Lectures.</li> <li>Group discussions</li> <li>Practical cessions</li> </ol>		
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7- Student Assessment:	7- تقويم الطلاب :	
a- Assessment methods: أ- الأساليب المستخدمة	<ul> <li>a. Class work: <ol> <li>Quiz</li> <li>Midterm theoretical</li> <li>Assignments</li> <li>Clinical Participation</li> </ol> </li> <li>b. Final exam: <ul> <li>Practical exam</li> <li>Written theoretical</li> </ul> </li> </ul>	
b- Assessment schedule: ب- التوقيت	<ul> <li>a. Class work:</li> <li>1. Quiz (5th week)</li> <li>2. Midterm (7<sup>th</sup> week)</li> <li>b. Final exam</li> <li>Practical exam (13<sup>th</sup> week)</li> <li>written exam (15<sup>th</sup> week)</li> </ul>	
C-Weight of Assessments: ج- توزيع الدرجات	Quiz : 5 mark Midterm: 10 marks Attendance 5 marks Clinical: 25 marks Clinical exam:15 marks Final written exam 90 marks. <b>Total percentage 150 mark</b> .	
7- List of References:	8 <mark>- قائمة الكت</mark> ب الدراسية والمراجع :	
a- Course notes: أ- مذكرات	Lecture notes of orthopedics diseases and fractures	
b- Essential books (text books) ب- کتب ملزمة	<ol> <li>Sam W. Wiesel. , Operative techniques in orthopaedic surgery, 2nd edition Wolters and Kluwers 2015.</li> <li>S. Terry canale MD. James H. Beaty MD. Willis C. Campbell. Campbell's operative orthopaedics , 12 edition. Philadelphia, PA: Elsevier, 2017</li> </ol>	
c- Recommended books ج- کتب مقترحة	Mark D. Miller MD (Author), Stephen R. Thompson MD MEd FRCSC (Author). Miller's Review of Orthopaedics 7th edition. Elsevier, Wolters and Kluwers 2015. Timothy White Samuel Mackenzie Alasdair Gray. McRae's Orthopaedic Trauma and Emergency Fracture Management 3rd Edition. Elsevier, 2015.	
d- Periodicals, web sites, ,,,,, د- دوريات علمية أو نشرات الخ	<ul> <li>Egyptian knowledge bank</li> <li>www.google.com</li> <li>www.pubmed.com</li> <li>Expert consult</li> </ul>	

## Contents

Course	
Description	4
Chapter1: preoperative patient preparation	
Chapter2: Equipment's in the orthopedic surgical room	
Chapter3: instruments in the orthopedic surgical room	
Chapter4: implants used in orthopedic surgery21	
Chapter5: Arthroscopy	)
Chapter 6: Basic techniques in orthopedic surgery	
Chapter 7: Bone cement	
Chapter 8: post - operative care	,
Chapter 9: Surgical team at risk	)
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## **Course Description**

This course discusses the events in orthopedic surgery starting when the patient is still in the ward till he gets out of hospital after surgery, in between there are many details as regard pre - operative patient preparation, equipment in the operating room, implants used and different techniques and materials used In orthopedic surgery

#### Core Knowledge

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#### By the end of this course, students should be able to:

Recognize methods of draping, sterilization, and different equipment and instruments

used in orthopedic surgery

Recognize principles of patient post - operative follow up

#### Cores kills

## by the end of this course, students should be able to: opulatio

- 4. Assist in patient draping and sterilization
- 5. Assist in orthopedic surgical procedures
- 6. Use and operate different equipment used in the OR

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7. Afford good patient post - operative follow up

## **Course summary**

Date	Subject
1 <sup>st</sup> week	Preoperative patient preparation
2 <sup>nd</sup> week	Equipment's part I
3 <sup>rd</sup> week	Equipment's part II
4 <sup>th</sup> week	Instruments
5 <sup>th</sup> week	Implants part I
6 <sup>th</sup> week	Implants part II
7 <sup>th</sup> week	Implants part III
8 <sup>th</sup> week	Arthroscopy
9 <sup>th</sup> week	Basic surgical techniques
10 <sup>th</sup> week	Bone cement
11 <sup>th</sup> week	Post - operative care
12 <sup>th</sup> week	Surgical team at risk
	or Health & Por

## **Preoperative Preparation**

#### Objectives

- Provides information about what should be done before surgery in details with coverage of all aspects even fine details.
- Show the mistakes that can occur during preoperative preparation

#### Overview

Preoperative preparation although simple but can be catastrophic if any faults occurred. It should be done only by well- trained persons

#### In the word (Table 1)

- Be sure of correct patient data (age address occupation insurance final diagnosis)
- Be sure that all laboratory and radiological investigations requested were complete
- Be sure that all consents requested from the patient or his family are fulfilled
- Be sure that pre operative medications were given to the patients
- Patients should wash using soap and water the evening before surgery
- Instruct the patient for fasting at least 6 hours before surgery
- Loose teeth, or crowns should be identified as a safety precaution to prevent choking during anesthesia
- Jewels should be removed
- Any history of allergy should be reported
- Vital signs should be recorded and abnormal readings reported
- Wristband details should be checked with patients and to ensure they match those on patient records
- Be sure that the patient wears gowns prepared for surgery

8

#### Preoperative check list

Correct patient date	Done	Not done
Full investigations		
Preoperative medications		
Vital signs		
consents		
Wrist band		
Loose teeth or crowns removed		
Jewels removed		
Final diagnosis		
History of allergy		
Instructions for fasting		
Pre - operative clothing		
Patient washing		

Table I: pre - operative check list

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#### In the operating room

#### Patient positioning

Patient positioning on the operating table should be safe for the patient and satisfactory to the surgeon to do surgery with ease. It should fulfill the following criteria

- There is no pressure on the chest and abdomen
- It should not obstruct airway passage
- When the patient is prone a small pillow is placed beneath symphysis pubis and another one beneath the shoulder to get the chest and abdomen free of pressure
- When the patient is lying on his side he should be tied to the operating table with a belt rolled round the patient's iliac crest
- Any bony prominence should be protected by soft pads as the sacrum, the greater trochanter and the head fibula
- The position of the patient on the operating table should not produce any pressure of stretch on a nerve or vessel

Take care on patient mobilization after being anaesthetized as any forceful limb traction may cause iatrogenic nerve injury



Figure 1: Different patient positions on the operating table

► Prophylactic antibiotic: administration of antibiotic before surgery decreases the incidence of post - operative infection. Antibiotics should be given before tourniquet application to allow the antibiotic to pass the operated limb with the circulation

#### Skin preparation

9

- Hair removal: presence of hair at the site of surgery is a potential source of infection. Also hair removal with removal with razors produces surgical trauma to the skin increasing the risk of infection so it is preferable to remove the hair with clippers (Hair cut machine). Timing of hair removal: it is done just before surgery
- The operative site should be marked before entering the operating room to avoid operation on the wrong site.
- Scrubbing: Cleaning and washing the skin to remove any debris with soap containing 7.5% povidone iodine and wash it with sterile saline in cases of iodine allergy use Hexachlorophene solution. This is done in the operating room just before surgery.
- Drying: after scrubbing the skin is dries with sterile towels to be removed just after application of the tourniquet then proceed to sterilization
- Sterilization: the sterilizing solution is then applied with sterile gauze starting on the site of the surgical wound then proceed peripherally (centrifugal). povidone-iodine is the commonest solution used till now. The solution is allowed to dry than removed with alcohol

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#### Precautions

- Take care to start with are area of surgery and proceed peripherally and do not go back in the opposite direction
- Areas known with contamination as the axilla groin, genitalia and perineum should be left to the end of the process
- Alcohol-based solutions should be removed from the field because they can be ignited by a spark from a cautery unit.
- If skin wounds are present avoid use of alcohol or any alcohol using solution and use. Povidoneiodine or hexachlorophene to avoid tissue death

#### ► Draping

- Place a waterproof sheet in the operating table before the patients is placed on it
- **Draping should be done only by experienced persons. Faults of draping** those results in exposure of unsterilized areas of skin during the operation can be disastrous.
- Drapes should cover prepared areas of skin at least 5 -7 cm away from the unprepared area (The drapes should not be placed at the junction between the prepared and the unprepared area)
- Towel clips should be placed to prevent slippage of the drapes.it may be placed through the drapes or even through the skin
- Use disposable draped better than ordinary cloth drapes
- Use adhesive plastic transparent drape to covet the area of surgery and do not touch the skin with your gloves before that.

## **Equipment in the operative room**



#### **Objectives**

• Provides detailed information about some of the most important devices specific to orthopedic surgery in the operating room

#### Overview

Many devices are present in the operating room (OR) but some of them are specific for orthopedic surgery. The surgical team must have a good knowledge how to use these devices and how to keep the surgical field sterile when using these devices

The orthopedic traction table, the image intensifier and the tourniquet will be discussed in this chapter

#### <u>Tourniquet</u>

Tourniquet use is essential in limb surgery to produce a blood field to facilitate surgery. Although it is a simple procedure, yet any mistake during application can lead to limb catastrophes

Aim of tourniquet use

Application of tourniquet during surgery aims to minimize bleeding from the surgical field to achieve two important goals

1 – Clear surgical field with better viewing structures (Bloodless surgical field)
 2 – Decrease operative time because in case done without tourniquet application much time is wasted to remove blood from the surgical field

► Indications and contraindications

Most orthopedic surgeries done for the upper limb and lower limb needs tourniquet application. It is applied routinely except in some situations in which tourniquet application is contraindicated as presence of limb ischemia or peripheral vascular disease in which the limb cannot withstand cut of arterial blood supply for few hours

#### ► Types

1 - Esmarch: It is a rubber band. It can be used in the lower limb around the upper thigh but preferable not used in the upper limb as the pressure produced by this tight band is not measured. The size of the band should be 10 cm for the upper limb and 15 cm for the lower limb, above and below these measures there is a higher risk of tissue damage

#### 2 - Pneumatic

It safer than the Esmarch type for the following reasons

- The cuff is self-padded in most types

  It can be inflated and deflated during surgery without removal of the cuff

  Image: the cuff of the cuff of
- Precautions during tourniquet use

A tourniquet should be applied by an individual experienced in its use.

Exsanguinate the limb form blood before tourniquet application: this is done either by limb elevation for two minutes or better by squeezing the limb using sterile rubber band

Wrap the skin in the area of tourniquet application with several layers of cast padding

Duration of application: two hours maximum allowed during tourniquet use. More than two hours increases the complications of tourniquet application

If the time of surgery is expected to be more than 2.5 hours, deflate the tourniquet 10 minutes every one hour

#### Inflation pressure (In case of pneumatic type)

- For the upper limb: 50 100 mmHg above systolic blood pressure or a pressure of 200 mm Hg is enough to produce blood less field
- For the lower limb: inflate to double systolic blood pressure or a pressure of 300 mm Hg is enough to produce blood less field

Duration	Not more than 2 hours , if more deflate for 10 minutes then re-inflate again	
Inflating pressure	200 mmHg for UL $-$ 300 mmHg for LL	
Site of tourniquet application	Upper arm and upper thigh	
Size of tourniquet cuff	At least 10 cm for UL and 15 cm for LL	
Padding layers	2 layer of cotton	

Table 2 : Summary of recommendations of safe tourniquet use

#### Complications of tourniquet use

1 - Tourniquet paralysis: loss of motor function of the limb after tourniquet use. There sometimes associated with limb tingling and numbness

Causes of tourniquet paralysis

- Excessive tourniquet pressure leading to nerve ischaemia
- Insufficient pressure: inadequate tourniquet pressure leads to congestion of the limb distal to the tourniquet. Congestion leads to nerve edema with loss of function
- Prolonged tourniquet application beyond the recommended duration
- Inadequate padding around the area of tourniquet application

Tourniquet paralysis is usually temporary and complete resolution eventually occurs in few weeks

2 – Muscle injury: Muscle injury is due to mechanical compression and ischaemia under the cuff. Injury increases with greater inflation pressures, and increased duration of ischaemia

3 – Skin injury: Chemical burns occur when alcohol-based solutions, used for skin sterilization, leak under the tourniquet and are held against the skin under pressure. To avoid chemical burns beneath the tourniquet, leakage should be prevented by the use of a water-proof self-adhesive plastic drape, prior to skin preparation.

Pressure necrosis and friction burns are due to inadequate padding. Soft wrinkle-free padding must be used below the cuff.

4 - Intraoperative bleeding and tourniquet failure: it commonly occurs due to incomplete exsanguination of the limb, or underpressurised cuff.

5 - Nerve injury is due to mechanical compression and ischaemia produced by pressure of the cuff

#### <u>Finger tourniquet</u>

A rubber ring tourniquet or a tourniquet made from a glove finger or a catheter that is rolled around the digit should (Figure 3)

Take care that tourniquet may be missed under the dressing or cast done after surgery leading to loss of the finger, to avoid this, the rubber tourniquet should be secured with a hemostat so it cannot be missed, it is difficult to include a hemostat inadvertently under the dressing or cast



Figure 3: finger tourniquet

#### **Orthopaedic Traction Table**

Traction table has many uses in orthopedic surgery. The start of its use was in 1927. It is extremely important in some cases which cannot be done without traction. Although it beneficial many risks and complications are related to the use of traction table in orthopaedic surgery

#### ► Rationale

Tractions greatly facilitated fracture reduction, without traction fracture reduction manually will be extremely difficult.

The ability of image intensified to rotate around the operated limb to take views in all direction is not possible unless the limb is placed in the traction table

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Indications

- Femoral shaft femur
- Fracture proximal femur
- Fracture neck femur
- Hip arthroscopy

Figure 4: Orthopedic traction table

Mechanism of action of the table

The operated limb will be fastened to a foot piece at the end of the table and a post is placed against the perineum. Traction of the limb form the foot piece with counter traction by the perineal post will produce the desirable traction effect

The other limb will be placed in abduction to facilitation movements of the image intensifier



Figure 5: Limb in traction

► Precautions during use

- Avoid excessive and prolonged traction
- The perineal post should be well padded
- The foot piece should be well padded

#### ► Complications

Over traction: Excessive limb traction in case of factures can increase limb length producing post - operative limb length discrepancy

Nerve injury: prolonged and excessive traction against the perineal post can lead to injury to the pudendal nerve in the perineum

Soft tissue injury: Excessive or prolonged pressure on the perineum can lead to perineal skin injury, necrosis and sloughing

#### Image intensifier

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The use of image intensifier becomes essential in most orthopedic surgical procedures. It has great benefits but also has many risks to the surgical team and also to the patients. Certain precautions should be followed to keep sterilization and prevent sepsis



Figure 6: image intensifier

15

- Radiography technician who works in the operating room must wear the same clothing and masks as the circulating personnel.
- Radiography technician should take care to avoid contaminating the drapes in the operative field.
- The C-arm portion of the machine must be draped in a sterile fashion.
- The surgical wound should be covered with a sterile towel when the image intensifier takes an image to avoid possible contamination from the machine as it is moved into position.
- The image intensifier machine should be placed in safe site away from the sterile instruments table. The site of placement of this machine also should not obstruct pathways in the operating room; it should allow the circulating personnel to move freely in the OR without touching any sterile object.



Electro cautery, also known as thermal cautery, refers to a process in which electric current is passed through a metal wire electrode (diathermy handle), generating heat. The heated electrode is then applied to living tissue to achieve hemostasis.

Indications:

- It used to stop bleeding from small vessels during surgery
- Tissue removal without bleeding





#### Precautions

- The diathermy handle should be sterile
- The patient should be isolated

## **Orthopedic Instruments**



#### Objectives

• Provides an idea about specific instruments used in orthopaedic surgery as regard their types and uses

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#### Overview

Orthopedic surgery has specific instruments in addition to basic surgical set of instruments. All members of the surgical team should be aware of these instruments

#### ► Drills

Th<mark>ese devic</mark>es are used

- Make holes in bone by drill pits attached to them
- Insertion of wires or inside bone

#### They are 3 types

Manual drill which is operated by hand. This is rarely used nowadays Power drill: works by electric battery Pneumatic drill: works by air compression



#### ► Drill pits

They are connected to drills to produce holes in bones. They are available in different sizes; 2.5 mm, 3.5 mm, 4.5 mm according to their diameter Precautions during use

• Rotation of drill pits through bone generate heat so try to reduce this heat generated by saline

• Don not push the drill pit but gently support it as the drill pit may break due to forced pressure



#### ► Power saw

This is a power drill but with attached saw blade instead of drill pit. It is used to cut bones



#### ► Screw drivers

- They are used for screw insertion inside bones
- They are hexagonal in cross section
- They are available in different sizes according to the size of the screw ; 3.5 , 4.5 etc.

- Osteotomes
  - They are used to cut bone manually by hammering
  - They have different sizes and shapes
  - They are small, medium and large
  - They may be straight or curved

#### **Figure 13: osteotomes**

Figure 12: Screw drivers

- Periosteal elevators
  - They are used for stripping periosteum and soft tissue off bones
  - There have different sizes ; small , medium and large

#### Figure 14: Periosteal elevators

- ► Reduction clamps
  - They are used to hold bone segments together
  - They have different sizes; small, medium and large



Figure 15: Bone reduction clamp

- ► Bone holding forceps
  - 50 This instrument is used to hold bone and grasp bone segments apart , thus help I • reduction of fractures
  - They have different sizes; small, medium, large.

Figure 16: Bone holding forceps

► Plate holding forceps They are used to fasten plated to bones They have different sizes; they may small to fit 3.5 mm plate or large to fit 4.5 plate.

Figure 17: Plate holding forceps

## Implants in orthopedic surgery



provides wide knowledge about different typed of bone implants as used in internal fixation, external fixation and joint replacement

Different implants are used in the field of orthopaedic surgery for different aims like

- Fixation of fractures •
- Correction of deformities •
- Replace damaged joints
- Limb lengthening
- Fixation of tendons and ligaments to bone •

All members of the orthopedic surgical team should have a good knowledge about the types and uses of these implants

Implants in orthopedic surgery can be used for

- 1. Internal fixation
- 2. External fixation
- 3. Joint replacement

#### **Internal fixation**

opulation Rationale of internal fixation: internal fixation is used to fix bone in cases of fractures or after correction of bone deformities or for fixations of tendons and ligaments to bone Internal fixation of bones can be achieved by

- Plates and screws ٠
- Intramedullary nails •
- Wires .
- Intramedullary nails •

## Screws

Design Each screw is composed of

- Head •
- Shaft •
- Threads
- Tip

Screws used in orthopedic surgery are available at sizes of 3.5mm, 4.5mm & 6.5mm



Figure 18: screw design

Types: according to the shape and size of the threads screws are classified into

- Cortical screws (fully threaded partially threaded): The threads are smaller and the spaces between them are narrower, they are suitable for cortical bone fixation
- Cancellous screws (fully threaded partially threaded): The threads are larger and the spaces between them are wider. They are suitable for cortical bone fixation
- Cannulated screws: They are cancellous screws but they are tunneled (cannulated). They are used for fixation of specific sites where the direction and site of screw placement should be done exactly as in fixation of femoral neck fractures where a guide wire is inserted at first in the correct position, then the cannulated screw is inserted along the guide wire



**Figure 20:** Different types of bone screws: cortical (a) cancellous (b) cannulated (c) Fully threaded screws: The screw be totally threaded with minimal smooth shaft Partially threaded screws: the screws have a smooth shat in part and threads in another part

Figure21: Fully threaded and partially threaded screws

Functions

- Direct fixation of bones (interfragmentary screws)
- Fixation of plated to bones
- Fixation of ligaments and tendons to bones





Screws fixing plate to fibula



Figure 22: Tendon to bone fixation by screw

#### **Plates**

They are used along with screws to fix a fracture. There are different types of plates. They differ according to shapes, design and function

Types of plates

- Dynamic compression plates
- Tubular plate
- Locked plate
- Buttress plate

#### **Dynamic compression plates**

The holes present in the plate are oval in shapes. This design allows compression of the fracture when the screws are placed at the far end of the hole.so these plates are named compression plates as their design allows compression of the fracture. This will not occur if the holes of the plate are rounded





Figure 23: when a screw is placed eccentric (on the far end of the hole) this causes the plate to move causing fracture compression

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#### **Tubular plates**

These pales shape like a part of the tube

- 1/3 tubular plate
- 1/4 tubular plate

They are specially designed to fit over small tubular bone as the ulna and fibula.





**Reconstruction plates** 

They have deep notches between holes. This allows the plates to be reshaped in multiple directions



Figure 25: Reconstruction plate with deep notches between holes

These plates are designed like that to be used in bones when the shape of the surface is complex as the pelvis, clavicle, and lower end of the humerus

According to the size these plates may be small reconstruction plates which receive 3.5mm diameter screws or large reconstruction plates which receive 4.5 mm diameter screws



Figure 26: contoured reconstruction plate to fit the shape of the pelvis

#### Locked plates

They are specially designed plates with threads in the holes of the plate to be engaged in screws with threads on the screw heads

Engagement of threaded screw head with the threads on the holes of the plates prevents pullout of the screw from the plate. This greatly increases stability of fixation



Figure 27: Locked plate and locked screw

#### **Buttress plates**

These plates have different shapes as T, L and clover leaf, they are designed so that to be used in area where bones flare as upper and lower ends of tibia, lower end of radius and lower end of femur.



The broad end of the plate supports (buttress) the widened part of the bone



Figure 29: buttress plate supporting the lower end of femur

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Wires

► Kirschner wires (K – wires)

Description:

- Thin, sharp ended, flexible wires
- Vary in size 0.8 mm up to 3 mm. The more the diameter the less the flexibility
- They are either smooth or threaded in the terminal part.

Figure 30:	Smooth k – wires	Threaded wires	

Functions: Fixation of bone fragments. These wires can be drilled through the bone to hold the fragments together

#### ► Tension band wires:

- They are strong stainless steel highly flexible wires used for fixation of bone fragments together
- They are suitable for fixation of fracture patella and olecranon

#### ► Intramedullary nails

• They are solid or cannulated thick rods inserted inside the medullar of long bone for fracture fixation

26

- They function as internal splint to the fractured bone
- It is suitable only for long bones as tibia, femur, and humerus
- The differ in shape and size according to the type of bone fixed

Recent typed have holes at the proximal and distal end of the nail for insertion of • transverse screws that fix the nail to bone (Interlocking screw) to increase stability of fracture fixation.



#### ► Structure

It is composed of a frame either rods or rings connected to bone with screws known as schanz screws



Figure 33: Schanz screw

▶ Indications of external fixators: they are mainly used for fixation of open fractures where

internal fixation is contraindicated for fear of contamination and sepsis

- ► Complications of external fixators
  - Pin tract infection: it is a common complication. It may reach up to 100% of cases
  - Loosening

#### **Artificial Joints**

#### ► Indications

Artificial joints are used to replace damaged joints due to

- Trauma
- Arthritis

Each joint has a specific type of prosthesis that fits its shape and function Common joint replacement

► Hip joint replacement

There are two types of hip joint replacement

- Total hip joint replacement : Has both femoral head component and acetabular component
- Hemi arthroplasty of the hip: only the femoral head is changed



Knee joint replacement

It is composed of two components femoral component and tibial component

- The tibial component is a metal tray in which a polyethylene liner is positioned
- The femoral component is made of metal and articulated with the polyethylene of the tibial component



Figure 35: total knee replacement

# Chapter 5 Arthroscopy Objectives • Provides detailed information about composition of the arthroscope , how to operate and use different parts

#### Overview

Every member of the surgical team should be aware how to operated different parts of the arthroscope. Sterilization of the arthroscope is critical and it is the responsibility of assistants.

Arthroscopy is a technique used to diagnose and treat problems inside the joints using the arthroscope

Indications of arthroscopy

- Diagnostic purposes for various painful intra articular disorders
- Treatment of articular ulcers
- Removal of intra articular loose bodies
- Reconstruction of cruciate ligaments
- **Removal and repair of torn meniscus**
- Fusion of joints

Basic Composition of the arthroscope

1 - Camera: it is the basic viewing tool in the arthroscope. Its focus can be adjusted according to the structures to be views



Figure 36: The camera

2 - Lens: It is used to magnify the field seen by the cameral. Lenses used in orthopaedic surgery are beveled by it end to form a 30 degrees angle (30° angle lens)



Figure 37: 30° lens

Light source: It used to increase lightening inside the joint. It is connected to the lens by a fibro - optic cable. Without light source inside the joint will be dark



Figure 38: Light source connected to a fibro optic cable

Water pump: it is used to inject saline into the joints. It draws fluids from saline bottles and injects them into the joints at certain adjustable pressure Value

- Facilitate viewing as viewing through a saline will be clearer
- The presence of saline will decrease ameliorate temperature elevation produced by the light source



Figure 39: water pump

Instruments used with the arthroscope 1 - Shaver

It used for debridement of soft tissue structures inside the joints





Figure 40: shaver machine and shaver blades

2 - Scissors, graspers and Basket forceps They are used for holding, trimming and cutting soft structures inside the joints

#### 3 - Trocar and cannula

The trocar is either has blunt end of sharp end. Sharp ended trocar is used only to piece the joint capsule while blunt ended trocar is used for all manipulations inside the joints The cannula : is used to control fluid injection inside the joints also the lens pass through it inside the joint



#### Sterilization of the arthroscope

Metal instruments and parts are sterilized by the autoclave

Non - metal parts are sterilized by soaking in Cidex solution for at least 15 minutes. They should be should be washed with sterile saline before use

The camera: Some types are autoclavable while others are not. Non autoclavable cameras are place in sterile transparent plastic case

#### **Complications of arthroscopy**

- Infection
- Hemoarthrosis
- Injury to the articular surfaces by sharp instruments
- Skin sinus

## **Basic Orthopedic Surgical Techniques**

## Objectives

Provide brief details about some common frequently done orthopaedic surgical techniques

#### Overview

Some basic techniques in orthopedic surgery are constant. Its knowledge is essential for all the surgical team

#### **Osteotomy**

- **Definition:** surgical cut of bone
- ► Indications
  - **Correction of deformities** •
    - **Bone** lengthening
- ► Instruments used
  - 1. Drill pits
  - 2. Power drill
  - 3. Power saw
  - 4. Osteotomes hammer

5.



Figure 42: upper tibial osteotomy to correct knee deformity



Figure 43: Osteotomy of the lower end of humerus to correct elbow deformity

#### <u>Osteoclasis</u>

- It is manual correction of bone deformity. it is a closed reduction of malunited fracture
- It is done under anaesthesia without surgical incisions
- It is done in children and not suitable for adults



Figure 44: Malunited fracture forearm needs osteoclasis

62

#### <u>Arthrodesis</u>

Definition: Surgical fusion of joints Indications:

- Painful joint disorders as severe arthritis not responding to any other treatment
- Joint destruction by trauma, infection, tumors or arthritis

Instruments used

- Power saw
- Osteotomes
- Hammer
- Power drill
- Drill pit
- Tap
- Plate and screws



Figure 45: shoulder fusion knee fusion

#### **Bone grafting**

It is an important procedure done too frequently in orthopaedic surgery. It means transfer of bone from one site (donor site) to another site (recipient site)

Types of bone graft

Natural bone graft: bone is derived from the body of the patient

Synthetic bone graft (Bone graft substitutes): many materials are used as synthetic bone grafts as tricalcium phosphate and hydroxyapatite

Sources of natural (autogenous) bone graft

- The iliac crest: it is commonest and the most rich source of natural bone graft
- The fibula : part of it or the whole fibula can be used as a graft
- Ribs
- Cancellous bone from proximal tibia, distal tibia or distal radius

Indications of bone graft

- Replaced missed bone
- Promote fracture healing



Figure 46: Bone graft from the iliac crest

## **Bone cement**



#### Objectives

• Provides detailed information about composition, uses and complications of bone cement.

#### Overview

Bone cement is an important material frequently used in orthopaedic surgery.it is widely used in bone tumor surgery, arthroplasty and trauma surgery

#### ► Indications

- Filling defects in cases of benign and malignant bone tumors
- Fixation of artificial joints to bones in cases of joint replacement
- Fracture fixation in cases of fractures secondary to malignant tumors
- Injection inside the vertebral body in cases of vertebral collapse



Figure 47: Bone cement filling a bone tumor defect

#### Composition

#### 2 components

- 1. Powder of polymethylmethacrylate (**PMMA**) and small amount (10%) barium sulphate (For the cement to be radiopaque.
- 2. Liquid of methylmethacrylate monomer
- 3. Addition of antibiotic
  - Aim; decrease the risk of perioperative infection
  - Ch.ch.: only powder form , heat stable (liquid forms inhibit polymerization)

35

Types : gentamicin , erythromycin , tobramycin

#### The powder is mixed with the liquid to produce the cement





**Cementation process** 

1. Mixing: according to manufacturer's recommendation with the powder is added first or the liquid

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**2.** Curing: it is the polymerization process that occurs due to mixing the powder with the liquid. It is divided into 3 periods

- 1. **Dough time:** Time from start of mixing till the cement becomes unsticky to powdered gloves (2-3 minutes)
- 2. Working time: from the end of the dough time till the cement becomes hard to manipulate (half maximal exothermic reaction)
- 3. Setting time: the sum of dough and working time (start of mixing till the end of working time -half exothermic reaction), 8 10 minutes

#### **Proper cementing technique**

- Bone surface should be dry
- Amount of cement should be enough to provide a cement of adequate thickness
- Apply cement while in the creamy semiliquid state to easily penetrate the cancellous cortices
- Pressurize the cement to ensure inadequate flow of cement into the interstices of the bone

#### **Complications of bone cement**

1. Hypotension can occur on pressurisation of the cement into the femur, maybe due to peripheral vasodilatation and direct myocardial depression due to monomer leakage (**PMMA** monomer is metabolised to methacrylic acid which produce adverse CVS effects)

#### 2. Local tissue effects of PMMA

- Heat of polymerisation may exceed the coagulation temperature of the tissue proteins (67 degrees)
- Occlusion of the nutrient bone vessels which may produce bone necrosis
- Cytotoxic effects

## **Postoperative care**

#### Objectives

• Provides detailed information about the steps and signs should be checked and followed to get safe post - operative period

#### Overview

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The early post - operative period  $(1^{st} 48 \text{ hours})$  is critical for safe and successful orthopedic surgery. Close patient observation is essential to detect any complication or emergency that may threaten the patient.

A number of signs should be checked and steps should be done in the way of safe post - operative period

1 -Take care that the tourniquet is removed and there are no any constrictions bands around patient limb. This is a disaster if missed or neglected.

2 – Ensure that treatment is written in patient file especially analgesia

3 – Vital signs (pulse – blood pressure – temperature) should be checked regularly every two, 6 or 8 hours maximum according to the condition of the patient.

4 – Limb position: The correct limb position determined by the nature of the operation e.g. limb elevation should be checked regularly and corrected if the limb is mal – placed.

5 – Any limb swelling or tight cast: Tight cast should be univalved or bivalve with limb elevation to guard against any circulatory disturbance.

6 – Cast integrity: check for presence of any broken cast or wet or soft cast and correct it if present. 7 - Peripheral circulation: It is very important check intact limb circulation. Note any changes in limb temperature, cold limb suggest the presence of circulatory problem. Check peripheral pulsations and capillary refill. Use pulse oxymeter to detect oxygen saturation of the operated limb and compare it with the non - operated side. Normal oxygen saturation should be above 90.



Figure 49: pulse oximeter

8 - Check neurological functions of the operated limb: Sensation and motor power should be evaluated to detect any nerve injury following surgery

9 - Abnormal bleeding: normally there will be some blood ooze from the site of surgery. This is acceptable but no more. Excessive bleeding is an abnormal and the surgeon should be informed without delay.

10 - Suction drain: It is a closed system composed of a tube placed inside the wound and secured to the skin from outside, this tube is connected to a bottle. This closed system aims to drain any remaining blood of fluids in the operative field under negative pressure

Accumulation of blood or fluids in the operative field will leads to hematoma formation and predispose to post - operative infection

- Notice if the suction drain is functioning or not and the draining tube is patent or blocked
- Note any kink in the draining tube
- Note the amount of collected blood in the bottle and rate of its fullness
- Take care when you are moving the patient not to dislodge the tube

Figure 50: suction drain Removal of the suction drain

Maximum 48 hours are allowed to remove the drain more than that time the risk of infection increases

11 – Post operative rehabilitation: encourage patients for active motions and call for a physical therapist for patient training

12 - Frequent change in patient positions to prevent development of pressure ulcers and bed sores.

13 – In cases of presence of excisional biopsy be sure that it is well packed and sent to histopathology

14 – Inform the medical team if any complications occur due to the surgery or after surgery as

- Urine retention
- Constipation
- Allergy
- Suspicious of DVT
- Suspicious of sepsis (fever wound pain abnormal wound discharge)

15 - Be sure that the operative sheet including all operative details, intra operative findings and operative time were recorded in patient's file, also record the name of surgeon (s) assistant (s), anaesthetist (s) and all persons who attended the operation in the patient's file

## Surgical team at risk

#### Objectives

Provides detailed information about different hazards that threat the surgical team and how they protect themselves.

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#### Overview

The health of the surgical team is so precious; every effort should be done to protect them from hazards that may threat them in the OR

#### Viral infection

- HIV : Human immunodeficiency virus
- HCV : Hepatitis C virus
- HBV : hepatitis B virus

Viral infection is transmitted form the patient to the health care provider through blood. Infection occurs after skin injury by contaminated sharp instruments or needle pricks or through mucosal surfaces as the eye.

American academy of orthopaedic surgeons (AAOS) task force guideline for protection

- 1 Do not hurry during surgery. Excess speed results in injury.
- 2 Wear water proof surgical gowns that offer protection against contact with blood.
- 3 Use knee-high, waterproof, surgical shoe covers.
- 4- Use protective eye wears and full head cover.
- 5 Double gloves should be worn at all times.

- 6 Surgical masks should be changed if they become moist or splattered.
- 7 To avoid inadvertent injury to surgical personnel, the surgeon should:
  - Avoid tying with a suture needle in hand.
  - Avoid passing sharp instruments and needles from hand to hand; instead they should be placed on an intermediate tray.
  - Announce when sharp instruments are about to be passed.
  - Avoid having two surgeons suture the same wound.
  - Take extra care when performing digital examinations of fracture fragments or wounds containing wires or sharp instrumentation.
  - Avoid contact with sharp instruments as osteotomes, drill bits, and saws.
  - Routinely check gowns, masks, and shoe covers of operating room personnel for contamination during the surgical procedure and change as necessary.

8 – In case of exposure of healthcare personnel to potentially infected fluids should be reported to infection control team. The source patient and exposed health care provider should be tested and followed up for infection

9. Post exposure prophylaxis for HBV and HIV should be provided. Till now there is no post exposure prophylaxis for HCV.

#### **Radiation** exposure

Nowadays most orthopaedic surgeries need the use of image intensifiers during surgery. Radiation exposure has many risks not only to the surgical team present but also the patient.

Hazards of radiation exposure

- Orthopaedic team exposed to radiation has been shown to have an increased incidence risk of cancer compared to non-exposed workers.
- The thyroid, eyes, hands, and gonads are among the most sensitive organs to radiation exposure.
- The eyes may exhibit the first effects of chronic radiation exposure in the form of cataracts. A surgeon's hands have the greatest exposure risk due to their constant proximity to the radiation beam

Measure to decrease the risk of radiation exposure

- 1 Use of protective lead aprons
- 2 Use of protective neck collars made of protective lead
- 3 Use of protective glasses against radiation
- 4 Used of leaded protective gloves if available
- 5 Increasing the distance between the X-ray source and the patient can reduce radiation for both the patient and the surgeon

6 - Continuous fluoroscopy with the C-arm should be avoided to prevent excessive radiation exposure.

40

