ORTHOPEDIC DEVICES
HOW TO DESCRIBE THEM

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LEARNING OBJECTIVES

1. Identify an orthopedic device in x-ray and understand its function

2. Categorize devices into groups and learn how to describe them

3. Recognize abnormal positioning / malfunction of the device, and complications
INTRODUCTION

ORTHOPEDIC DEVICES

... are commonly seen in all imaging modalities

... can obscure structures of interest

... identify patient medical problems

... are continuously being developed

SO IT IS MANDATORY THAT RADIOLOGISTS KNOW HOW TO INTERPRET THEM
TYPES OF DEVICES

Internal / External Fixation Hardware

Joint Replacement / Fusion Hardware

Types:
- Internal
- External
- Arthroplasty
- Arthrodesis

Cases:
- Case: Frank Gaillard rID: 8895
- Case: Shailaja Muniraj rID: 49420
- Case: Craig Hacking rID: 37771
- Case: Craig Hacking rID: 79941
Internal Fixation Hardware

Intramedullary nail

Spinal fixation devices

Case: Neel Parikshak rID: 51601

Case: Mohammadtaghi Niknejad rID: 60641
Screws should be evaluated for correct positioning and function.

Cannulated screws used in slipped upper femoral epiphysis

Case: Frank Gaillard rID: 7894

Scaphoid fracture fixed with Herbert screw

Case: Ahmed Abdrabou rID: 24334

Normal dynamic hip screw on the left

Case: Maulik S Patel rID: 10152
SCREWS: EXAMPLES AND IMPORTANCE

Screws can migrate, become loose or fracture.
Holes created to insert screws weaken the bone -> Look closely for fracture at these sites.
Repeated trauma in the same location can cause failure of internal fixation and fracture.

Fractured clavicle and bent cannulated screw

Dynamic hip screw with wire cerclage
Inferior screws are fractured and the plate is lifted off
Malalignment of the femoral neck of fracture

Case: Craig Hacking rID: 92973
Case: Maulik S Patel rID: 19626
There are different types of plates used in **different anatomic locations**.

**Extensive ORIF of the lower left thoracic cage**
Case: Ian Bickle ID: 50366

**Surgical fixation of the 1st proximal phalanx fracture**
Case: Amanda Er ID: 90040

**Boxers 5th metacarpal fracture with previous ORIF for the same fracture**
Case: Craig Hacking ID: 79913
Plates are typically **combined with screws** in the treatment of complex fractures.

**Left acetabular fractures**

**Extensive left pelvic plate and screws. Right SI joint screw**
Distinguish plates with correct positioning and function from fractured plates!

**Case: Matt A. Morgan**
ID: 37713
Distal radius fracture
Volar locking plate fixation

**Case: Bálint Botzr**
ID: 81408
Fracture of dynamic compression plate

**Case: Bálint Botzr**
ID: 71854
Derotational osteotomies with blade plates
Two blades and screws used in mandible fractures

Case Courtesy of Dr. Ana Loureiro
Intramedullary rods and nails = invasive procedure used for fractures. Search for implant malposition, fragment displacement, malalignment, implant loosening, signs of fracture healing or hardware failure.

POSSIBLE COMPLICATIONS:
- impairment of blood supply
- thermal osteonecrosis
- fat emboli

Always get x-rays in two orthogonal planes.
Spinal fixation devices = Combinations of wires, clamps, screws, different plate-screw and rod-screw interfaces, intervertebral prosthesis and disk replacements.

Case: Kirollos Bechay rID: 151244
Harrington rod for thoracic realignment

Idiopathic scoliosis with posterior spinal fusion (two rods and screw fixation), upper thoracic to mid-lumbar. Reduction in both curves.

Case: Jeremy Jones rID: 89552
Describe all the materials used in the spinal fixation.

Anterior cervical discectomy and fusion (ACDF) at C4-C5 and C5-C6 levels with anterior plate and screws and intervertebral disc space cage.
Look for **displacement of the materials**.

Expandable vertebral body replacement device insertion in the L1, which is mildly displaced to the right side.

Pedicle screw fixation in T11, T12, L2 and L3.

Always get x-rays in two orthogonal planes.

**Case:** Mohammadtaghi Niknejad  
**rID:** 157349
Spinal fixation device: Lateral rods + pedicle screws

Intervertebral disc space cages at L3-L4 and L4-L5

Vertebral body cementoplasty at T8, T9, L2, L3

SI joints screws

Cse Courtesy of Dr. Carina Ruano
External Fixation Hardware

Include *intraosseous metallic pins and wires* connected by *external rods*.

**Indications:** stabilising open limb fractures and other complex limb injuries until definitive surgical treatment can be safely performed, limb-lengthening procedures in children.

**Possible Complications:**
- loosening of the pins
- infection

Open tibia and fibula fracture
Internal and external fixation

Case: Shailaja Muniraj rID: 49420
**Total arthroplasty** = complete replacement of all sides of the joint (total joint replacement)

**Hemiarthroplasty** = only one articular surface is replaced

- **Total elbow arthroplasty**
  - Case: Matt A. Morgan rID: 35679

- **Total hip arthroplasty**
  - Case: Henry Knipe rID: 147934

- **Hip hemiarthroplasty**
  - Case: Craig Hacking rID: 37705

- **Talocrural arthroplasty**
  - Case: Craig Hacking rID: 153506
**Joint Replacement Hardware**

Reverse total arthroplasty = flips the normal mechanical arrangement
Unicompartmental arthroplasty = for single compartment pathology

**Reverse total shoulder arthroplasty**
- Case: Domenico Nicoletti rID: 66150
- Case: Amanda Er rID: 99475

**Shoulder hemiarthroplasty**

**Unicompartmental knee arthroplasty**
- Case: Craig Hacking rID: 158912

**Proximal interphalangeal joint arthroplasty**
- Case: Ashesh Ranchod rID: 151668
Joint replacement hardware can be malpositioned, dissociate or cause fractures in adjacent bones.

- **Malpositioned humeral resurfacing arthroplasty**
  - Case: Domenico Nicoletti rID: 99394

- **Reverse total shoulder arthroplasty with dissociation/dislocation**
  - Case: Cheng Zhou rID: 158678

- **Periprosthetic humeral fractures after shoulder arthroplasty**
  - Case: Domenico Nicoletti rID: 91925
For each joint, there are specific rules to search for complications. In this example, we use hip joint arthroplasty (one of the most commonly seen).

Acetabular component should have an angulation of 45° (intersection between blue and red lines)

Dysmetria can be assessed using the blue line (difference > 1 cm)

Green lines should be equal in size, otherwise suspect prothesic wear

The upper portion of the greater trochanter should be at the same level as the femoral head

Case Courtesy Dr. Pedro Pegado
Main complications of hip arthroplasty include **dislocation**, **wear of prosthetic materials**, **failure / loosening** and **heterotopic calcification**.
Joint replacement hardware increase the risk of infection.

Septic arthritis of the metallic PIP arthroplasty

Case: Ashesh Ranchod rID: 151668
Elective left hip arthroplasty

After a fall during medical stay
Clinical suspicion of fracture

CT scan confirms periprosthetic fracture

New surgery with additional stabilization with cerclage wires and plate

Case Courtesy of Dr. Augusto Gaspar
Arthrodesis = artificial induction of joint ossification between two bones

Scapulohumeral arthrodesis

Spider plate. Four-corner fusion of right wrist

Arthrodesis of the knee

Case: Domenico Nicoletti rID: 91120

Case: Matt A. Morgan rID: 37660

Case: Maulik S Patel rID: 17811
Antibiotic impregnated beads in the abdomen
Gun shot pellets to left flank

Internal screws span the comminuted patellar fracture
Tubular lucency in the tibia represents the bone graft site
There are four groups of orthopedic devices, depending on their function: internal fixation, external fixation, joint replacement and joint fusion.

For each orthopedic device, we should evaluate its position, integrity and adjacent bone. As foreign bodies they increase the risk of infection which should always be suspected.

When an orthopedic device is present, it is mandatory to include the whole device in the same film with some margin, to compare the x-ray with previous studies, and to obtain two orthogonal films if possible.

The presence of orthopedic devices can obscure areas of interest, increasing the need of supplementary incidences or CT studies.

