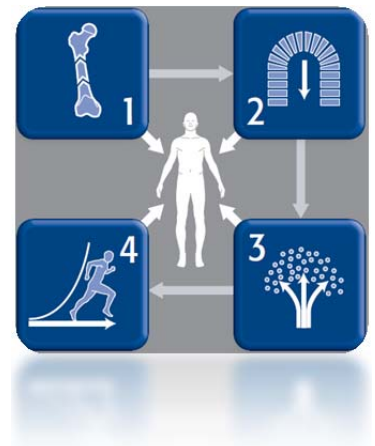


Principles of fracture fixation

Josefa Bizzarro, Pietro Regazzoni

How to use this handout?

The left column is the information as given during the lecture.
The column at the right gives you space to make personal notes.



Learning outcomes

At the end of this lecture you will be able to:

- Outline the four principles of fracture fixation

The four AO principles

The four AO principles of fracture fixation are

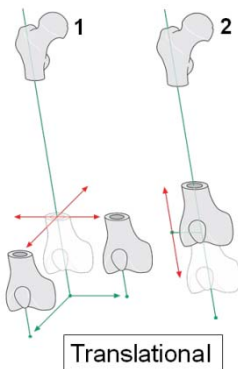
1. **Fracture reduction to restore anatomical relationships.**
2. **Fracture fixation providing absolute or relative stability** as the “personality” of fracture, patient and injury requires.
3. **Preservation of blood supply** to soft tissues and bone.
4. **Early and safe mobilization** of the injured part and the patient as a whole.



1. Fracture reduction

What does fracture reduction mean?

There are two forms of displacement:

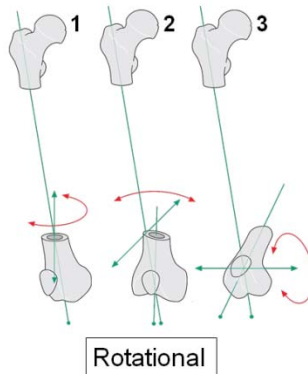


Translational displacement:

1. Medial or lateral and posterior or anterior
2. Shortening or lengthening

Rotational displacement:

1. Internal or external rotational malalignment
2. Valgus or varus malalignment
3. Flexion or extension malalignment



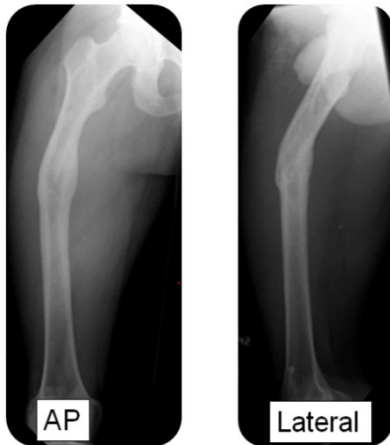
Why fracture reduction?

Example 1



On the x-rays we can see a fracture fixed with an intramedullary nail that looks reduced on the lateral view. On the AP view however we can see that there is some valgus angulation of the distal fragment.

Example 2



This fracture was not treated operatively and has healed with varus, antecurvatum, and shortening malunion.

Aim of reduction

Some fractures are reduced to restore

1. the bony anatomy and morphology. Perfect or **anatomical reduction** is required.
2. the relationship between the proximal and distal main fragments. Length, alignment and rotation are restored. This is **functional reduction**.

Reduction methods

The decision, which reduction method should be used, depends on the location of the fracture:

1. Meta- and diaphyseal fractures usually need functional reduction.
2. Joint fractures need anatomical reduction.

Reduction of diaphyseal fractures

- The functional anatomy is restored (length, alignment, and rotational axis).
- The load-bearing axis of the extremity is restored (especially important in the lower limb).
- An exception is the forearm which functions as a single articular unit.



Reduction of articular fractures

- The joint surface is restored anatomically. Gaps and steps in the articular surface must be avoided.
 - “Steps” means that there is a difference between the levels of two main articular fragments.
 - “Gaps” means that there is some space between two adjacent main articular fragments.
- The axial alignment is restored.





2. Fracture fixation

What does fracture fixation mean?

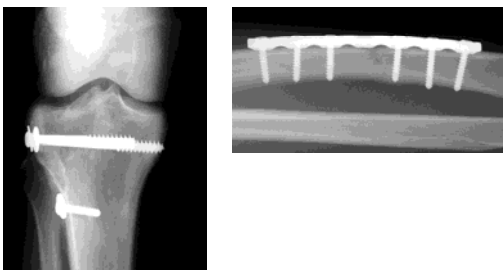
Goal of fracture fixation

1. To maintain the reduction
2. To create adequate stability which:
 - Allows early and optimal function of the injured limb
 - Minimizes pain

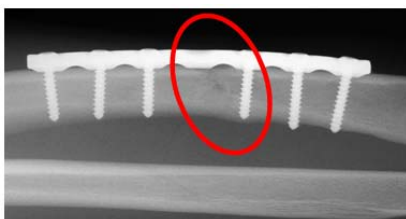
The main goal of internal fixation is to achieve prompt and, if possible, full function of the injured limb. Although reliable fracture healing is only one element in functional recovery, its mechanics, biomechanics, and biology are essential for a good outcome.

Absolute stability

- There is no movement at fracture site.
- It is achieved by interfragmentary compression, eg. lag screws, compression plate



- There is no callus formation. Direct bone healing is achieved.



When is absolute stability required?

How is absolute stability achieved?

Which fixation techniques are used?

Relative stability

- Movement at fracture site
- There is no interfragmentary compression at fracture site. It is achieved by splinting or bridging, eg. elastic nails
- There is callus formation. Indirect bone healing is achieved.



When is relative stability required?

How is relative stability achieved?

Which fixation techniques are used?



3. Preservation of blood supply

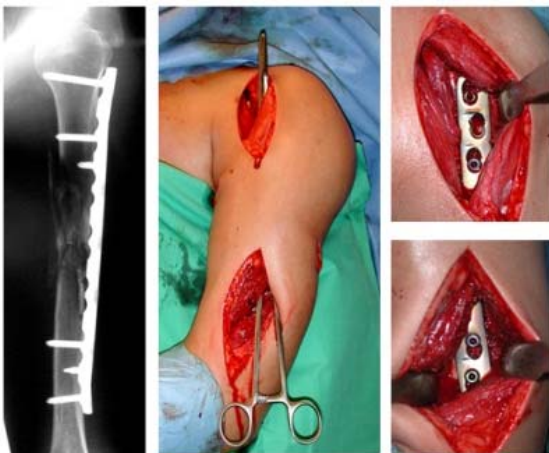
To what does "Preservation of blood supply" refer to?

Care for the soft tissues

- Evaluation of limb swelling
- Consideration for staged procedure is important:
 - Primary stabilization → external fixation
 - Secondary stabilization → definitive fixation
- Careful reduction procedure
 - Too intense efforts for perfect reduction are risky
 - Increases infection rate
- Minimal invasive surgery

Example

42y-old-man with a humerus fracture after a gun shot



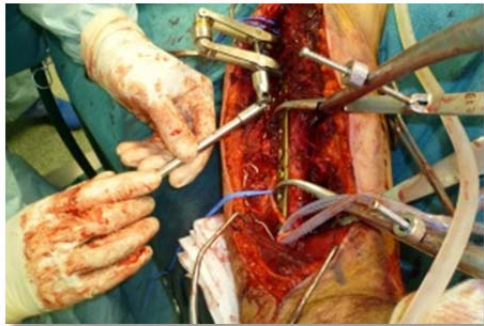
Courtesy of: C Sommer

- Nursing care of patient with fractures
 - Care during transfer and positioning

- Taking care of body temperature
 - In old and young patients
 - During long surgeries



- Intraoperative nursing care
 - Use of atraumatic soft-tissue forceps and retractors
 - Reduce pressure on bone elevators
 - Irrigate wound regularly
 - Cover wound with wet pads





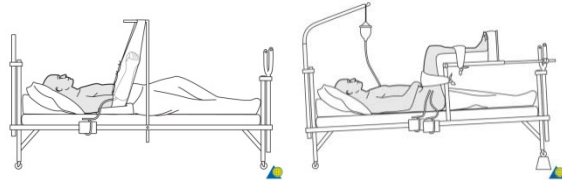
4. Early and safe mobilization

What does this mean?

Postoperative care

- Immediately after surgery

- Elevation of the limb



Immediately after the operation, the treated extremity is positioned above the level of the heart to minimize swelling.

Following osteosynthesis of the upper extremity, the limb is either placed on a cushion or elevated in a bag. When the latter is used, flexion of the elbow should not exceed 75° . After any procedure, pressure, malpositioning, and deformity must be prevented. In particular, the medial epicondyle of the elbow (ulnar nerve) and the head of the fibula (fibular nerve) must be well padded.

During follow-up treatment, not only look at the x-rays but also at the injured limb. Pain, swelling, and tenderness are signs of either instability or infection.

- Early joint motion: Use of CPM machines



CPM (continuous passive motion) machines are used to provide a continuous but passive (without force of the patient) motion for limbs where after

surgery (knee or elbow) stiffness of the limb might be expected.

- Partial weight bearing
- Adequate pain control
- Thrombosis prophylaxis
- Early recognition of complications

Postoperative management is not limited to the time spent in hospital, but must be carried on at home, at work and during leisure and sport. To achieve this three postoperative phases are recognized:

1. Immediately after surgery emphasis is on pain control, mobilization, thrombosis prophylaxis, and early recognition of complications.
2. When the patient leaves the hospital, attention is centered upon integration into the home and into the professional and social environment. Good mobilization is important.
3. Treatment is finished. The patient returns to his/her preoperative capabilities.

Summary

You should now be able to:

- Outline the four principles of fracture fixation

Questions

1. What type of reduction is performed here?



2. What type of stability is required here?



3. The patient has a forearm fracture and blisters on the skin. What to do next?



Answers on in-course questions

1. Fracture reduction

Question 1—What does fracture reduction mean?

Reduction is the action of restoring a dislocation or fracture by returning the affected part of the body to its normal position.

Question 2—What does fracture fixation mean?

The fracture is fixed providing absolute or relative stability as the personality of the fracture, the patient and the injury requires.

2. Fracture fixation

Absolute stability

Question 1—When is absolute stability required?

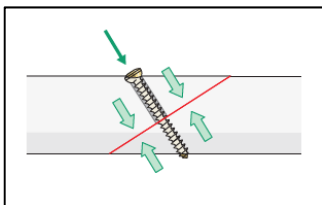
Important indications for absolute stability are articular fractures.

Question 2—How is absolute stability achieved?

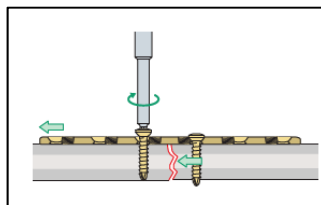
It is achieved by interfragmentary compression.

Question 3—Which fixation techniques are used?

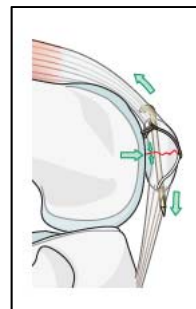
Lag screws



Compression plates



Tension band



Relative stability

Question 1—When is relative stability required?

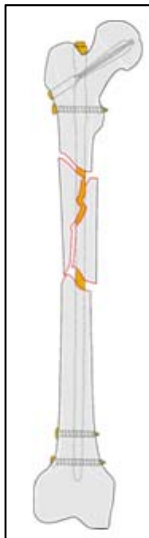
Important indications for relative stability are diaphyseal fractures.

Question 2—How is relative stability achieved?

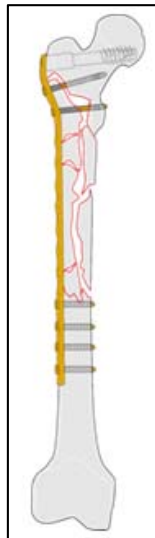
It is achieved by splinting or bridging.

Question 3—Which fixation techniques are used?

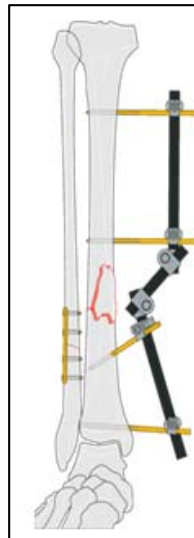
Intramedullary nailing



Internal fixator



External fixation



3. Preservation of blood supply

Question 1—To what does "Preservation of blood supply" refer to?

- Handling and care of patient with fractured bone(s):
 - Decontamination of fracture site
 - Positioning of fractured limb
- Perioperative care of the soft tissues
 - Vessels, muscles

4. Early mobilization

Question 1—"Early mobilization" what does this mean?

This means mobilization of the injured part and the patient as a whole.