

## Osteosynthesis involving a joint

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### How to use this handout?

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

### Learning outcomes

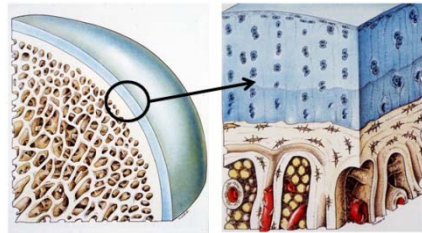
At the end of this lecture you will be able to:

- Outline the pathophysiology of articular cartilage
- Describe the need for anatomical reduction and rigid fixation
- Discuss “staged surgery”

### Articular cartilage

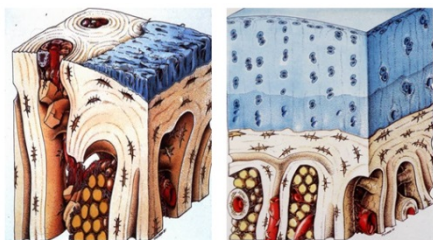
#### Anatomy

Articular cartilage and chondrocytes stay alive because they receive oxygen and nutrients by diffusion from joint fluids. This only works if there is both regular movement and physiological loading forces.



#### Pathology

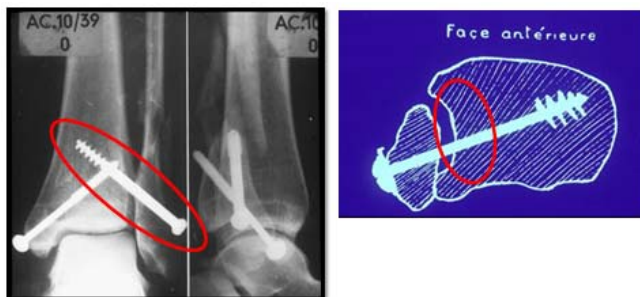
To work properly, the articular cartilage must be very smooth. This minimizes friction. When a fracture occurs near to the cartilage, it can change this environment. Any changes in the axial alignment or step-offs in the articular surface may lead to rapid degenerative change in the joint, eg, posttraumatic arthrosis and arthritis.



## Historical introduction

Over 100 years ago, Lambotte observed that only “perfect anatomical reduction and stable fixation” by screws combined with early motion allows to obtain a good functional outcome in articular fractures.

Lambotte described that a transfixation screw (between fibula and tibia) in an unreduced fibula must result in a severe osteoarthritis. The drawing and the x-rays below show a clinical example of such a situation from the early days of AO.



The x-ray on the left shows the same case 20 years later with severe posttraumatic osteoarthritis resulting in spontaneous fusion (ankylosis).

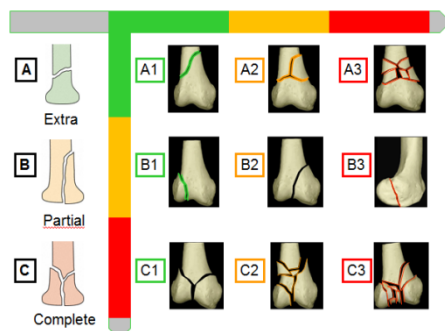
## Classification

In order to improve the outcome, it is suggested to classify the fracture which helps preoperative planning and making a prognosis.

Articular fractures are divided in types and subgroups. The example below shows the distal femoral fractures.

- Type A, extraarticular fractures, have a better prognosis than type B and C, respective partial and complete articular fractures.

- The sub-group 1 has a better prognosis than the sub-groups 2 and 3.



This example is an extract of the AO/OTA Classification of Fractures and Dislocations (previously known as the Müller/AO Classification).

## Reduction

Articular fractures must be reduced anatomically, which requires good visualization of the entire joint, including critical structures like the ulnar nerve.



## Fixation

In displaced articular fractures anatomical reduction and reconstruction with rigid fixation is the treatment of choice. Early rehabilitation is important.



## Complications of operative fracture treatment

Complications of surgery can be a result of:

- Poor reduction
- Inadequate fixation
- Wrong implant choice
- Poor soft-tissue care
- Wrong timing

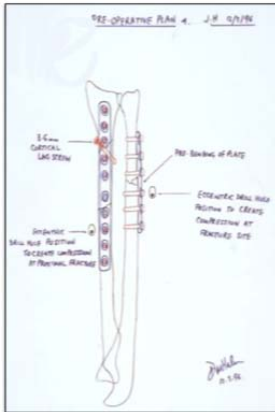
Most complications can be avoided with careful planning.

## Preoperative planning

Preoperative planning involves

- Correct assessment of fracture and soft-tissue
  - X-ray imaging, including CT: Traction views and CT scans (3-D) are most insightful also in view of the planning of approaches
- Classification of the fracture
- Reduction and drawing on paper

- Discussion of the:
  - Procedure, step-by-step
  - Approach
  - Position of patient
  - Choice of implant(s) and position of implant(s)
  - Choice of instruments
  - Need for bone graft



This picture illustrates a drawing or preoperative plan reflecting the procedure to be carried out.

## Timing of surgery

The timing of surgery is always crucial and very important, certainly when the soft tissue is vulnerable. This is often the case when the layer of subcutaneous fat is thin and hardly no muscle structure is present.

Tension of the skin results in ischemia and later on in necrosis.

In case of doubt temporary stabilization of the fracture is chosen until the skin and soft tissue recovered. ORIF (Open Reduction Internal Fixation) is done at a later stage.



The timing of surgery depends on:

- The history of the injury. What kind of energy was involved (high or low)? How long was the interval since the accident?
- Swelling, skin tension, blisters, hematoma
- The fracture. Is it open or closed? Is it contaminated? What is the neurovascular status?
- Compartment pressure

Open and contaminated fractures, bad neurovascular status, and high compartment pressure are an indication for immediate surgery; temporary or definitive.

The longer the interval since the accident, the quicker the operation needs to be done, certainly in open and contaminated fractures.

Swelling, skin tension, and bad soft-tissue conditions are indications to delay definitive surgery and proceed to staged surgery.



There are three types of surgery, based on the soft tissue conditions:

1. Primary definitive surgery
2. Secondary surgery
3. Staged surgery

Each one has advantages and draw backs. Most important in all cases are the soft tissues. This will define to which surgery the surgeon will proceed.

## Primary definitive surgery

### Condition of injury

- Unproblematic soft tissues
- Simple, open articular fracture (1° and 2°)
- Fractures with vascular injury

### Prerequisites

- Complete preoperative planning
- Access to OR
- Full equipment available
- Experienced team of surgeons and nurses

## Secondary surgery

A second look is carried out after primary surgery.

## Staged surgery

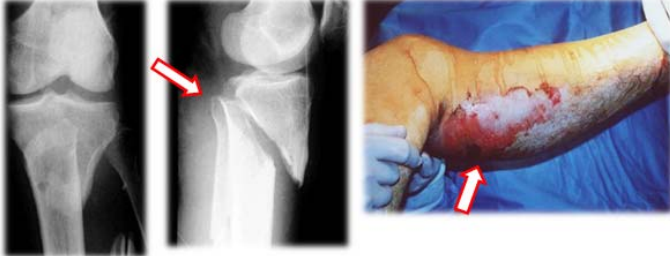
Staged surgery or minimally invasive preliminary fixation is the preferred technique for complex articular fractures today. An example is a joint bridging external fixator.

The advantages are:

- Protection of soft tissue
- Reduction aid for definitive surgery
- Patient remains “mobile”
- For “less experienced” at night

## Case 1: Motorbike accident

A young man sustained an open proximal tibia fracture (III C) after a motorbike accident. There is only a puncture wound but pulses are poor.

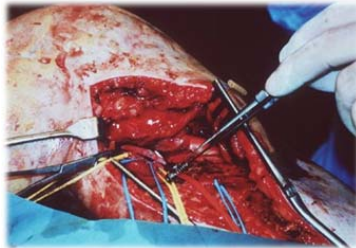


An angiography in the operating room was done to detect the status of the popliteal artery. An injury of this artery is confirmed.



### Primary surgery

1. The injury was approached through a medial incision. The popliteal vessels were repaired in a first step.
2. In a second step the fracture was reduced and fixed with a 3.5 mm angled blade plate.



3. Because of the long duration of the ischemia the compartments were also released prophylactically through several incisions.

Both interventions, the vascular repair and the osteosynthesis, were done by the same team. One and the same approach was used.



**Second look**

After 5 days, necrosis of the skin had to be removed at level of the tibial tuberosity.

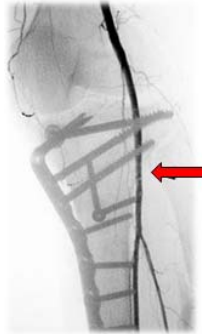


The defect was then covered with a gastrocnemius flap.



**Postoperative**

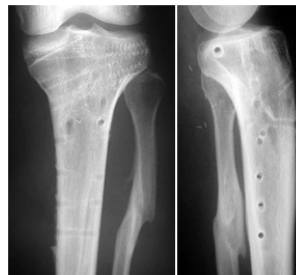
A control angiogram was done to prove the patency of the popliteal artery.



There is good function and there are no complications 13 weeks later.



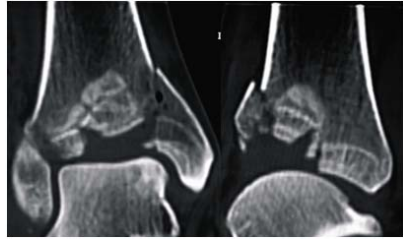
The result after 1 year shows a well healed bone with congruent articular surfaces.



**Case 2: Ski accident**

This case shows an anterior impaction of the distal tibia after a skiing accident (43-C fracture).

A CT scan shows that the case is an absolute indication for surgery.



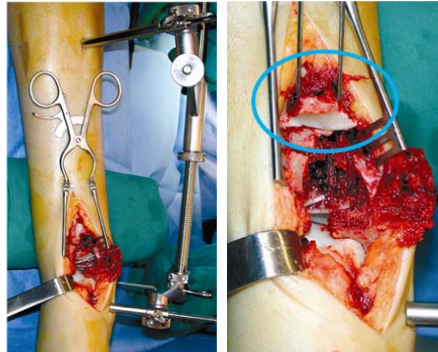
### Staged surgery 1

In the first stage an external fixation has been installed to fix the fracture temporarily allowing the soft tissue to recover before definitive surgery.



### Staged surgery 2

Definitive surgery took place 14 days later. A standard approach and distraction at the fracture site created space allowing to elevate the articular fragment with two K-wires.



A K-wire cage is built as temporary fixation.



An LCP is used as anterior buttress.



### Postoperative

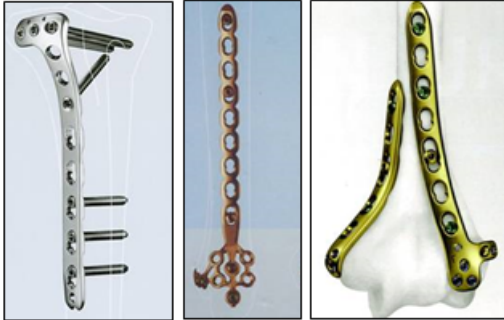
We can see a congruent joint on the x-rays 8 months later. The patient has good functionality of the ankle. There are no complications.



## What is the choice of implant for articular fractures?

In most cases 3.5 mm implants are used. Screws and plates (1/3 tubular plate, LCDCP, and LCP) are more adequate than intramedullary nails.

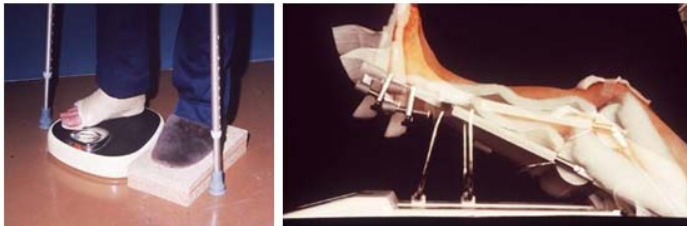
Also preshaped plates can be used. However a special preshaped plate is not a guarantee for success.



## Postoperative care

If the patient is compliant, the postoperative care consists of:

- Continuous passive motion (CPM) for 5–6 days
- No external splint
- Immediate toe-touch (15 kg) weight bearing
- From 6–8 weeks partial weight bearing (30–40 kg)



## Results after ORIF in articular fractures

The results after ORIF in articular fractures are in general good provided there is:

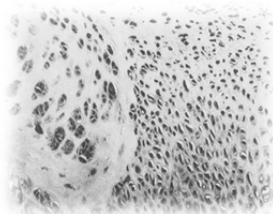
- Anatomical reduction and rigid fixation
- An experienced surgeon doing the surgery
- Early rehabilitation

The results are:

- 70–80% is good to excellent
- 10–15% is moderate
- 5% is bad

Remember the physiology of cartilage:

- ✓ Damaged cartilage never "heals" completely.
- ✓ Its repair "depends" on early joint motion.



## Summary

1. Displaced articular fractures are an absolute indication for surgery provided there is anatomical reconstruction and rigid fixation.
  - Staged surgery is advisable in complex fractures.
2. Correct timing and planning are crucial:
  - Good imaging and classification
  - Choice of approach(es)
  - Choice of reduction
  - Choice of implants and instruments
  - Choice of bone grafts or substitutes
3. New locking plates may have advantages but a good surgeon is more important.

Injured cartilage never heals completely, but early mobilization is mandatory to reduce cartilage damage.

## Questions

What is the correct answer? More answers can be possible.

### 1. Displaced articular fractures are an indication for surgery providing...

- Anatomical reconstruction and rigid fixation
- Anatomical reconstruction and relative fixation
- Reconstruction of length and axis and rigid fixation

### 2. Advantages of staged surgery with external fixator are...

- Recovery of soft tissue
- "Early" mobilization of patient
- Use of the fixator as a reduction aid

### 3. Cartilage...

- Heals completely
- Heals partially
- Does not heal

## Reflect on your own practice

Which aspects of this lecture will you transfer into your practice?