

Malleolar fractures

Anna Ekman, Lena Brauer

Disclaimer

All contents of this study guide are owned by AO Foundation/AO Trauma and cannot be used for any other than private purposes. This work may only be used for your private education.

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.



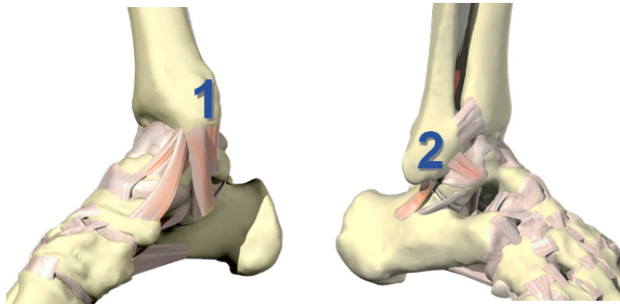
Learning outcomes

At the end of this lecture you will be able to

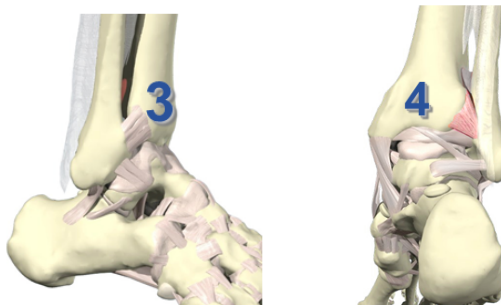
- describe principles of malleolar fracture classification
- outline indications for nonoperative and surgical treatment
- discuss principles of malleolar fracture fixation

Malleolar fractures

Malleolar fractures include injuries of bones (malleoli) and or ligaments. There is the medial malleolus with the deltoid complex (1) and the lateral malleolus with the lateral ligaments (2).



There is also the anterior tubercle with the anterior syndesmodic ligaments (3) and the posterior tubercle with the posterior syndesmodic ligaments (4).



Common symptoms of a malleolar fracture are:

- Deformity around the ankle
- Swelling
- Heamatoma
- Bony tenderness
- Instability and pain on attempting to walk

In the presence of such symptoms, clinical examination follows the principles of “look—feel—move”.

The biomechanics of the subtalar joint are such that violent inversion (supination) of the hindfoot produces external rotation of the talus, causing a fracture of the distal fibula or a rupture of the lateral ligament.

If talar rotation continues, the medial malleolus is avulsed and the deltoid ligament may rupture.

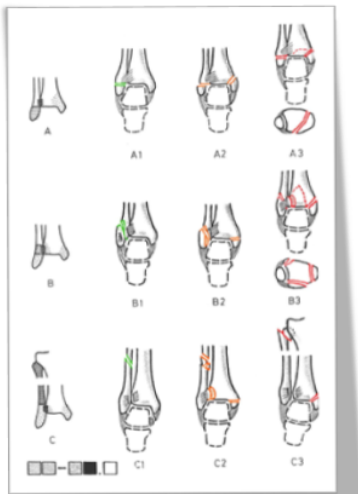
The anterior tubercle gives origin to the anterior syndesmotic ligament and at the posterior tubercle the very strong posterior syndesmotic ligaments are attached.

The important facts about malleolar fractures are:

- They are intraarticular injuries.
- Soft-tissue injury is common as the bones are subcutaneous.
- Uni malleolar fractures are the most common (68%), followed by bi malleolar fractures (25%) and tri malleolar fractures (7%).

Classification of malleolar fractures

The most common malleolar classification is the Müller-AO classification, originally developed by Danis and later Weber.

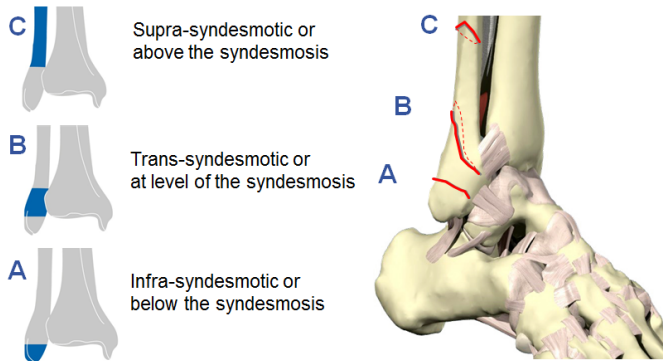


The Müller-AO Classification (Danis-Weber) is based on the fracture location of the fibula. The fractures are divided into 3 lesion types according to their relationships to the level of the syndesmotic ligament complex.

A – refers to an infra-syndesmoti fibular fracture, or a fracture below the syndesmoti ligaments.

B – refers to a trans-syndesmoti fibular fracture, or a fracture between the anterior and posterior syndesmoti ligaments.

C – refers to a supra-syndesmoti diaphyseal fibular fracture.

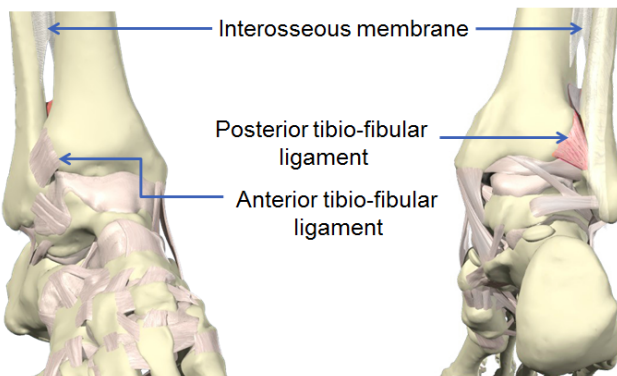


What is the syndesmosis?

There are several ligaments/membranes referring to the syndesmosis or structures which hold the tibia and fibula in position.

These are:

- the interosseous membrane
- the syndesmoti ligaments
 - posterior tibio-fibular ligament
 - anterior tibio-fibular ligament



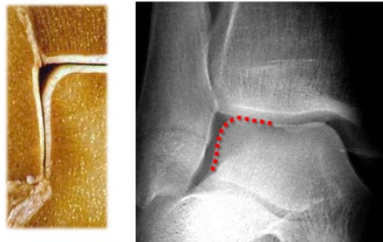
Goal of reduction

The goal of reduction is restoration of articular congruity. In order to achieve a congruent ankle joint:

1. The fibula should be restored to its original length and rotational alignment. An x-ray of the uninjured ankle will serve as a guide to reduction.



2. The small beak on the fibula must form a smooth curve with the tibial articular surface.



Treatment

Indications for nonoperative treatment

- Undisplaced and stable fractures (for example isolated B fracture of fibula).
- Clinically no injury of medial ligament.
- Patients with diabetes and impaired circulation. They have delayed healing entailing prolonged immobilization time in cast.
- Unfit patients or limbs (e.g. swollen).



Example of an indication for nonoperative treatment. This fracture is an isolated undisplaced 44B fracture of the lateral malleolus.

X-Ray control after 10 days is undertaken to check stability. If fracture displacement has occurred, then surgery must be considered.

Indications for operative treatment

Indications for operative treatment of ankle fractures are dictated by the stability of the ankle joint.

Indications for surgery are:

- Articular fractures
- Displaced fractures
- Unstable fractures



An important condition is that the soft tissue is in a good condition allowing surgery. Surgery involves open reduction and internal fixation (ORIF).

Example of an indication for operative treatment. This fracture is a displaced, unstable 44B2 injury.

Principles of fracture treatment— preoperative preparation

Preoperative preparation is very important. Before the surgery starts, many items must be prepared, checked and discussed.

- On clinical examination, it is important to assess condition of nerves and vessels.
- It is important to palpate the entire fibula because there may be an associated fracture proximally.
- Radiographic examination includes AP, lateral and mortise views (The mortise view is an anteroposterior x-ray taken with the ankle internally rotated some 10°-20°, so that the joint space between the lateral malleolus and the lateral facet of the talus is clearly seen).

Timing of surgery depends on

- Patient details—e.g., co-morbidities, such as diabetes, allergies etc.
- Status of soft tissue—good condition of soft tissues is the key to a successful outcome.

In all cases a displaced ankle fracture must be reduced and splinted immediately.

Because of the delicate soft-tissue cover over the two malleoli, the timing of surgery is crucial to avoid compromised healing.



If the ankle is very swollen and the skin looks like an orange peel and has blisters, definitive surgery is postponed, ankle and foot splinted and the limb elevated, until the swelling has reduced.

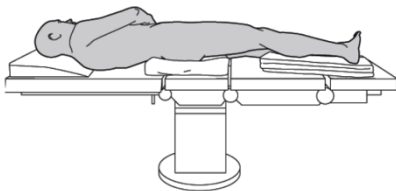


Temporary stabilization with a large spanning external fixator in a triangular configuration is recommended as splintage until soft tissues have recovered sufficiently to allow definitive surgery. This can take up to 15 days.

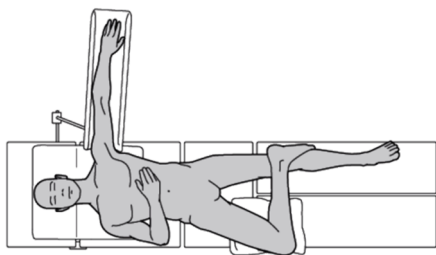


Positioning of the patient

- Position the patient.
 - The patient is positioned on a radiolucent operating table in supine position with supports under the hip. A sandbag under the ipsilateral buttock rotates the limb and allows lateral and posterolateral access. A support under the ankle positions the ankle joint laterally.



- The figure of 4 position affords good medial and posteromedial access.



- Perform a preoperative check;
 - correct patient
 - correct side
 - correct site

- Apply a tourniquet on the thigh of the affected side, but inflate it only if required.
- Position the image intensifier and screen on the opposite side from the injured leg.



Procedure of surgical treatment

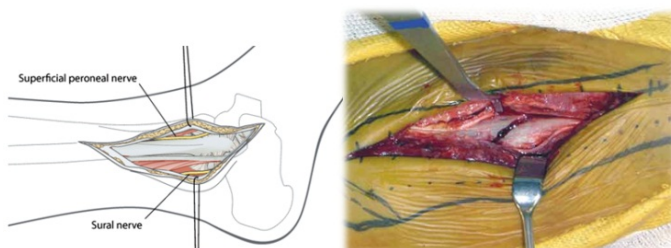
The surgical procedure follows generally the following steps:

1. **Lateral malleolus:** The operation is usually started laterally with the fibula. Generally, in B fractures, reduction of the fibula also reduces any posterior malleolar fragment (Volkman triangle).
2. **Medial malleolus:** If reduction is difficult, the medial side should be exposed to clear any soft tissue trapped in the medial side of the ankle joint.
3. **Posterior malleolus:** Fixation of a posterior malleolus fracture is only required if the fragment bears more than one quarter of the tibial articular surface, as seen on the lateral x-ray of the ankle.
4. **Syndesmosis:** If the syndesmotic ligament is ruptured, a positioning screw, between the fibula and tibia, may be needed, provided the fibular fracture has been reduced, thereby restoring length and rotational alignment.

Lateral malleolus

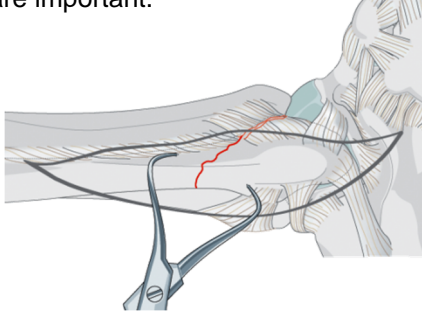
1. Approach

A 10-15 cm straight lateral incision over the distal fibula is made.



2. Reduction

The fracture is reduced anatomically. Reduction of both length and rotation are important.

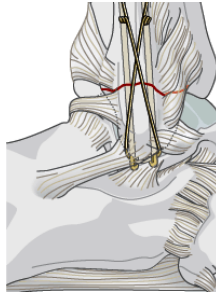


3. Fixation (options)

- A 3,5 mm cortex screw is inserted as a **lag screw**. A **neutralization (protection) plate** is added.



- Other options for fixation are **tension band wiring** and...



- ...intra medullary fixation of the fibula with a **large screw**.



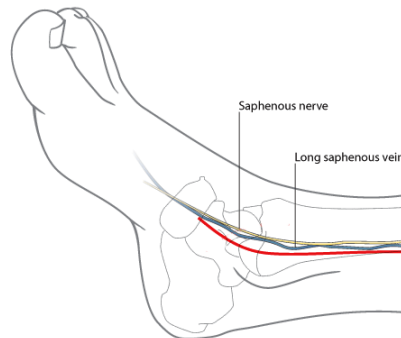
The distal screws in the fibula do not penetrate the joint. The position must be checked with the image intensifier.

Medial malleolus

1. Approach

- Incision

The incision starts 2 cm distal to the anterior tip of the medial malleolus and curves towards the anterior edge of the medial malleolus and in the direction of the middle of the distal tibia.



The saphenous vein and nerve are retracted with a vessel loop.

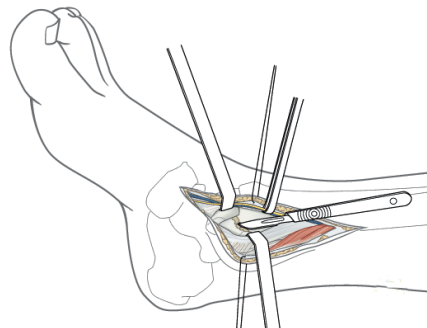
The fracture is exposed and any interposed soft tissue that may be preventing reduction is removed.

Note

Be careful not to damage the saphenous vein and nerve, especially distally.

- Inspection of joint

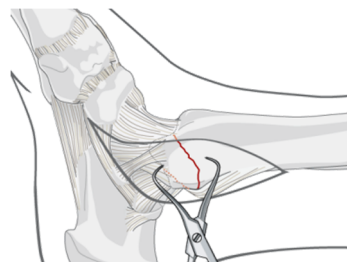
The anterior part of the fracture site is exposed, the periosteum is removed from the edges of the medial malleolus to the distal tibial joint surface and the joint inspected.



If necessary, a vertical incision at the anteromedial edge of the joint capsule is made. The capsule is dissected as far as necessary to visualize the fracture and the joint surfaces.

2. Reduction

The fracture is reduced anatomically.

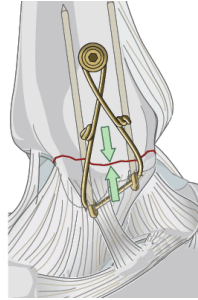


3. Fixation

- The medial malleolus is fixed with two **partially threaded cancellous bone screws 4,0 mm**.



- If the quality of the bone is not so good, or the fragment is small, a **tension band wiring** can be used.



- If the fragment is large and the fracture plane is vertical, as in some type A fractures, the fracture is fixed with a **medial buttress plate**.

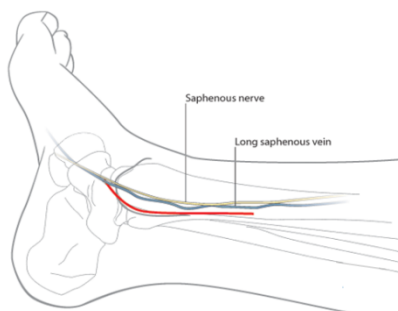


Posterior malleolus

1. Approach

This approach is indicated in cases of posterior comminution and/or posterior extension of a medial malleolar fracture.

- The incision starts 1 cm distal and 1 cm anterior to the middle of the tip of the medial malleolus. The incision curves proximally and posteriorly over the tip of the medial malleolus and then follows the direction of the posterior crest of the distal tibia.



Note

Be careful not to damage the saphenous vein and nerve, especially distally.

2. Reduction

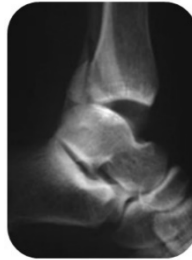
The fracture is reduced anatomically.

3. Fixation

Posterior malleolar fractures of significant size are usually associated with B fracture patterns.

Fracture fixation of the posterior malleolus should be undertaken:

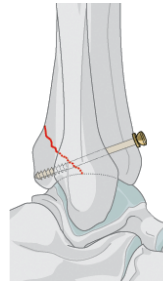
- After the medial and lateral malleoli have been reduced and fixed anatomically.
- If there is persistent posterior subluxation of the talus.



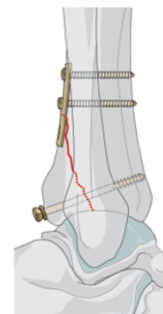
- If the posterior fragment bears more than 20-25% of articular surface.



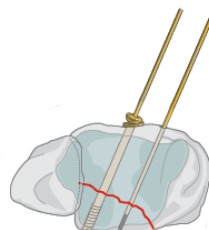
- Antero-posterior screw fixation is usually with **one or two partially threaded cancellous bone screws**, after reduction and temporary K-wire stabilization.



- In large, long fragments, fixed via a posterolateral approach, a **small buttress plate (1/3rd tubular plate 3.5)** can be added.



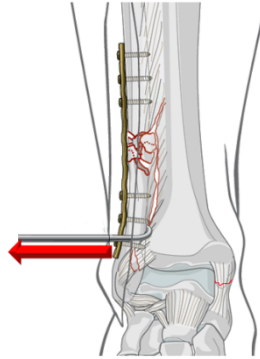
- **Cannulated screws** can be used if they are available in the OR.



Syndesmosis

1. Stability testing

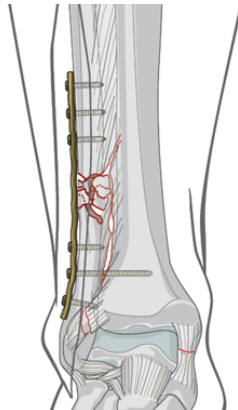
After plating of the fibular shaft in type C fractures, if there is no anterior tibial tubercular fracture, then stability of the syndesmosis is tested by attempting to distract the fixed fibula from the tibia, using a bone hook.



2. Fixation

Fixation of the syndesmosis is only necessary if the hook test is unstable.

- The fully threaded positioning screw(s) must grip in all 3 cortices.
- In certain fracture types 2 screws must be used (Maisonneuve injury).
- The position screw should be above, not through, the inferior tibio-fibular syndesmosis.
- The position screw may be inserted through the fibular plate.



3. Removal of position screw (syndesmosis screw)

- Remove the position screws in young and active patients after 8-12 weeks.
- In very unstable fractures (Maisonneuve injuries), in smokers, or in patients with diabetes, wait a least 12 weeks.
- If not removed, the screw may eventually break.



Aftercare

- Apply a plaster of Paris back-slab to the lower leg with the foot in neutral position.
- Start physiotherapy on postoperative day 1, with active range of motion exercises out of the splint, reapplying splint after exercise.



- Allow immediate partial weight bearing (10-15kg) to cooperative patients.
- Apply a short leg cast once a good range of motion is obtained.
- Remove sutures and make X-ray after 2-3 weeks.
- Weight bearing once full bone and ligamentous healing is assured (6-10 weeks), depending on fracture pattern.
- Eventually remove the syndesmosis screws after 8-12 weeks if bone healing is satisfactory.

Summary

You should now be able to:

- describe principles of malleolar fracture classification
- outline indications for nonoperative and surgical treatment
- discuss principles of malleolar fracture fixation

Questions

1. **What is the syndesmosis?**
 2. **What are the indications for operative treatment?**
- **Which implant is most commonly used for fixation of a lateral malleolar fracture?**

Reflect on your own experiences

- **How are in general malleolar fractures treated in your hospital?**
- **What would you take out this lecture and transfer into your practice?**

Acknowledgement

All anatomical pictures are used from the 3D human anatomy software Primal Pictures.

