

Bløddelenes biologi og betydning for knogleheling

Disclosure: No potential conflicts of interest

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I have no financial relationships with commercial entities that produce health-care related products.

Learning objectives

Forstå bløddelenes betydning for knogleheling

Prioritere behandlingen af bløddelsskader

Gennemgå strategi for behandling af brud med samtidig bløddelsskade

There is a fracture..



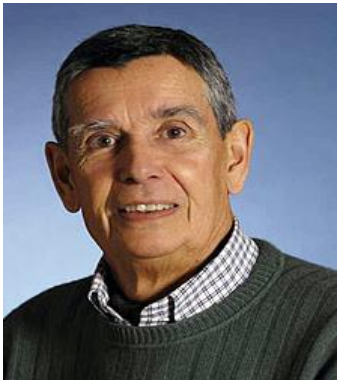
There is a fracture..



Bløddele



*“a fracture first and foremost is a soft-tissue injury,
in which the bone happens to be broken”*



Thomas P Rüedi, MD, Professor, Founding and honorary
member of the AO Foundation

Bløddele



“ ... the bone is a plant, with its roots in the soft tissue, and when its vascular connections are damaged, it often requires, not techniques of a cabinet maker, but the patient care and understanding of a gardener”.

Gathorne Girdlestone 1881 - 1950



En fraktur består af:

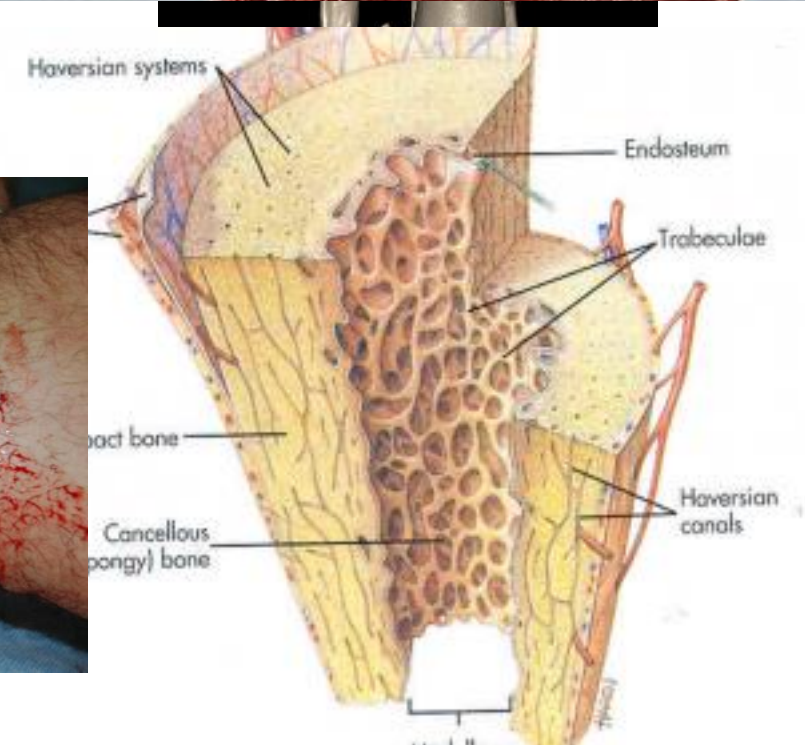
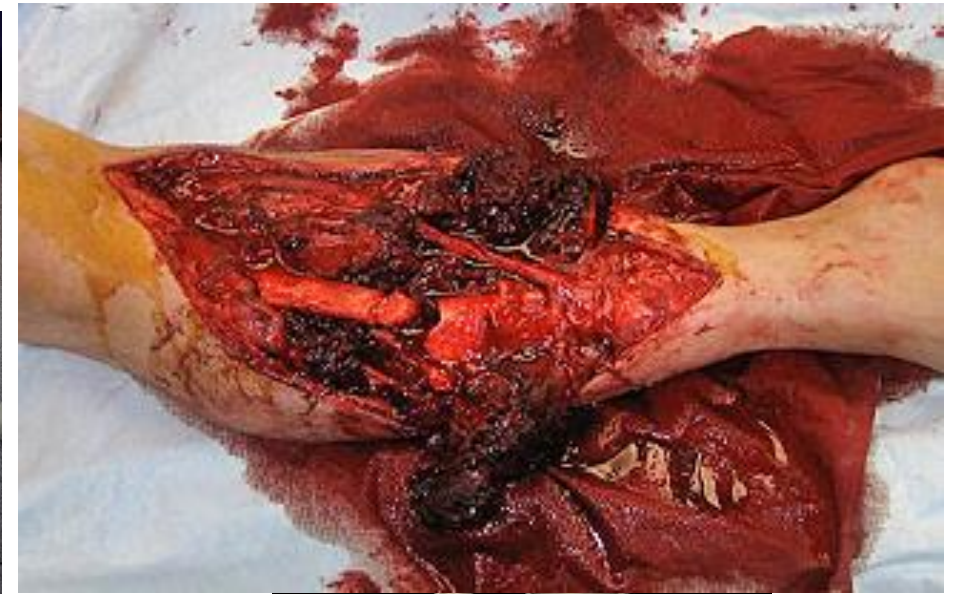
Knogle

Periost

Muskel (med fascie)

Subcutis

Hud



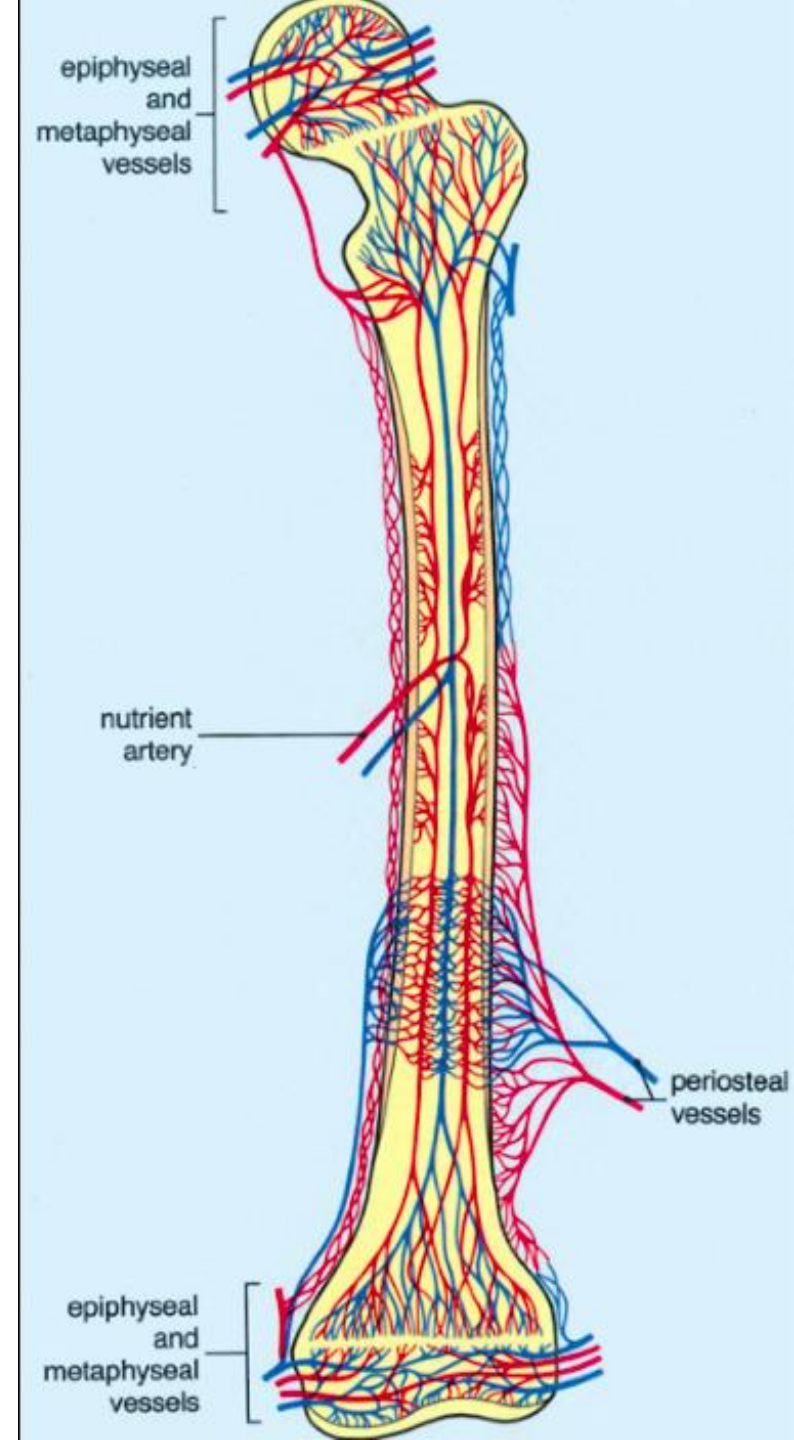
Blodforsyningen til knoglen

Ydre 1/3 - Periost

- Forsynet af periostale kar fra navngivne arterier
- Disse kar penetrerer dér, hvor fascie eller ligament hæfter

Indre 2/3 – Endost

- Forsynet af a. nutriciae, der deles i arterioler, som så forsyner hele endostiet



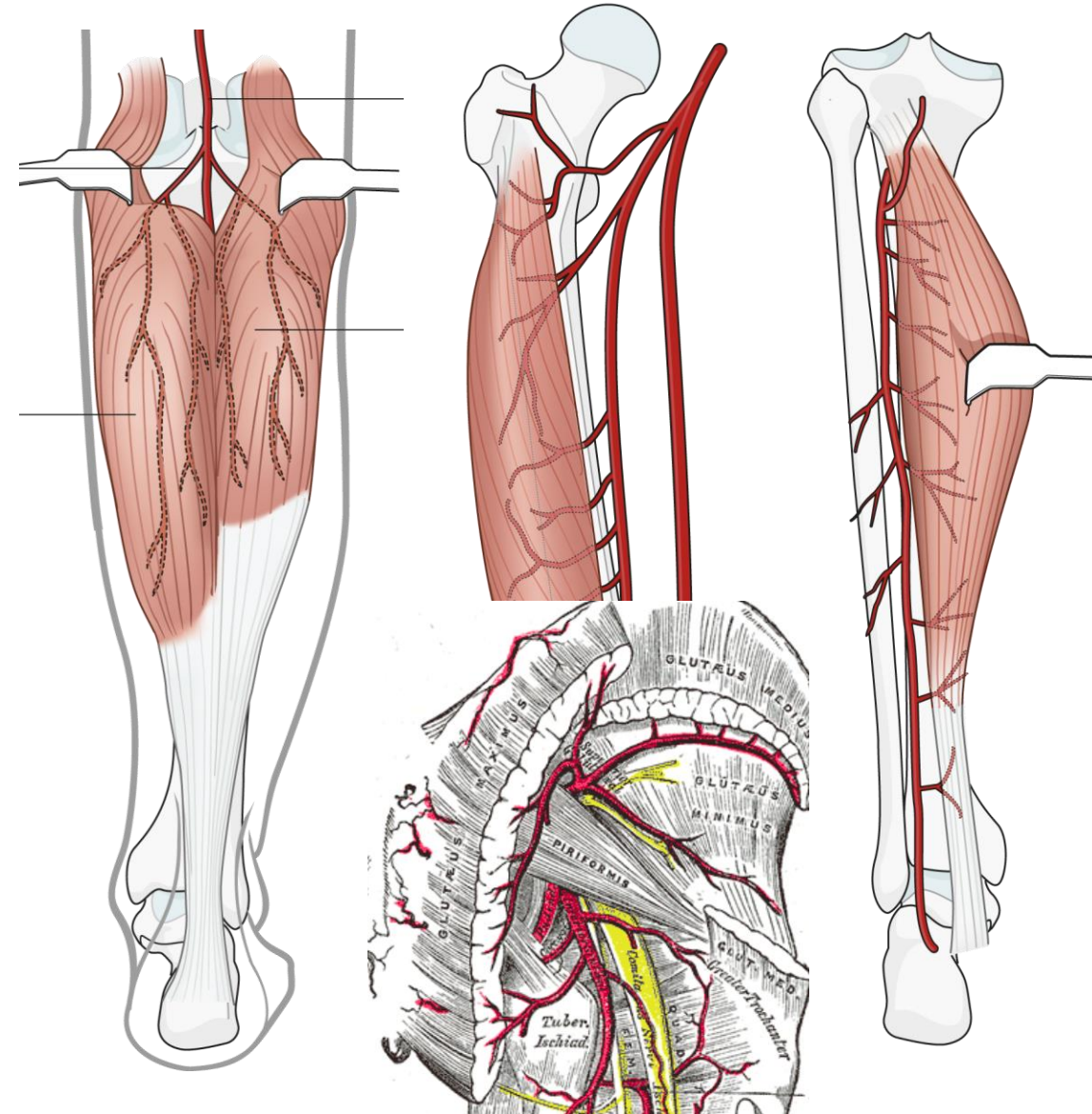
1. Rhinelander FW. Tibial blood supply in relation to fracture healing. *Clin Orthop Relat Res.* 1974 Nov-Dec;(105):34–81.
2. Nelson GE Jr, Kelly PJ, Peterson LF et al. Blood supply of the human tibia. *J Bone Joint Surg Am.* 1960 Jun;42-A:625–636

Blodforsyningen til musklen

Kommer normalt fra navngivne arterier

Forskellige mønstre af blodforsyning

- Single pedicle (proximal)
- Single major pedicle + multiple minor pedicles
- Two major pedicles (m. glut. max.)
- Segmental pedicles

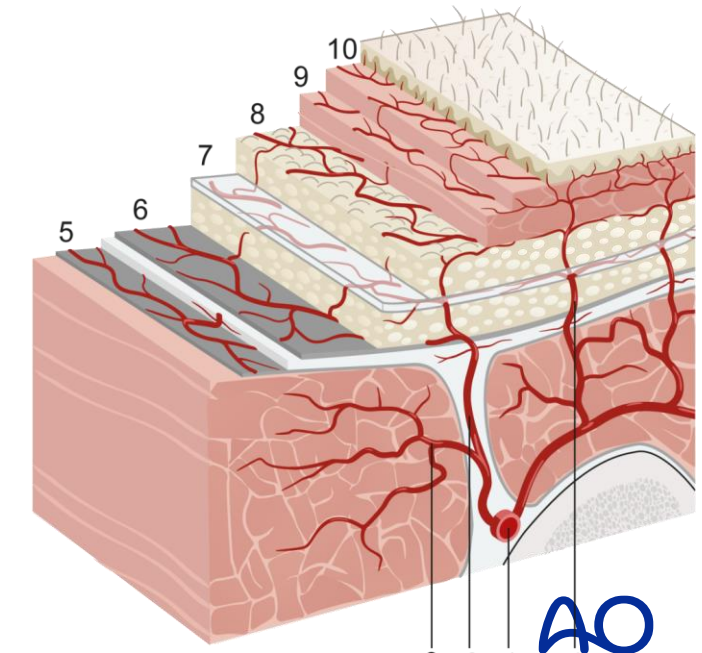
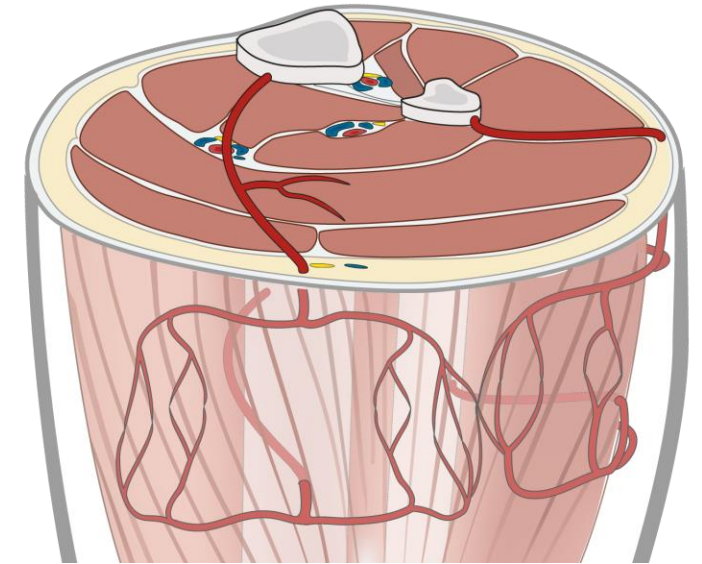


Blodforsyningen til huden

Direkte relateret til perforanterne

Perforanterne kommer gennem musklerne fra navngivne arterier

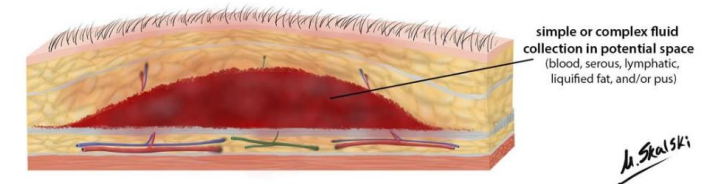
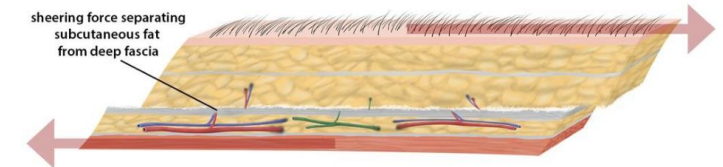
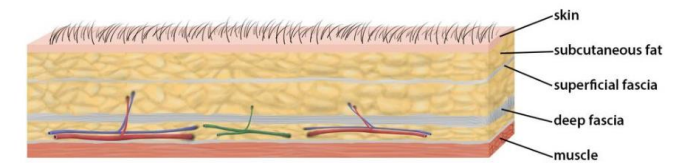
Pas på (!!)



Blodforsyningen til huden



Morel-Lavallée mechanism



Alt kirurgi ville være lettere uden bløddele, men...

Hud er den primære barrier ifht. infektion

Muskel

- Sørger for blodforsyning til huden
- Er nødvendig for bevægelse
- Beskytter knoglen

Periost

- Sørger for blodforsyning til knogle (ydre 1/3)

Altså respektér bløddelene – **kirurgiske teknikker!**



Beskrivelse af bløddele efter skade

Rent deskriptiv

AO soft-tissue classification

Gustilo klassifikation (åbne frakturer)



AO soft-tissue classification

Integumentum closed (IC)

- IC 1 = no skin injury
- IC 2 = contusion without skin laceration
- IC 3 = local degloving
- IC 4 = extensive, closed degloving
- IC 5 = necrosis due to deep contusion

Integumentum open (IO)

- IO 1 = skin perforated from inside out
- IO 2 = skin perforation from outside < 5 cm
- IO 3 = local degloving, contusion > 5 cm
- IO 4 = loss of skin, deep contusion
- IO 5 = open degloving

Neurovascular injury (NV)

- NV 1 = no injury
- NV 2 = isolated nerve injury
- NV 3 = local vascular injury
- NV 4 = combined neurovascular injury
- NV 5 = sub/total amputation

Muscle and tendon injury (MT)

- MT 1 = no injury
- MT 2 = isolated (one group)
- MT 3 = two or more groups
- MT 4 = loss of muscle groups, tendon
- MT 5 = compartment/crush syndrome

Åben fraktur klassifikation

Gustilo	
Type I	• Low energy • Minimal soft-tissue damage • Wound < 1 cm
Type II	• Higher energy • Laceration > 1 cm • No flaps/crushing minimal contamination • Slight comminution
Type IIIA	• High energy • Adequate soft-tissue coverage despite flaps/lacerations • Comminution/segmental fracture
Type IIIB	• High energy • Extensive soft-tissue stripping • Inadequate cover • Massive contamination
Type IIIC	• Vascular injury requiring repair

Infektion og Gustilo grad

Metaanalyse, åbne tibiafrakturer

Marvsømmet

Fracture grade	Number of studies	Number of fractures	Number of infections
I	9	469	18 (4%)
II	10	510	33 (6%)
III, A	7	186	31 (17%)
III, B-C	6	109	25 (23%)

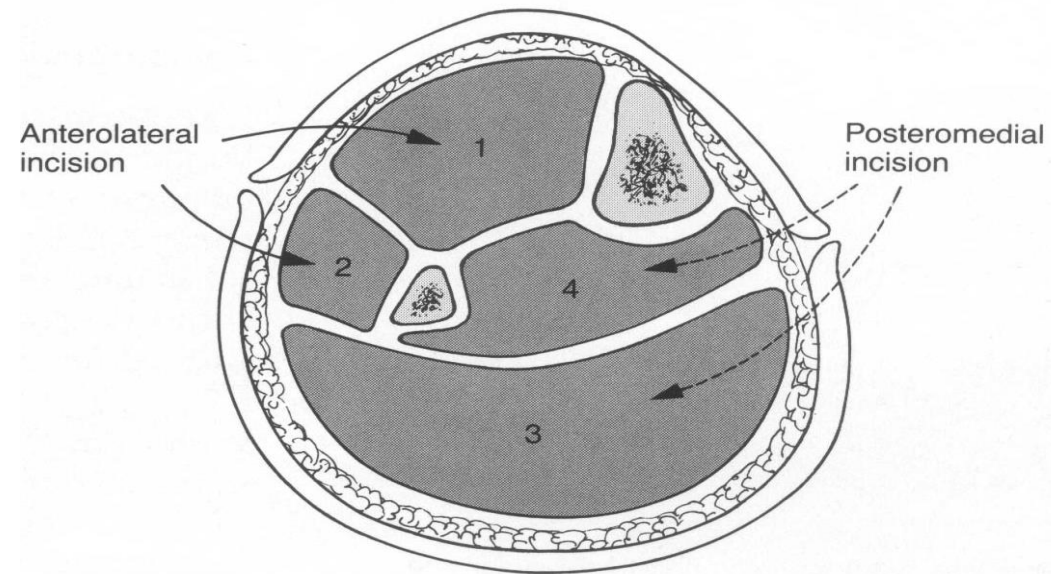
Healing og Gustilo grad

Gustilo grade, tibial fracture	Time to union
I	15 weeks
II	24 weeks
IIIA	27 weeks
IIIB	38 weeks
IIIC	74 weeks

Compartment syndrom

Dekompression af compartment

- Minimere yderligere bløddels skade
- Lange incisioner



I skadestuen

ATLS – liv før lemmer

Åben fraktur:

- IV AB asap + tetanus
- Én eksposition
 - Værste snavs væk
 - Klinisk foto
- Fugtig meche + steril bandage
- Immobilisering + rtg

Kar-/nerveforhold?

Compartmentsyndrom?



Ud over fraktur og bløddele..

Pt faktorer

- Medicin
- Komorbiditet
- Rygning
- Forventninger
- Andre skader

Energi

- Lav- vs højenergi

Team

- Har vi grejet?
- Er det mig der skal lave det?
- Specialeplan?

Infrastruktur

- Præhospitalt
- Sygehus

Take-home messages

En fraktur er (desværre) ikke bare en brækket knogle

Anerkend bløddelenes betydning for knogleheling

Hav kendskab til blodforsyning til både hud, muskel og knogle

Vær i stand til at vurdere og beskrive bløddelene

Mange faktorer bestemmer udkommet

Husk liv før lemmer

Spørgsmål?