

# BLØDDELENES BETYDNING FOR KNOGLEHELING

15 MIN.

AO TRAUMA COURSE – BASIC PRINCIPLES OF FRACTURE MANAGEMENT

FREDERICIA 23-26/4-2019

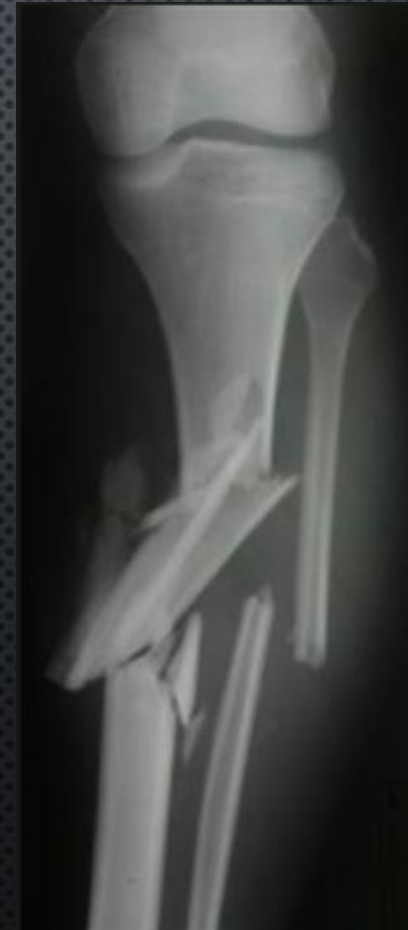
JEPPE BARCKMAN



Aarhus Universitetshospital



**THERE'S A FRACTURE AND I NEED TO FIX IT!**



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BLØDDELE !



THOMAS P RÜEDI, MD, PROFESSOR, FOUNDING AND HONORARY MEMBER OF  
THE AO FOUNDATION

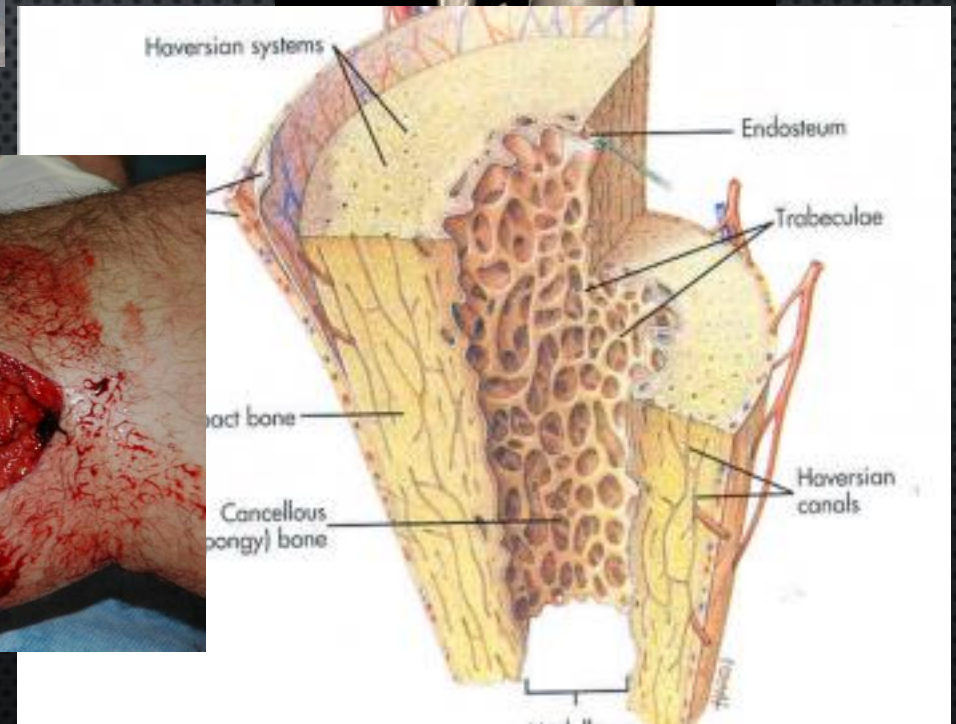
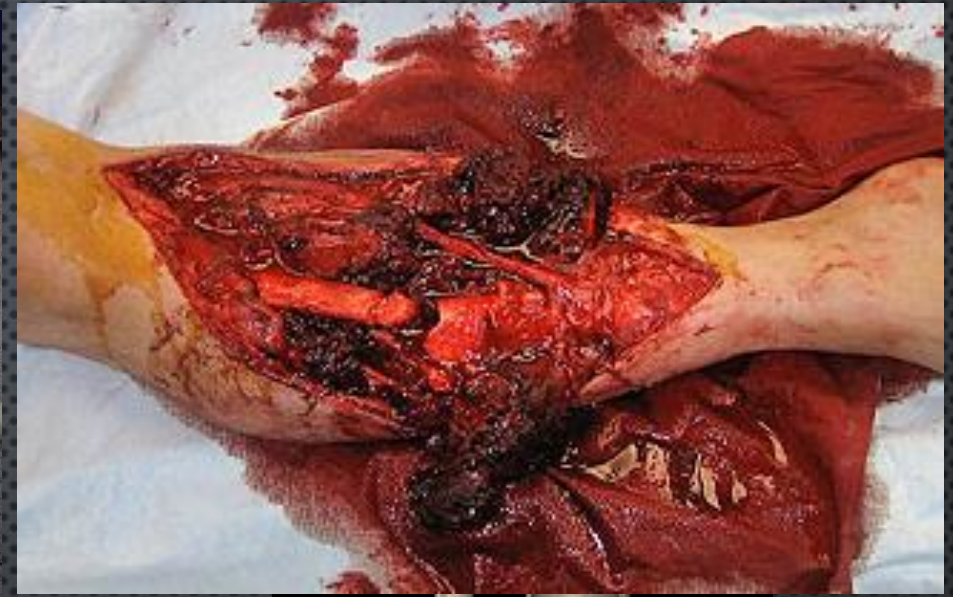
*“A FRACTURE FIRST AND FOREMOST IS A SOFT-  
TISSUE INJURY, IN WHICH THE BONE HAPPENS  
TO BE BROKEN”*

# LEARNING OUTCOMES

- FORSTÅ BLØDDELENES BETYDNING FOR BRUD HELING
- PRIORITERE BEHANDLINGEN AF BLØDDELSSKADER
- GENNEMGÅ STRATEGI FOR BEHANDLING AF BRUD MED SAMTIDIG BLØDDELSSKADE
- COMPARTMENT SYNDROM

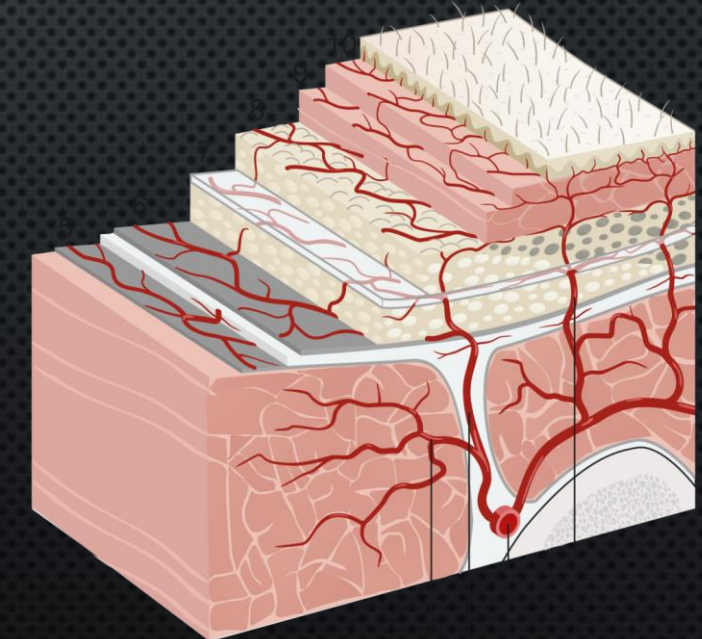
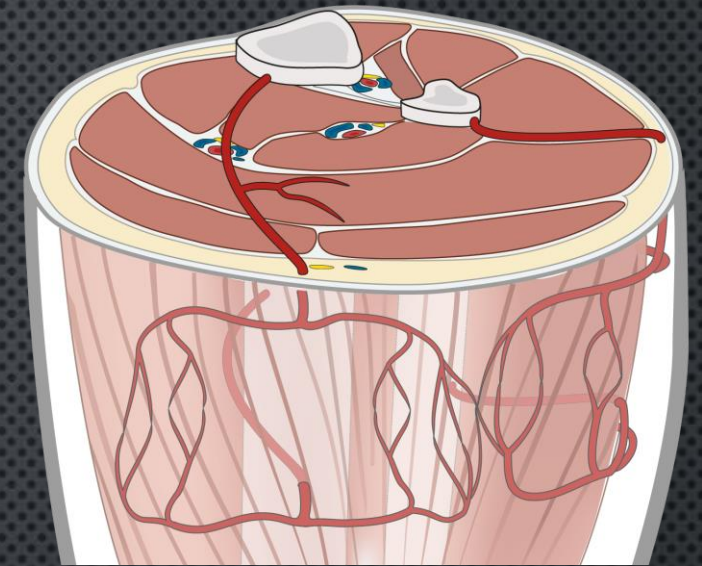
# EN FRAKTUR BESTÅR AF:

- KNOGLE!
- PERIOST
- MUSKEL (MED FASCIE)
- SUBCUTIS
- HUD



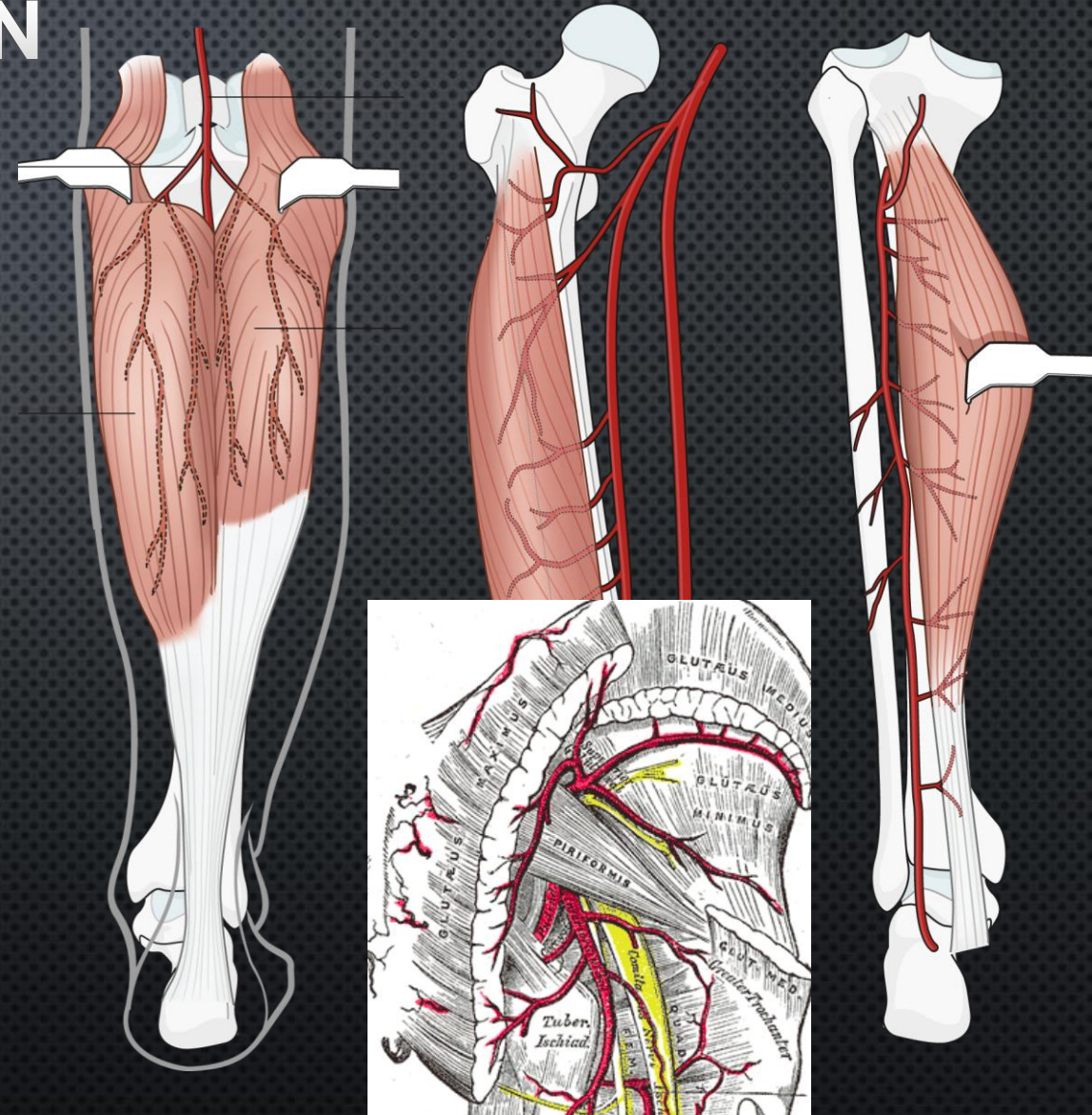
# BLODFORSYNINGEN TIL HUDEN

- DIREKTE RELATERET TIL PERFORANTERNE
- PERFORANTERNE KOMMER GENNEM MUSKLEN FRA NAVNGIVNE ARTERIER
- CAVE KNOGLER UDEN MUSKELDÆKKE!



# 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





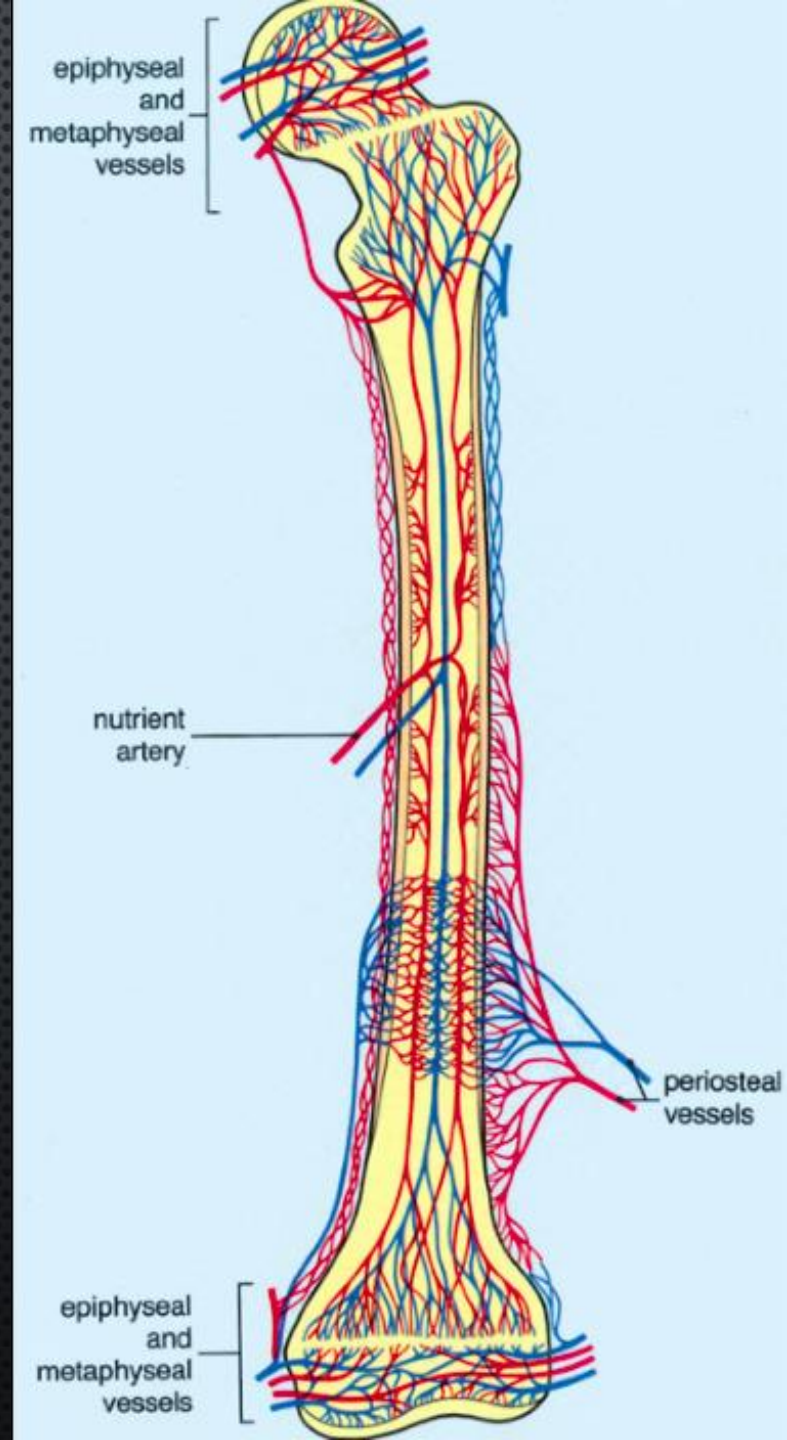
# BLODFORSYNINGEN TIL KNOGLEN

## YDRE 1/3

- FORSYNET AF PERIOSTALE KAR FRA NAVNGIVNE ARTERIER
- DISSE KAR PENETRERER DÉR, HVOR FASCIE ELLER LIGAMENT HÆFTER

## INDRE 2/3

- FORSYNET AF A. NUTRICAE, 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

# 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)
  - SØRGER FOR OSTEOPROGENITOR CELLER TIL KNOGLE

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

# OPEN FRACTURE CLASSIFICATION

| Gustilo          |   |
|------------------|---|
| <b>Type I</b>    | <ul style="list-style-type: none"><li>• Low energy</li><li>• Minimal soft-tissue damage</li><li>• Wound &lt; 1 cm</li></ul>   |
| <b>Type II</b>   | <ul style="list-style-type: none"><li>• Higher energy</li><li>• Laceration &gt; 1 cm</li><li>• No flaps/crushing minimal contamination</li><li>• Slight comminution</li></ul> |
| <b>Type IIIA</b> | <ul style="list-style-type: none"><li>• High energy</li><li>• Adequate soft-tissue coverage despite flaps/lacerations</li><li>• Comminution/segmental fracture</li></ul>      |
| <b>Type IIIB</b> | <ul style="list-style-type: none"><li>• High energy</li><li>• Extensive soft-tissue stripping</li><li>• Inadequate cover</li><li>• Massive contamination</li></ul>            |
| <b>Type IIIC</b> | <ul style="list-style-type: none"><li>• Vascular injury requiring repair</li></ul>  |

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# INFEKTION OG GUSTILO GRAD

- METAANALYSE
- ÅBNE TIBIAFRAKTURER
- BEHANDLET MED MARVSØM

| 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%)             |

# HELING 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      |

# MANGEL PÅ BLØDDELE ELLER ØDELAGTE BLØDDELE?

1. DEBRIDEMENT OG PRIMÆR LUKNING (HVIS MULIGT OG KIRURGEN ER MODIG)
2. SEKUNDÆR SUTURERING
3. SEKUNDÆR SUTURERING FORUDGÅET AF VAC-BEHANDLING
4. SPLITSKIN OVEN PÅ GRANULATIONSVÆV (CAVE OVER LED, SENESKEDE, KNOGLE)
5. Z-PLASTIKKER
6. LOKALE LAPPER (ROTATIONS-/SVINGLAPPER)
7. FRIE LAPPER

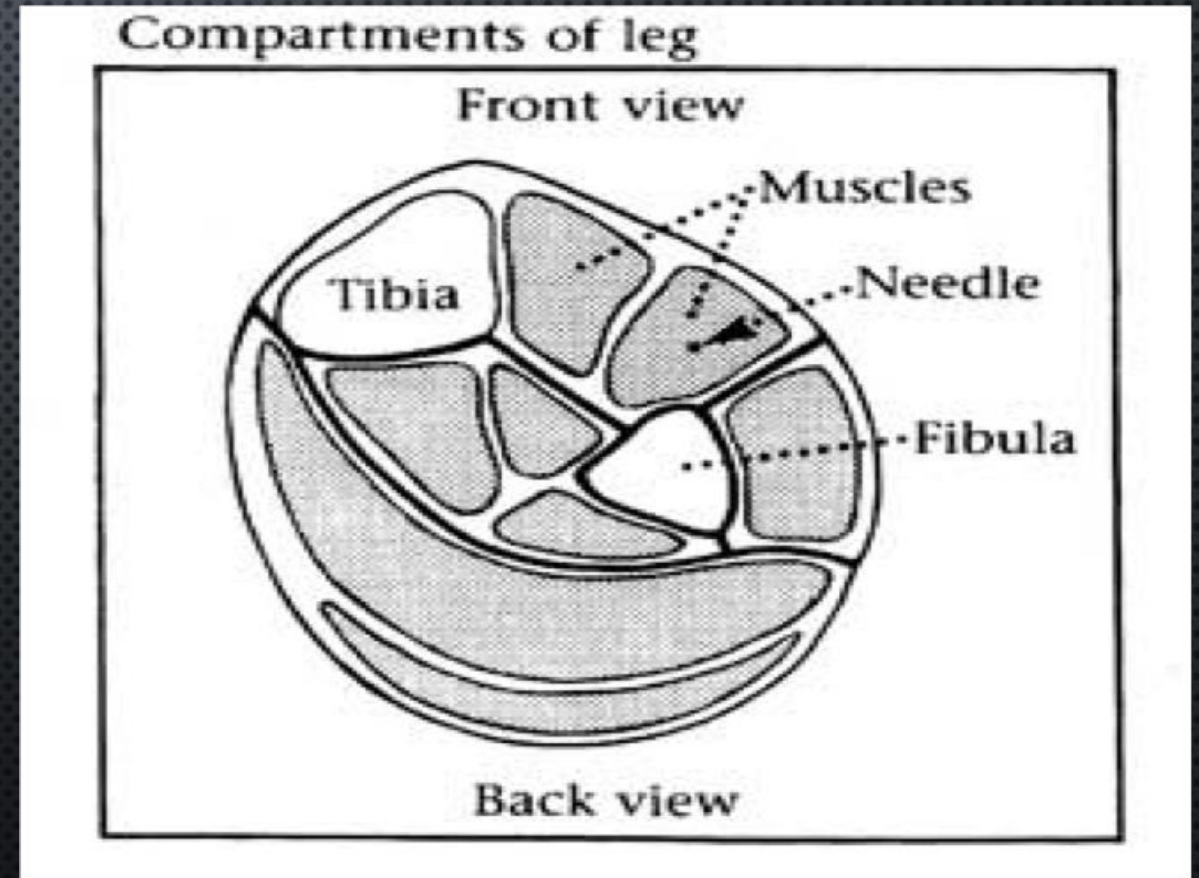


# COMPARTMENT SYNDROM



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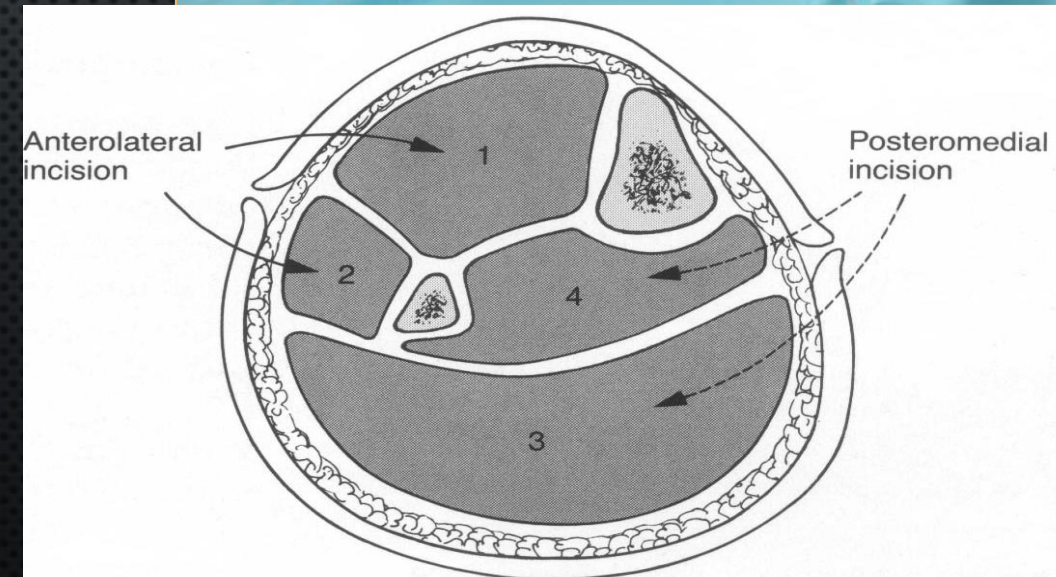
- INCIDENCE:
  - 5-15%
- ANAMNESE
  - HØJ-ENERGY
  - KNUSNINGS SKADER
- KLINIK
  - 6 P's
    - PAIN
    - PAIN WITH PASSIVE STRETCH
    - PARAESTHESIA
    - PULSLESS
    - PALLOR
    - PARALYSIS



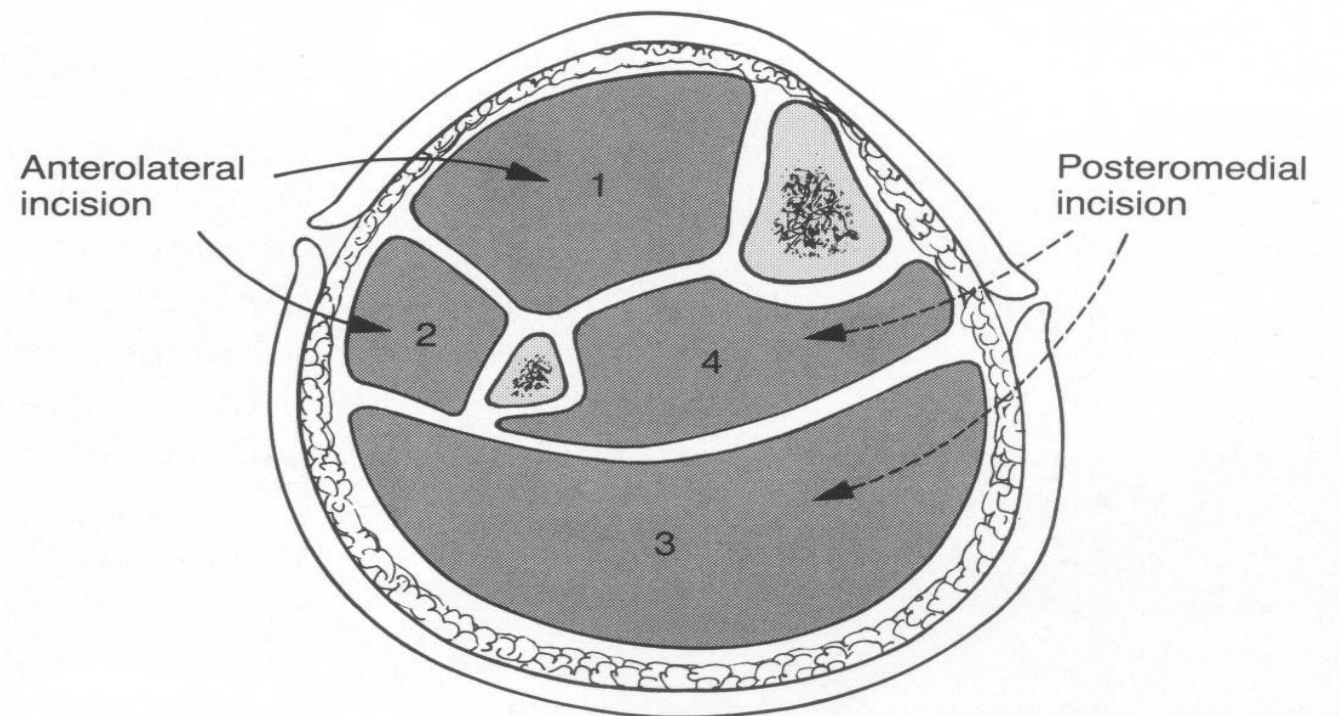
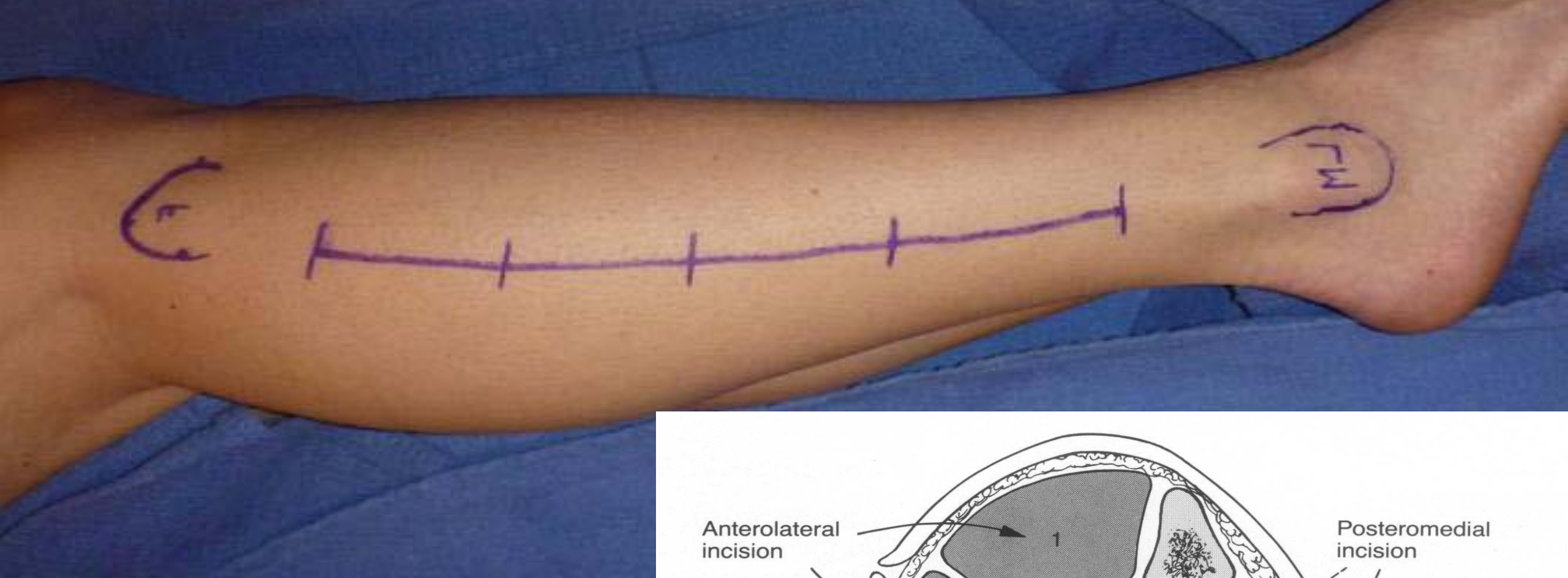
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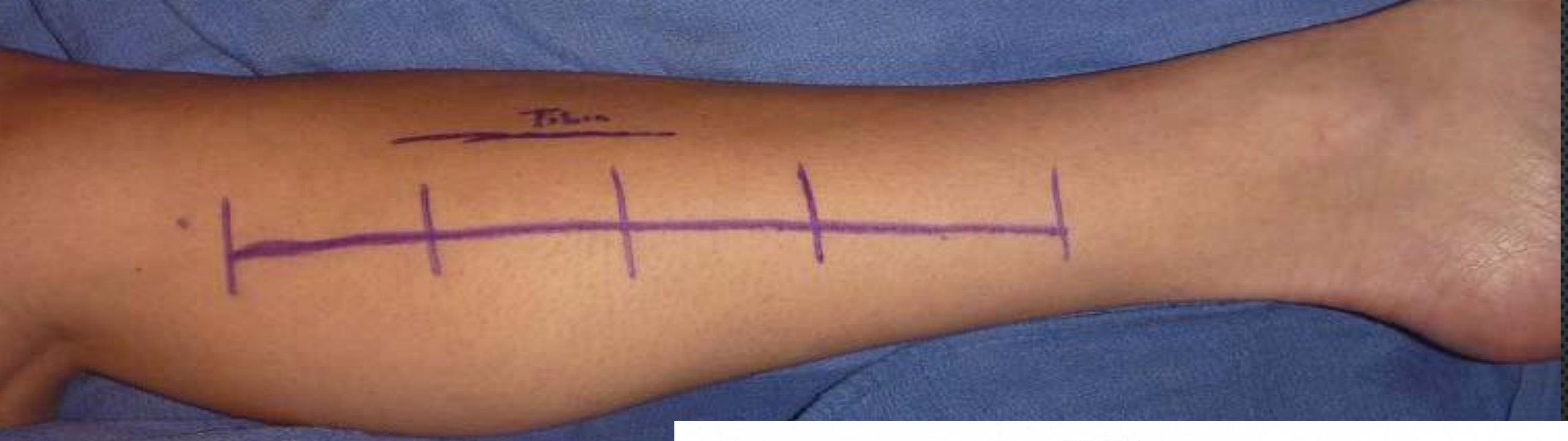
## MÅL MED FASCIOTOMI

- DEKOMPRESSION AF COMPARTMENT
  - MINIMERE YDERLIGERE BLØDDELS SKADE
- SINGLE VS. DOBBEL INCISION
  - INGEN KLINISK FORSKE, MEN STØRRE RISIKO VED SINGEL INCISION FOR INSUFFICIENT DEKOMPRESSION
- LANGE INCISIONER



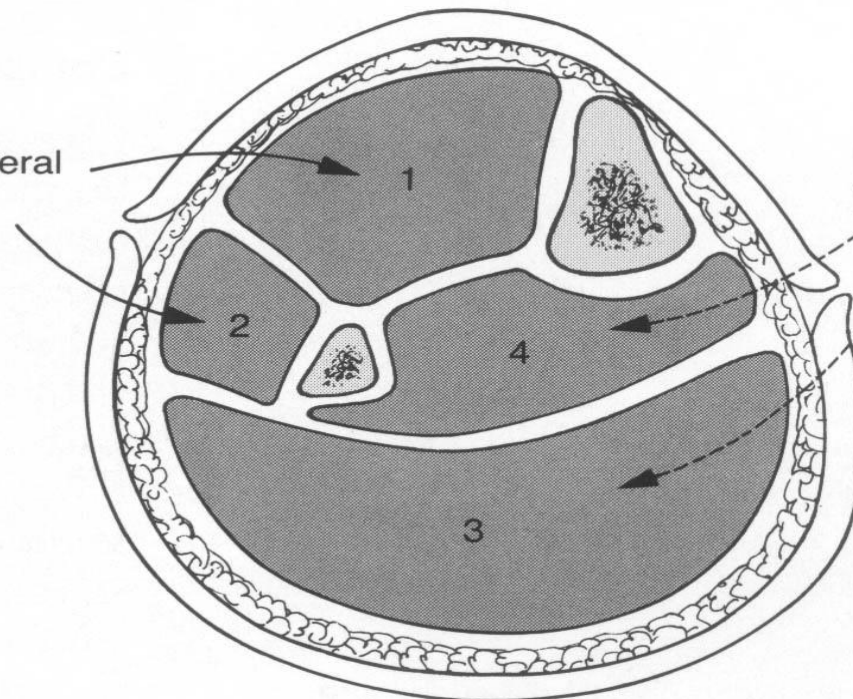






Anterolateral incision

Posteromedial incision



# TAKE HOME MESSAGE

- 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
- KEND BEHANDLINGSTEKNIKKER – OG HVEM DER SKAL TAGE SIG AF DE KOMPLEKSE CASES
- IDENTIFICERE COMPARTMET SYNDROM OG KENDE TIL PRINCIPPERNE I BEHANDLING