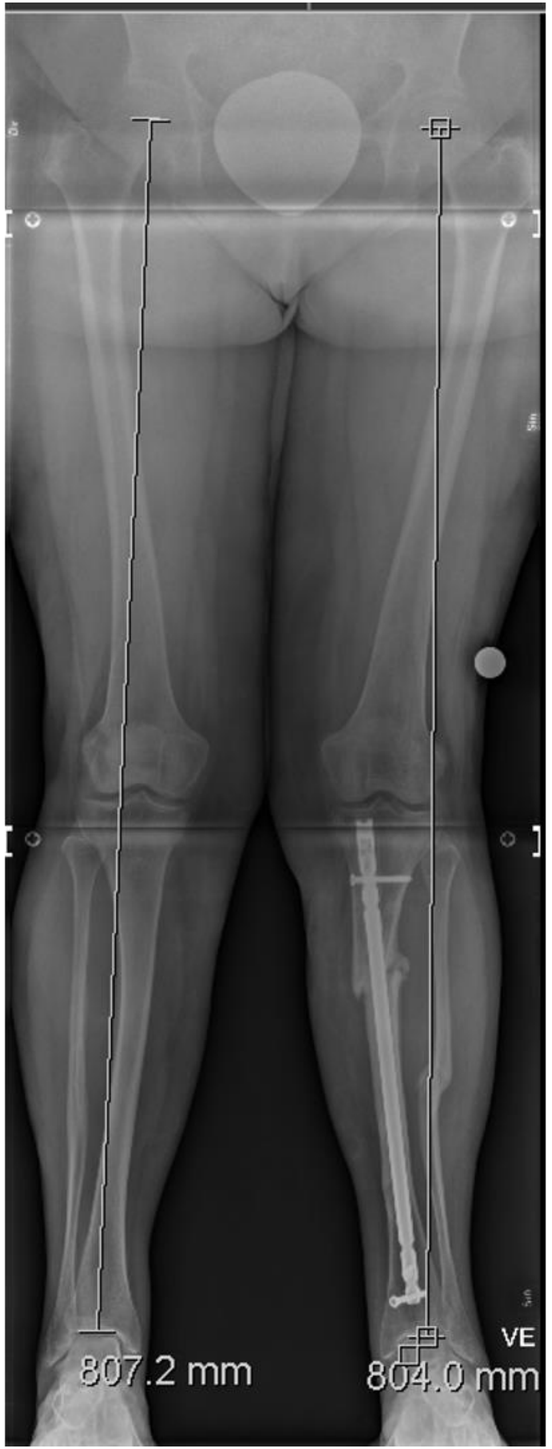
Principles, violation of principles. Delayed union, mal-union og non-union

Juozas Petruskevicius, Aarhus Universitetshospital

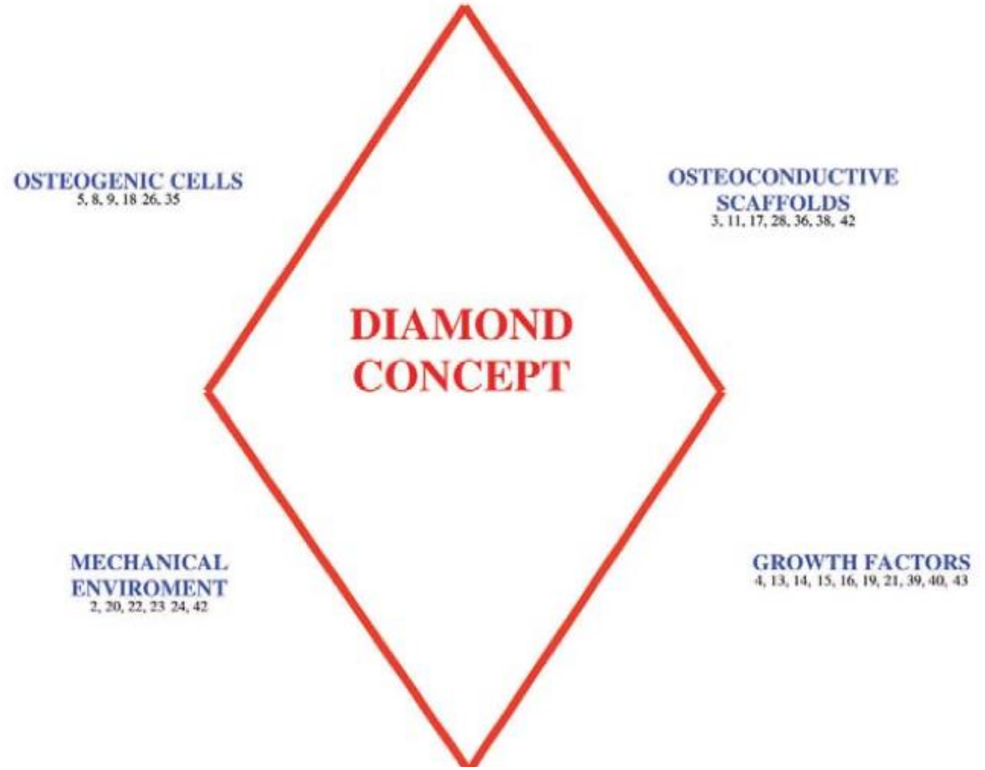
AO-Basic, April 2023



Betingelser for knogleheling

Vitalitet

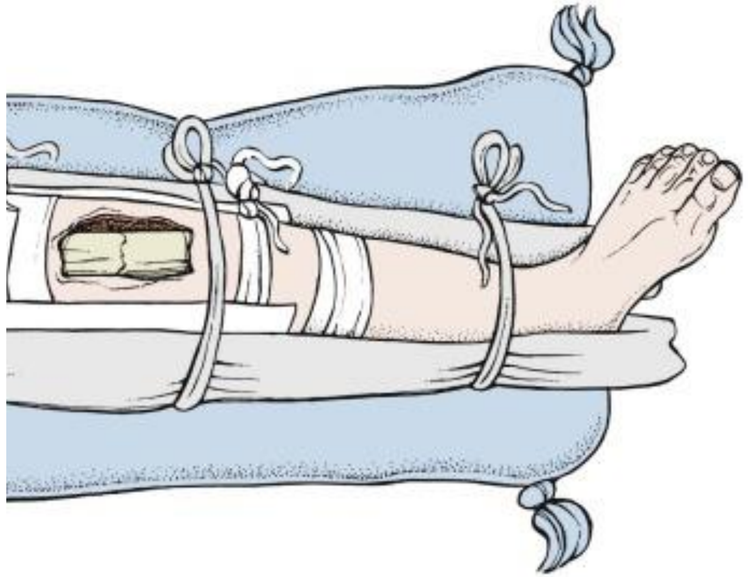
Fracture healing: the diamond concept



Can we accelerate fracture healing?
A critical analysis of the literature

Peter Giannoudis[1], Spyridon Psarakis[1], George Kontakis[2]

Stabilitet

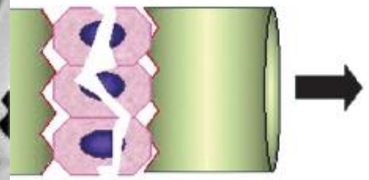


Mechano-biology

ability of the body's physiological
processes to respond to the mechanical environment

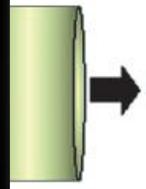
Physical and Biological Aspects of Fracture Healing with Special Reference to Internal Fixation

S. M. PERREN, M.D.

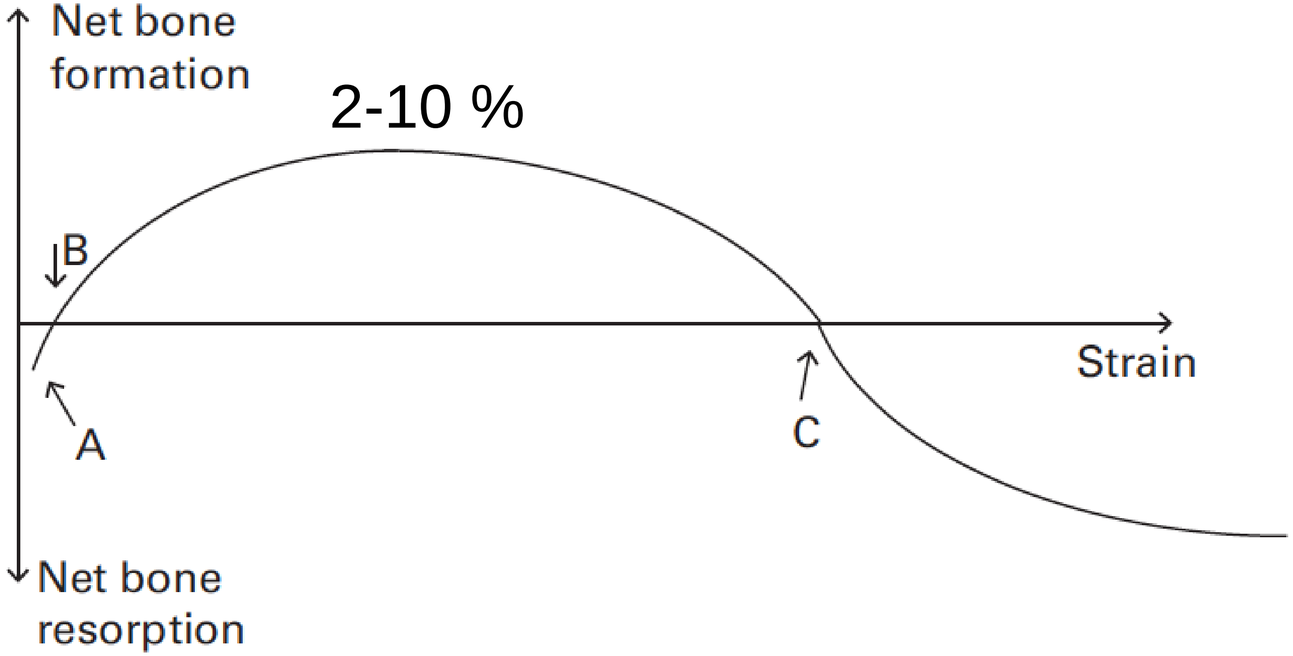


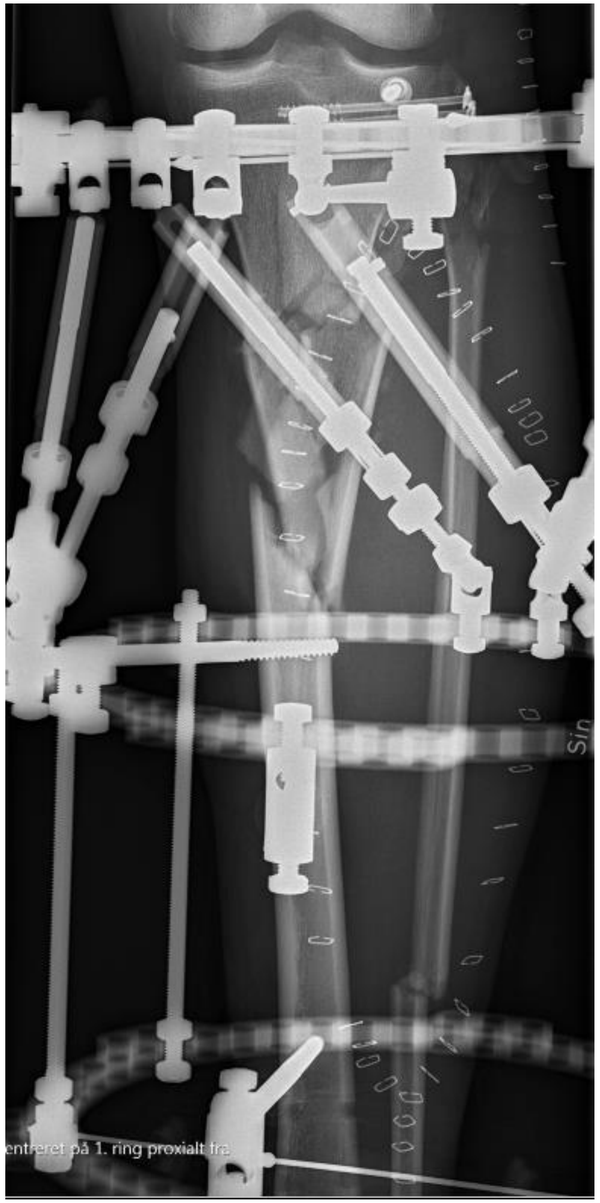
high strain → no healing

Fig. 1b



healing





Mechano-biology

■ ANNOTATION: TRAUMA

A unified theory of bone healing and nonunion

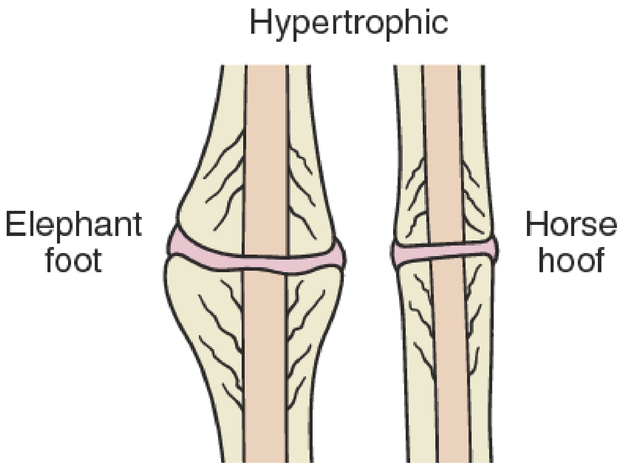
BHN THEORY

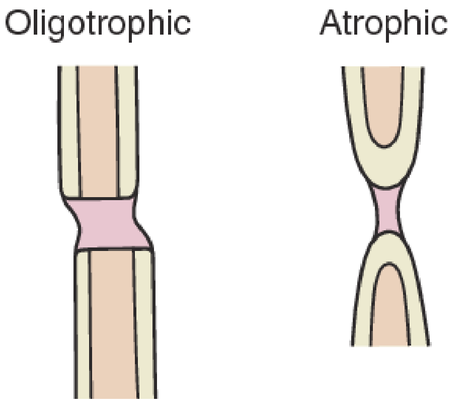
Ikke som forventet

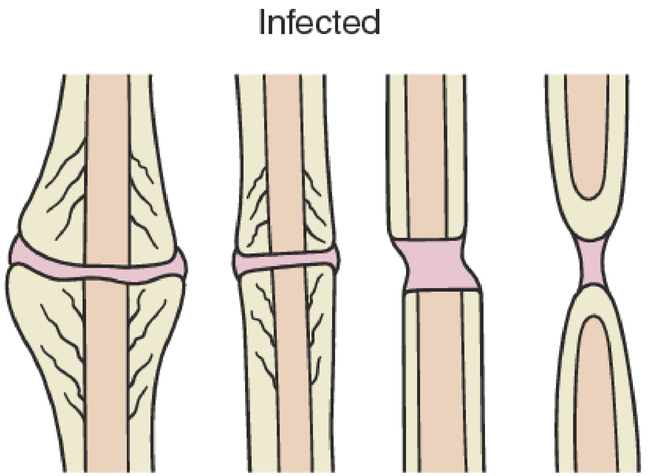
Non-unions typer

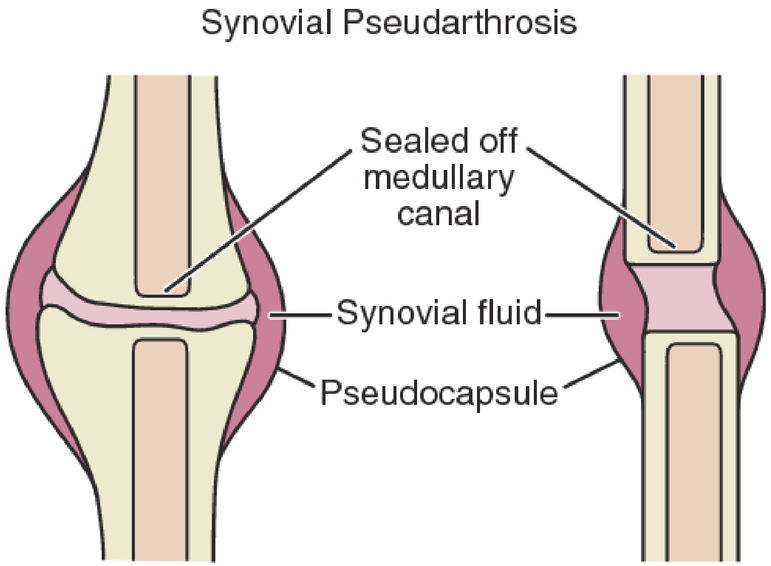
Risiko faktorer

- Åben fraktur
- Rygning
- Diabetes
- Hypothyroismus
- Intern fiksation af en simpel fraktur med et gab
- Specifik lokalisation
  - skrå distal tibiafraktur
  - os scaphoideus fr,
  - Jones fr









Diagnostik

- Clinical exam
  - Neurovascular
  - Wound/Scars
  - Deformity
  - **Mobility at non-union**

- X-ray
- CT-scan
- PET/MRi
- Blood analysis

Basic treatment principals

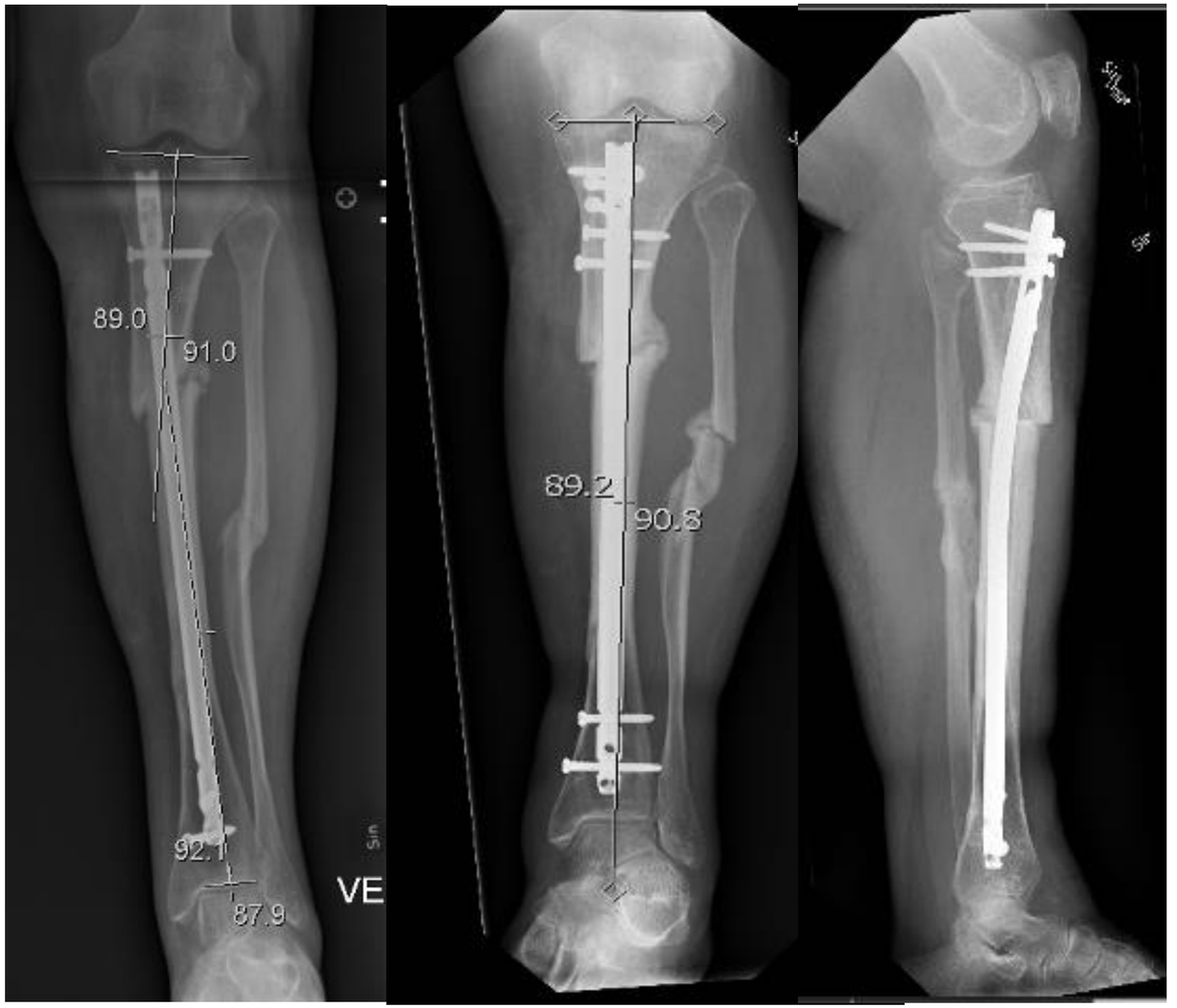
5 pillars of
non union management

Optimisation of host factors	Mechanical alignement	Functional rehabilitation	Stable fixation	Biological stimulation

Basic treatment principals

Mechanical problems - reduce the strain !

- Re-etabler alignement/akse
- Neutraliser deformerede krafter
- Genskab stabilitet
  - tykkere & længere søm
  - længere skinner
  - overvej en anden implantat



Management of tibial non-unions: Prospective evaluation of a comprehensive treatment algorithm

N Ferreira[1] BSc, MBChB, FC Orth(SA), MMed(Orth), PhD
LC Marais[1] MBChB, FCS Orth(SA), MMed(Ortho), PhD
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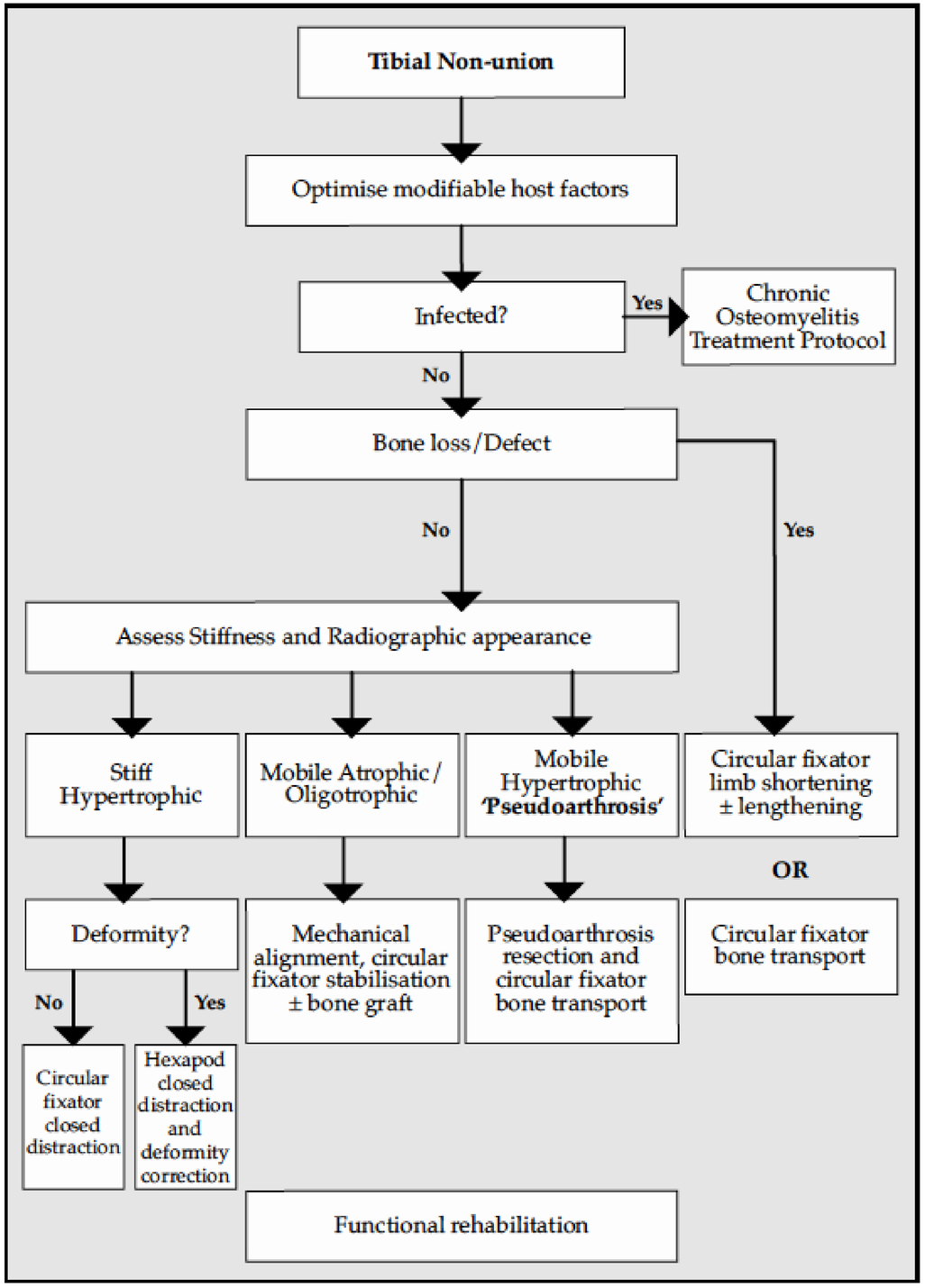


Basic treatment principals

Mechanical problems - reduce the strain !

Take home messages

Violation of principles

- Soft tissue/Vascularity
- Fracture reduction

- Osteosynthesis
  - Simple fracture - absolute stability
  - Complex fracture - relative stability

- Mobilisation

Take home message

Behandling af non-unions

- Følg de basale osteosyntheseprincipper
- Løs mekanisk problem
  - Alignement
  - Stabillitet
- Optimer systemiske faktorer
- Udeluk infektion
- Autograft?

Malunion

Bone doesn’t heal correctly = deformity

Valgus/Varus

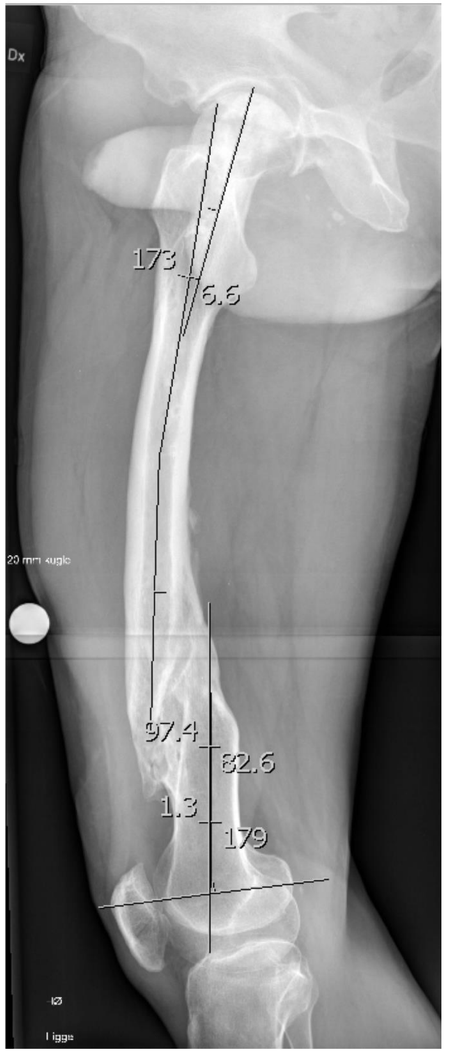
Recurvatum/Procurvatum

Limb length discrepancy (LLD)

Rotational

Diagnosis

???



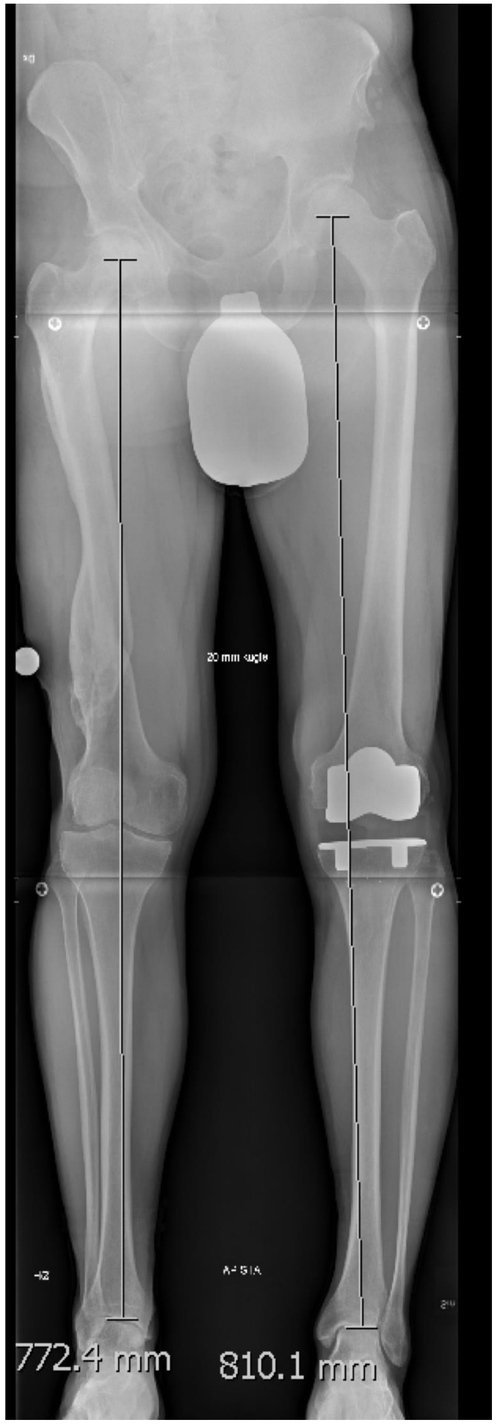
51-year-old man

Previously open fracture of distal diaphysis and femoral neck in 1986

Postraumatic LLD ≈3 cm

ROM of hip:
External rotation 90°
Internal rotation ÷ 30°

ROM of knee:
0-125°



Indications for surgery

– Pain:
  - Osteoarthritis
  - Limp

– Functional deficit:
  - Joint instability
    - Muscular
    - Ligaments
  - Joint incongruency
  - Rotational deformities
  - Shortening

No absolute values of the angular magnitude of deformity exist that indicate surgery

> 5 degrees in coronal plane

> 10 degrees in sagittal plane

> 10 degrees rotation

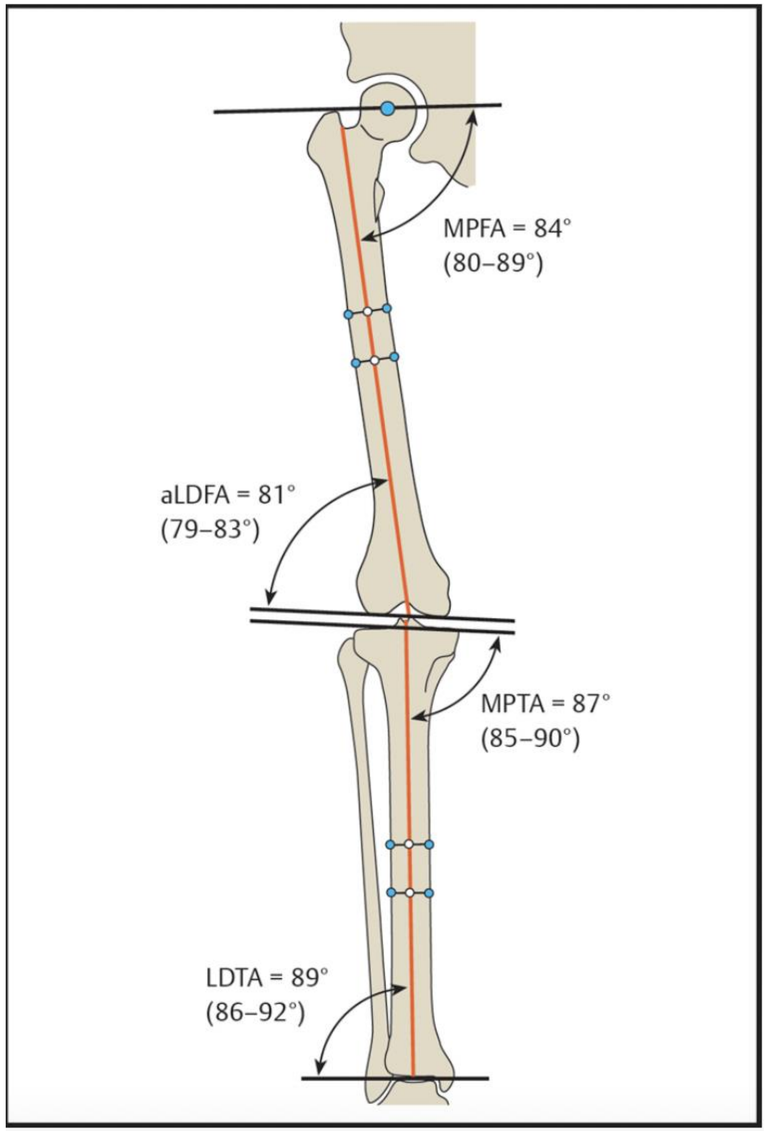
> 2 cm shortening

Important considerations

- Associated translation (additive or compensatory)
- Level of deformity
  - near knee-joint has greatest impact on mechanical axis deviation

Considerations

- Symptoms
- Age
- Activity level
- General medical condition (diabetes, smoking, nutrition)
- Compliance
- Prior vascular or nerve injuries (acute versus gradual correction)
- Soft-tissue contractures
  - Equinus foot (Achilles tendon lengthening)
  - Knee contractures (Quadricepsplasty)
  - Subtalar stifness (Subtalar arthrodesis)



Fraktur relateret infektion - FRI

16 juli 2021

28 juli 2021

14 august 2021

04 juni 2022

Dagens fokuspunkter om FRI

- Hvad ved vi om FRI?
- Hvordan stiller man en FRI diagnose?
- Behandlingsalgoritme?

Diagnose

Infektion?

- Arens et al. 1996
- AO FOUNDATION 2016
- FRI expert group 2016-2018

Contents lists available at ScienceDirect

Injury

journal homepage: www.elsevier.com/locate/injury

Full length article

Fracture-related infection: A consensus on definition from an international expert group

WJ. Metsemakers[a,s,*], M. Morgenstern[b], M.A. McNally[c], T.F. Moriarty[d], I. McFadyen[e], M. Scarborough[c], N.A. Athanasou[f], P.E. Ochsner[g], R. Kuehl[h], M. Raschke[i], O. Borens[j], Z. Xie[k], S. Velkes[l], S. Hungerer[m], S.L. Kates[n], C. Zalavras[o], P.V. Giannoudis[p,q], R.G. Richards[d], M.H.J. Verhofstad[r]

Forekomst af FRI

1 - 30%

???

Åbne frakturer (Gustilo 3 type fr)

Komoribiditet (DM)

Osteosyntesemetode

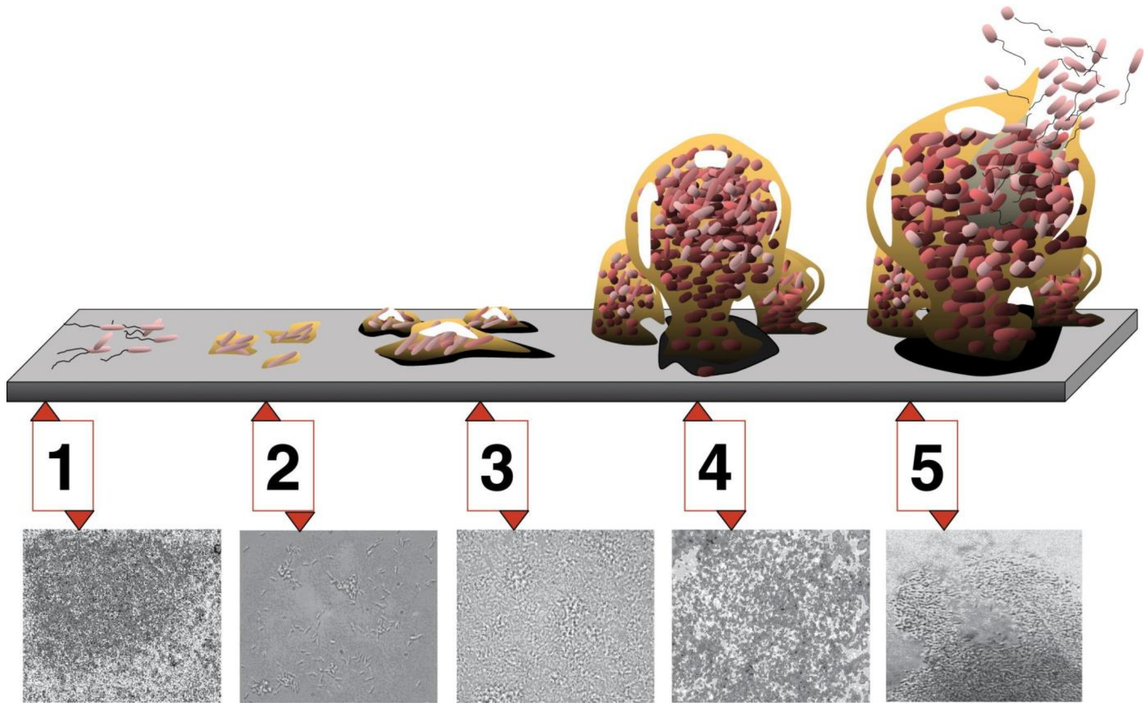
Forkert valg af implantater

Ekstern fiksation

INGEN DEFINITION AF FRI

Biofilm

- 10-1000 gange øget resistens for antibiotika



Profylakse

- Præoperativ antibiotika

- AO kursus: BLØDDELE, BLØDDELE,….
  - Timing af kirurgi
  - Frakturstabilitet
  - Kirurgiske adgange
  - Kirurgisk teknik, håndtering af væv
  - Valg af implantat: intern versus ekstern

Diagnose

FRI Kriterier

Sikker kriterier (Confirmatory criteria)

Kliniske kriterier

Sårruptur, defekt, fistel med kommunikation til implantat/knogle

Purulent sivning/pus

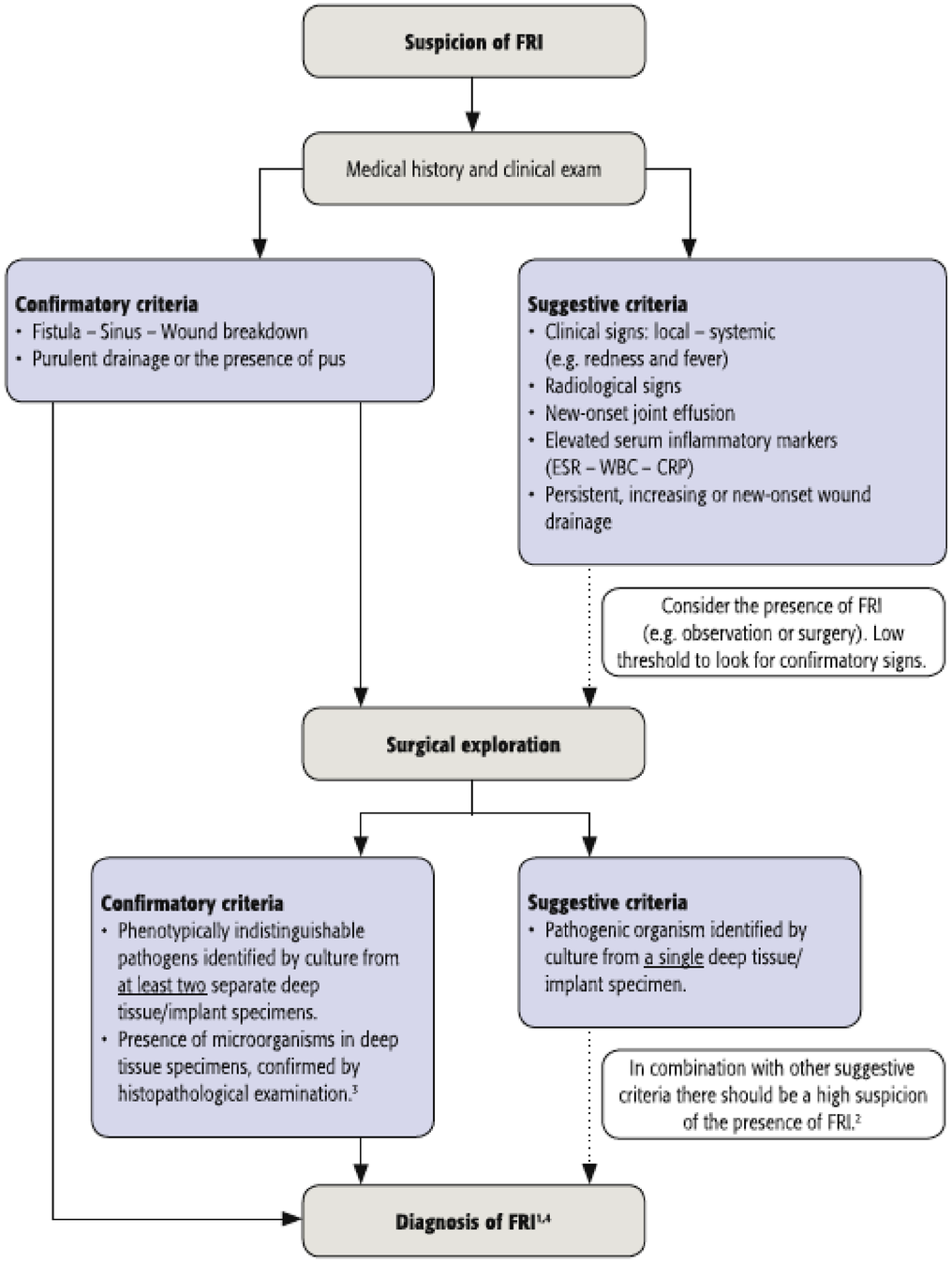
Mikrobiologiske kriterier

2 positive separate biopsier (dybt væv eller implantat)

Histopatologiske kriterier

Bakterier ved histopatology

>5 polymorfonuklear neutrofiler i HPF



Klassifikation

- Lokalisation
- Fraktur helingsstatus
- Symptomshastighed
- Radiologisk status

- Tidlig <2 uger
- Forsinket 3-10 uger
- Sen >10 uger

Vejledning af behandlingen

Romano CL, Romano D, Logoluso N, Drago L. Bone and joint infections in adults: a comprehensive classification proposal. *Eur Orthop Traumatol.* 2011;1(6):207–217. doi: 10.1007/s12570-011-0056-8

Hotchen AJ, McNally MA, Sendi P. The classification of long bone osteomyelitis: a systemic review of the literature. *J Bone Jt Infect.* 2017;2(4):167–174. doi: 10.7150/jbji.21050.

Behandling af FRI

Der er kun én ting, som er værre end en inficeret fraktur

Mål for behandling

- Frakturheling
- Eradikation af infektion (eller suppression)
- Heling af bløddele
- Forebyggelse af kronisk osteomyelitis
- Gennskabelse af funktion

FRI behandlingsstrategi

MDT- multidisciplinær team

- Kirurgisk team
  - Ortopæd- og plastikkirurgi + Anæstesi
- Medicinsk team
  - Infektionsmediciner
  - Endokrinologer
  - Diatister
- Mikrobiologer + Pat. anatomi

2 kirurgiske behandlings modaliteter

DEBRIDEMENT and RETENTION

- Stabil osteosyntese
- Tidlig infektion <2 uger
- Gode bløddele
- Yngre patient

DEBRIDEMENT and REMOVAL

or EXCHANGE

- Ustabil osteosyntese
- Sen infektion
- Åben fraktur/dårlige bløddele
- Marvsøm
- Ryger

Behandling af infektion

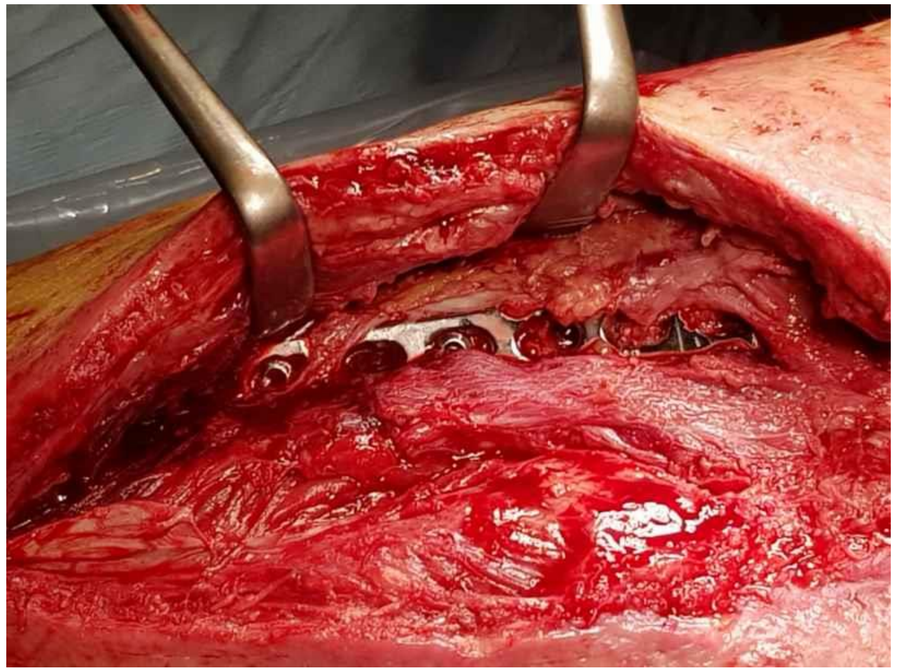
Altid debridement (evt. VAC/Skylle VAC).

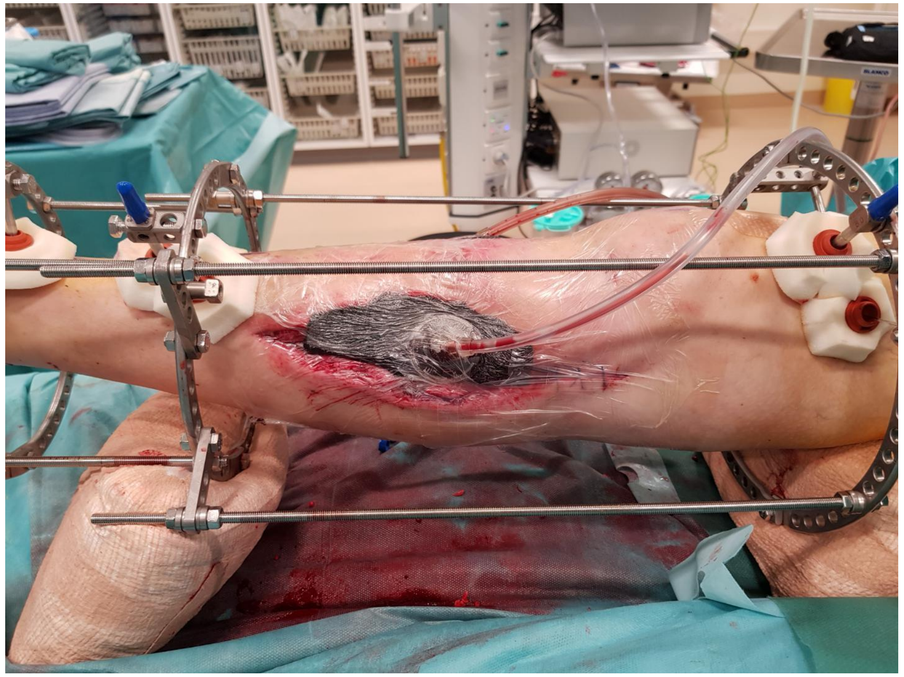
1. Stabil osteosyntese + helet fraktur
   - Fjern osteosyntese, antibiotika

2. Stabil osteosyntese + ikke-helet fraktur
   - Antibiotika
   - Evt. antibiotika-coated implantat

3. Ustabil osteosyntese + ikke-helet fraktur
   - Fjern osteosyntese, temporær stabilisation, spacer, antibiotika, senere rekonstruktion

Septisk patient: fjern osteosyntesemateriale



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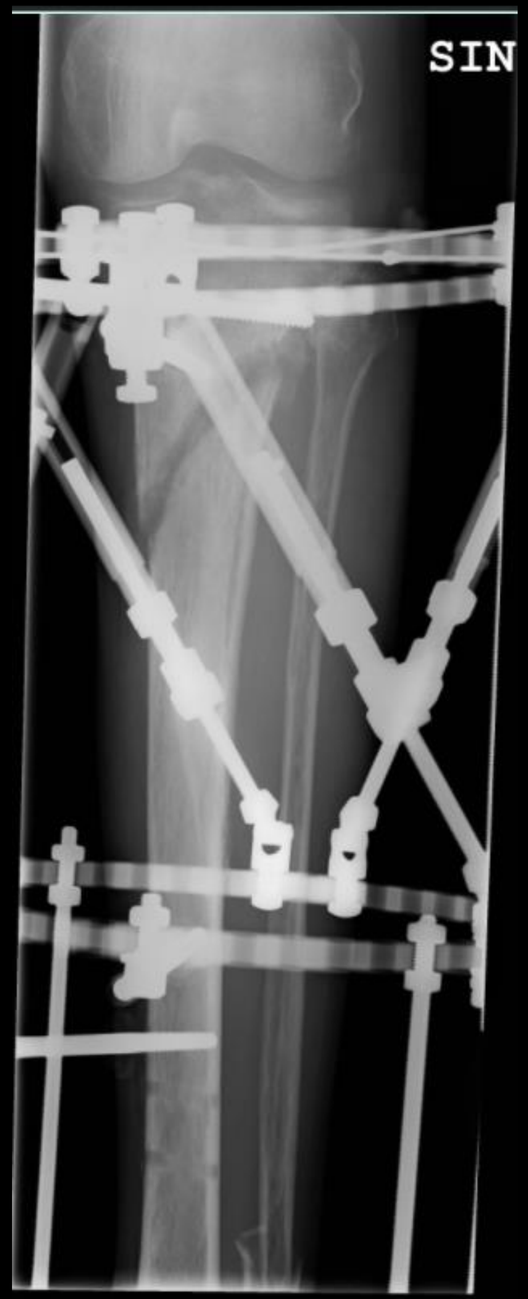
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Kronisk osteomyelitis

Kurativ behandling:

Resektion og langt forløb

Amputation og kort forløb

Palliativ behandling:

antibiotika, evt. episodisk debridement

Dx
2 af 2

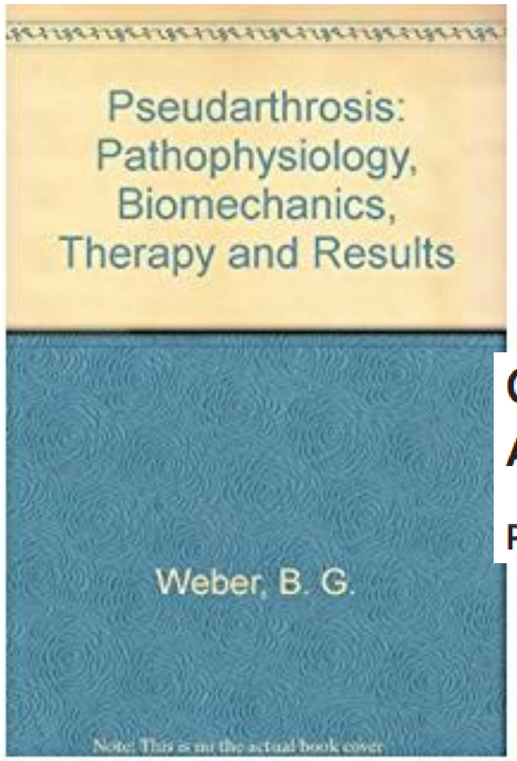
Hø
Dx
1 af 2

DX

Take home masseges

Behandling af FRI

- MDT approach
- Fracture stability is a key factor
- Always debridement
  - Removal
  - Retention/exchange
- Antibiotics -local and systemical
- Chronical osteomyelitis- tumor surgery



TAK!!!

BJR

RESEARCH

The effect of smoking on bone healing

A SYSTEMATIC REVIEW

Can we accelerate fracture healing? A critical analysis of the literature

Peter Giannoudis[1], Spyridon Psarakis[1], George Kontakis[2]

van Trikt et al. BMC Geriatrics (2022) 22:985
https://doi.org/10.1186/s12877-022-03670-8

BMC Geriatrics

RESEARCH Open Access

Operative treatment of nonunions in the elderly: Clinical and radiographic outcomes in patients at minimum 75 years of age

Clinton H. van Trikt[1], Johanna C. E. Donders[1], Craig E. Klinger[2*], David S. Wellman[3], David L. Helfet[2] and Peter Kloen[1]

Trauma

EOR | VOLUME 5 | JANUARY 2020
DOI: 10.1302/2058-5241.5.190037
www.efortopenreviews.org

EFORT open reviews

Nonunion – consensus from the 4th annual meeting of the Danish Orthopaedic Trauma Society

Hagen Schmal[1,2]
Michael Brix[1]
Mats Bue[3]
Anna Ekman[4]
Nando Ferreira[5]
Hans Gottlieb[6]
Søren Kold[7]
Andrew Taylor[8]
Peter Toft Tengberg[9]
Ilija Ban[9]
Danish Orthopaedic Trauma Society[9]

Injury, Int. J. Care Injured 45S (2014) S93–S97

Contents lists available at ScienceDirect

Injury

journal homepage: www.elsevier.com/locate/injury

Validation of the Non-Union Scoring System in 300 long bone non-unions

G.M. Calori [a,*], M. Colombo [a], E.L. Mazza [a], S. Mazzola [a], E. Malagoli [a], N. Marelli [a], A. Corradi [b,c]

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