



20 år mand
MC-styrt - lav hastighed
Ingen sår
Ingen andre læsioner



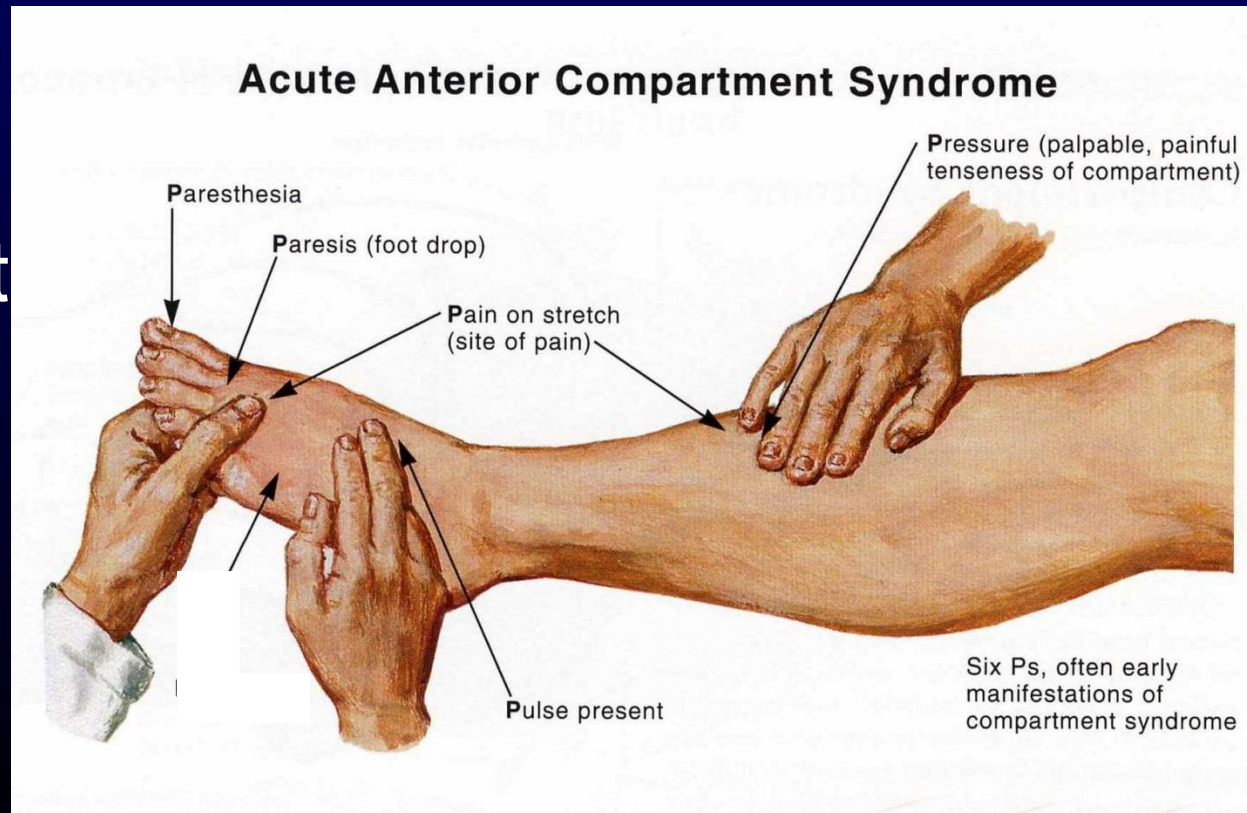






Symptomer

- Pain out of proportion
- Pressure (palpable painful tenderness)
- Pain on passive stretch
- Paraesthesia
- Paresis
- Pulses present



De 5 P'er

Pain

Pain

Pain

Pain

Pain

Børn – de 3 A'er

Agitation



Anxiety



Analgesics



SYSTEMATIC REVIEW

Factors Associated with Development of Traumatic Acute Compartment Syndrome: A Systematic Review and Meta-analysis

Sharri J. Mortensen, MD^{1*}; Sebastian Orman, MD^{2*}; Joseph Serino, MD^{3*}; Amin Mohamadi, MD, MPH¹; Ara Nazarian, PhD^{1,5,6**}; Arvind von Keudell, MD^{4,5**}

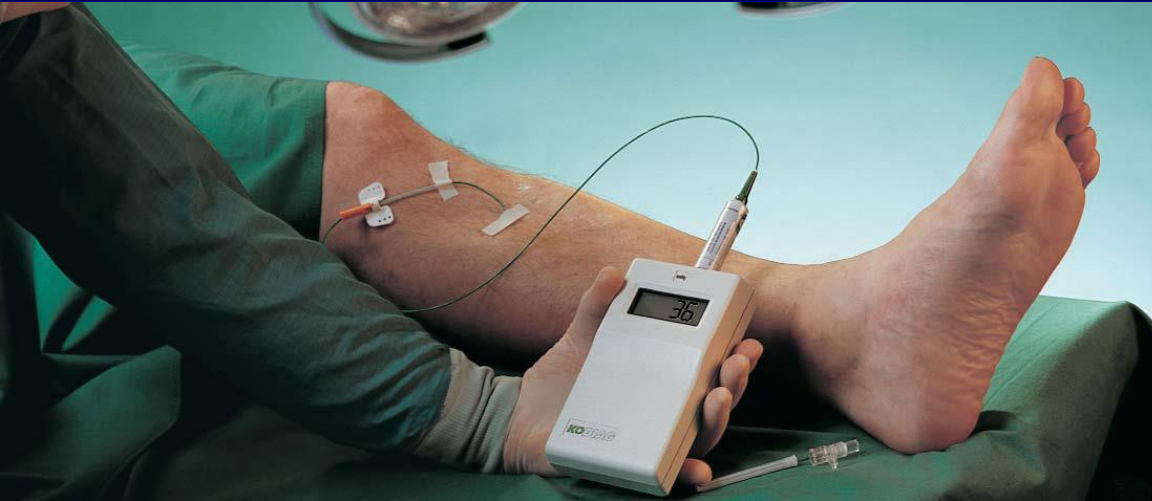
Research performed at Brigham and Women's Hospital, Boston, MA, USA

**Unge
Mænd
Karlæsion
Højenergitraume**

Mistanke om kompartment

- Opklip/fjern bandager
- Ekstremiteten i hjertehøjde
- Ilt-tilskud
- Tæt observation (hver 1-2 timer)
- Evt. trykmåling
- Spalt hvis du er i tvivl

Trykmåling



NIRS = Near InfraRed Spektroskopi (princip som pulsoxymetri)
?????

Continuous Near-Infrared Spectroscopy Demonstrates Limitations in Monitoring the Development of Acute Compartment Syndrome in Patients with Leg Injuries

Andrew H. Schmidt, MD, Michael J. Bosse, MD, William T. Obrensky, MD, MPH, Robert V. O'Toole, MD, Eben A. Carroll, MD, Daniel J. Sinner, MD, David J. Hak, MD, Madhav Karunakar, MD, Roman Hayda, MD, Katherine P. Frey, RN, MS, MPH, PhD, Junrui Di, MS, Vadim Zupnikov, PhD, Ellen MacKenzie, PhD, and the Major Extremity Trauma Research Consortium (METRC)*

Results: For the original cohort, clinically useful NIRS data were available a median of 9.1% of the expected time, while IMP data were captured a median of 87.6% of the expected time ($p < 0.001$). Excluding 46 patients who had erroneous NIRS data recorded, the median percentage was 31.6% for NIRS compared with 87.4% for IMP data ($p = 0.00001$). Fractures with an associated hematoma were less likely to have valid data points (odds ratio [OR], 0.53; $p = 0.04$). Gustilo types-I and II open fractures were more likely than Tscherne grades C0 and C1 closed fractures to have valid data points (OR, 1.97; $p = 0.03$).

Conclusions: In this study, NIRS data were not collected reliably. In contrast, IMP measurements were collected during >85% of the expected monitoring period. These data raise questions about the utility of current NIRS data capture technology for monitoring oxygenation in patients at risk of ACS.

J Bone Joint Surg Am. 2018;100:1645-52

Can intramuscular glucose levels diagnose compartment syndrome?

Christopher J. Doro, MD, Thomas J. Sitzman, MD, and Robert V. O'Toole, MD, Madison, Wisconsin

RESULTS: Within 15 minutes of creating compartment syndrome, glucose concentration and oxygen tension in the experimental limb were significantly lower than in the control limb (glucose, $p = 0.02$; oxygen, $p = 0.007$; two-tailed t test). Intramuscular glucose concentration of less than 97 mg/dL was 100% sensitive (95% confidence interval [CI], 73–100%) and 75% specific (95% CI, 40–94%) for the presence of compartment syndrome. Partial pressure of oxygen less than 30 mm Hg was 100% sensitive (95% CI, 72–100%) and 100% specific (95% CI, 69–100%) for the presence of compartment syndrome. Pathology confirmed compartment syndrome in all experimental limbs.

CONCLUSION: Our results show that intramuscular glucose concentration and partial pressure of oxygen rapidly identify muscle ischemia with high sensitivity and specificity after experimentally created compartment syndrome in this animal model. (*J Trauma Acute Care Surg*.

J Trauma Acute Care Surg
Volume 76, Number 2

Muscle Microvascular Blood Flow, Oxygenation, pH, and Perfusion Pressure Decrease in Simulated Acute Compartment Syndrome

Sravya T. Challa, BS, Alan R. Hargens, PhD*, Amarachi Uzosike, and Brandon R. Macias, PhD*

Investigation performed at the Department of Orthopaedic Surgery, UC San Diego Medical Center, University of California, San Diego, San Diego, California

Results: As IMP increased, muscle microvascular blood flow ($p = 0.01$), oxygenation ($p < 0.001$), and pH ($p < 0.001$) all decreased significantly in the experimental leg compared with the control leg. At all IMP levels, leg elevation significantly decreased muscle oxygenation ($p = 0.013$) and perfusion pressure ($p = 0.03$) compared with the control leg at heart level.

Conclusions: These results indicate that muscle microvascular blood flow, oxygenation, pH, and perfusion pressure decrease significantly as IMP increases in a human model of ACS.

Clinical Relevance: This study identifies hemodynamic and metabolic parameters as potential noninvasive diagnostic tools for ACS.

J Bone Joint Surg Am. 2017;99:1453-9

Extremity compartment syndrome: A review with a focus on non-invasive methods of diagnosis

Martin Novak¹, Marek Penhaker², Pavel Raska³, Leopold Pleva¹ and Martin Schmidt^{2*}

TYPE Review

PUBLISHED 18 July 2022

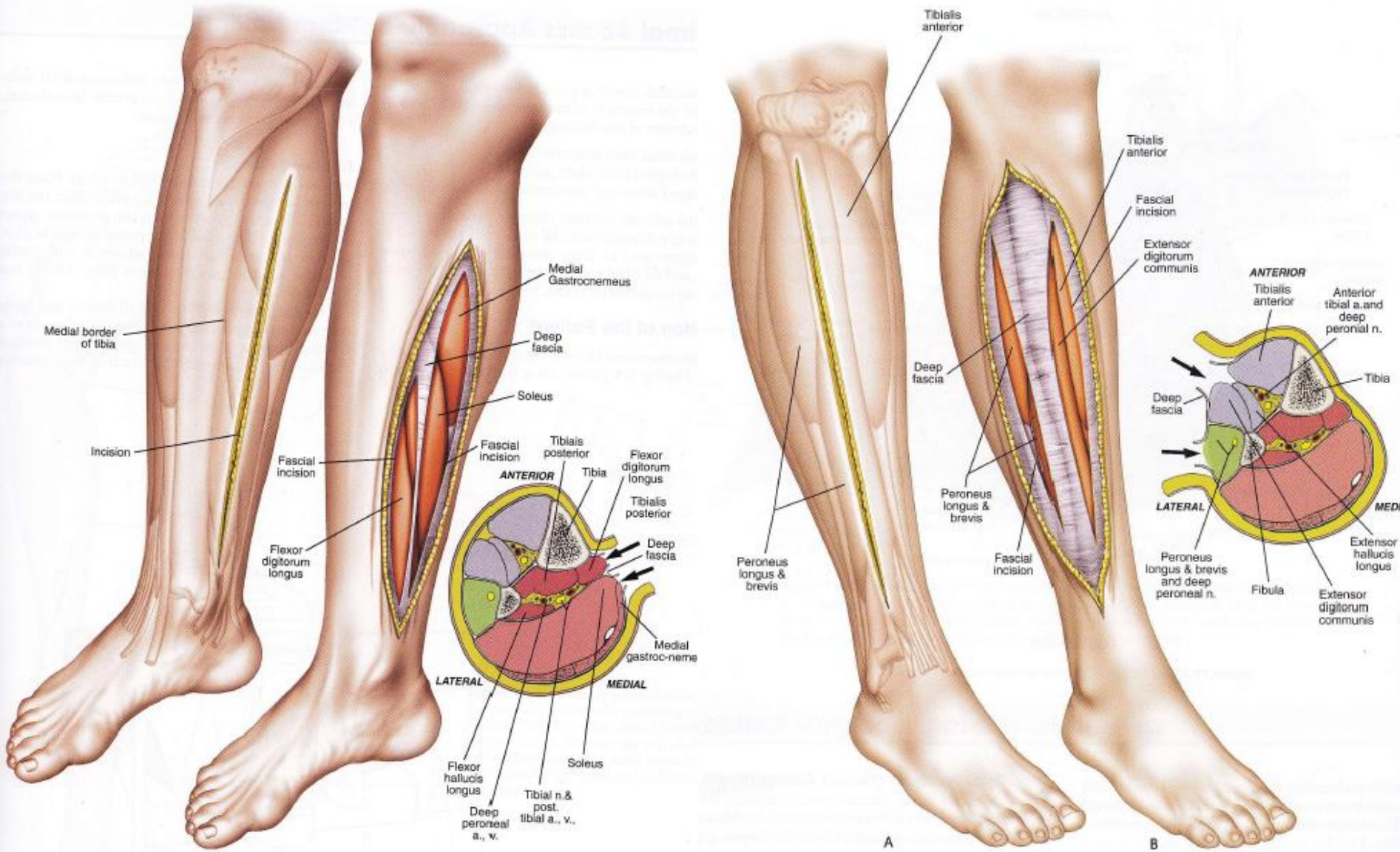
DOI 10.3389/fbioe.2022.801586

Frontiers in Bioengineering and Biotechnology

TABLE 1 Comparison of available diagnostic methods.

Method	Invasive	Continuous	Advantages	Disadvantages
IMP (Intramuscular Pressure)	Yes	Yes	Accurate, verified	Painful for the patient, risk of infection
Quantitative Hardness	No	No	Simple use	Low specificity, affected by the amount of subcutaneous fat
NIRS (Near Infrared Spectroscopy)	No	Yes	Simple and continuous monitoring	Depth max. 3 cm, unreliability of data acquisition, requires measurement on the control compartment, affected by pigment, skin damage, hematomas
SE (Strain Elastography)	No	No	Allows imaging of the compartment - it is not affected by hematomas and subcutaneous fat	Has not been validated in patients with ECS
SWE (Shear Wave Elastography)	No	No	Allows direct measurement of tissue stiffness	Not verified in patients with ECS, expensive, poor repeatability of measurements
PPLL (Pulsed Phase-Locked Loop)	No	Yes	Simple and continuous monitoring	Has not been verified in patients with ECS, may be affected by low blood pressure
Bioimpedance	No	Yes	Simple and continuous monitoring	Few studies performed, requiring control contralateral compartment

Operationstechnik







Efter fasciotomi

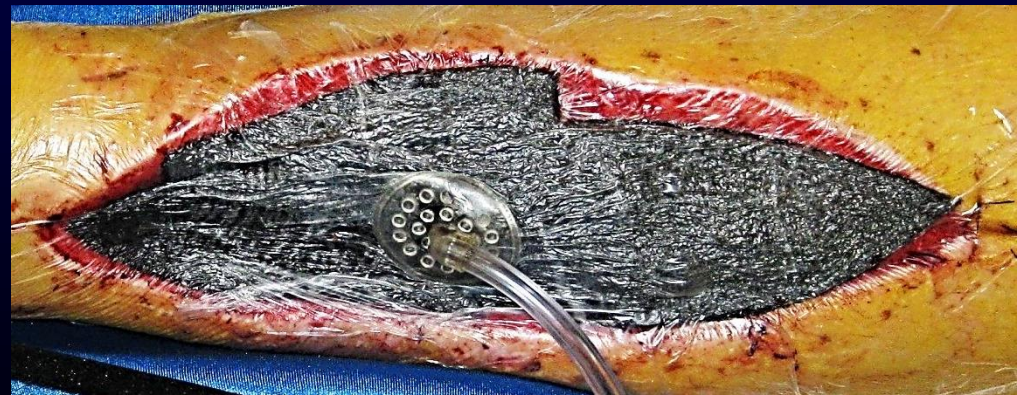
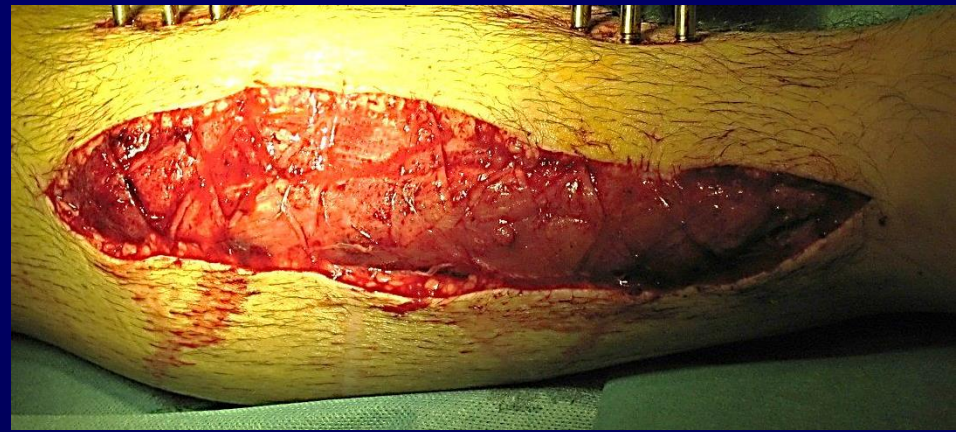
Åben
med fugtig sugende forbindelse

24 – 48 timer: second look

Sammentrækning med elastikker
(på afd.)

VAC

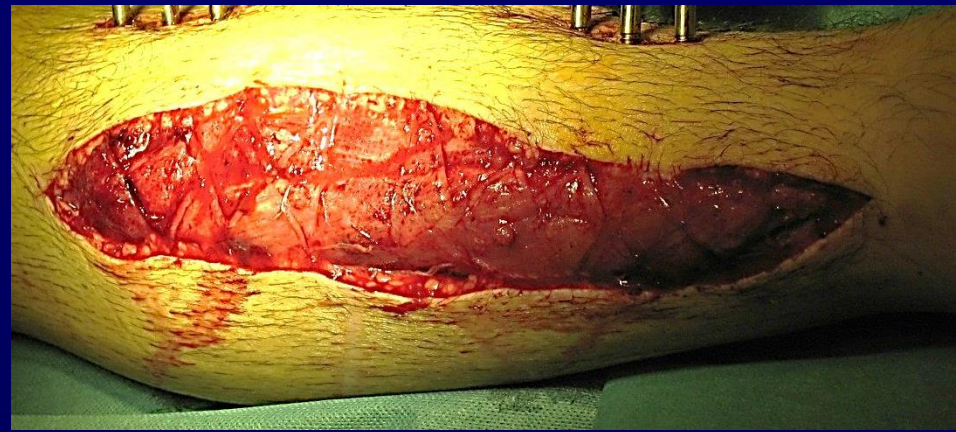
split-skin / lap-plastic



Efter fasciotomi

Åben
med fugtig sugende forbindelse

24 – 48 timer: second look



Elastikker hurtigere og billigere

ELSEVIER

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



Wound closure of leg fasciotomy: Comparison of vacuum-assisted closure versus shoelace technique. A randomised study

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^a Department of Plastic and Reconstructive Surgery, Democritus University in Thrace Hospital, Alexandroupolis, Greece

^b Department of Orthopedics, Democritus University in Thrace Hospital, Alexandroupolis, Greece

^c Department of Orthopedics, Hellenic Red Cross Hospital, Athens, Greece

^d Department of Medical Statistics, Democritus University in Thrace, Alexandroupolis, Greece


Sent opdaget????

Spalt IKKE hvis:

- Mere end 24-48 timer
- Ingen aktiv muskelfunktion



THE LANCET

Volume 386, Issue 10000, 26 September–2 October 2015, Pages 1299–1310



152174||
Series

Diagnosis and treatment of acute extremity compartment syndrome

Dr Arvind G von Keudell, MD^a,  , Michael J Weaver, MD^{a, c}, Paul T Appleton, MD^{a, e}, Donald S Bae, MD^{a, d}, George S M Dyer, MD^{a, b, c}, Marilyn Heng, MD^{a, b}, Prof Jesse B Jupiter, MD^{a, b}, Prof Mark S Vrahas, MD^{a, b, c}

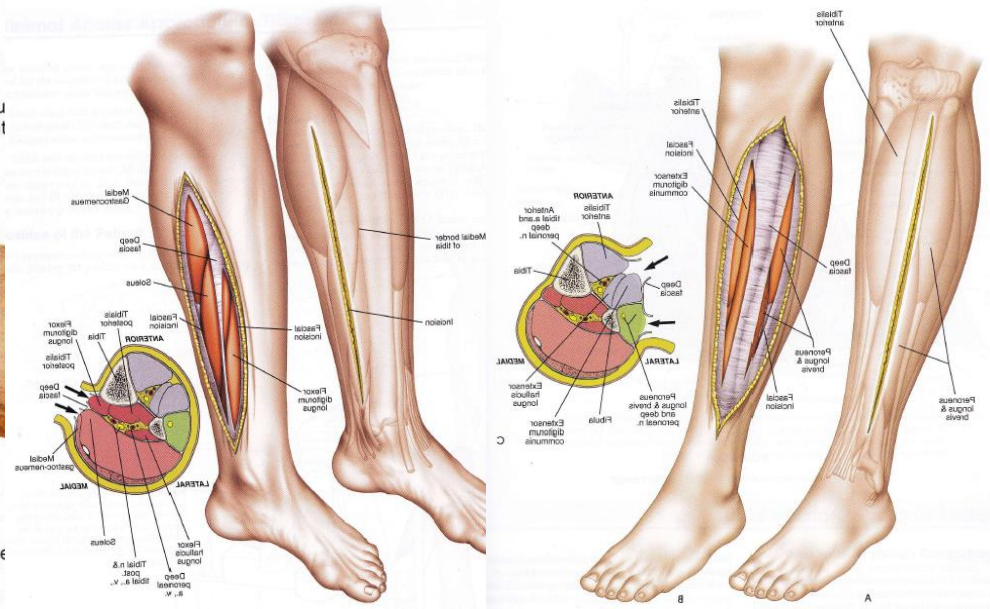
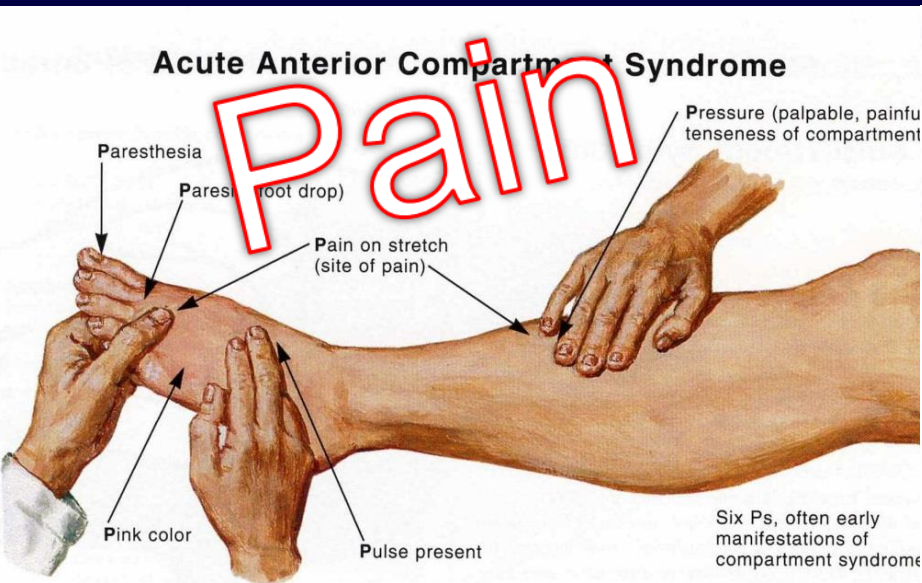
Akut kompartmentsyndrom

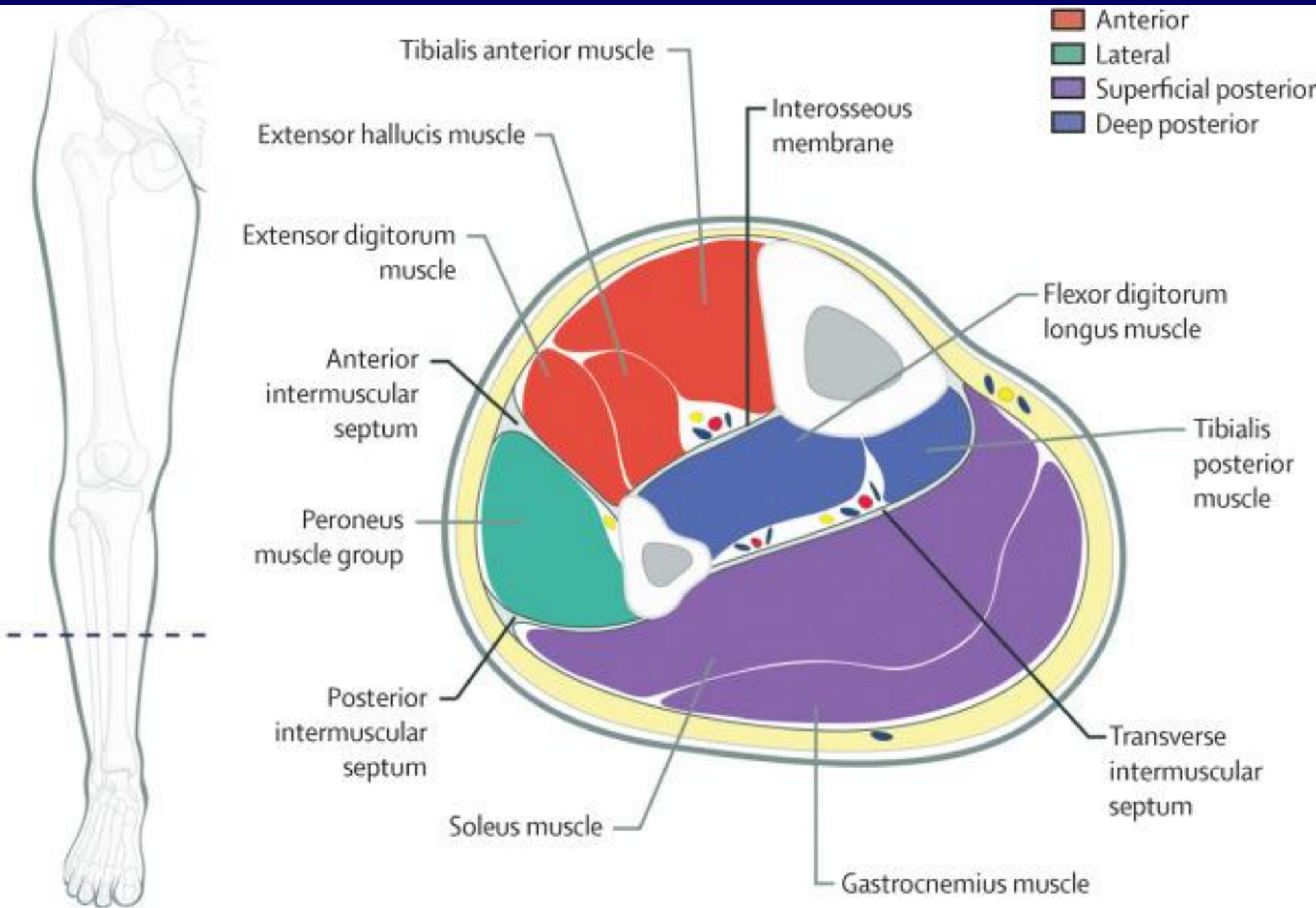
Symptomer

- Pain out of proportion
- Pressure (palpable painful tenderness)
- Pain on passive stretch
- Paraesthesia
- Paresis
- Pulses present

Ved mistanke

- Opklip/fjern bandager
- Ekstremiteten i hjertehøjde
- Ilt-tilskud
- Tæt observation (hver 1-2 timer)
- Evt. trykmåling
- Spalt hvis du er i tvivl





Risk factors for acute compartment syndrome of the leg associated with tibial diaphyseal fractures in adults

**Babak Shadgan · Gavin Pereira · Matthew Menon ·
Siavash Jafari · W. Darlene Reid · Peter J. O'Brien**

Køn

Alder

Åben/lukket fraktur

Marvsømning

Polytraume

Received: 19 April 2014 / Accepted: 25 November 2014

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Hyppigere hos yngre

De kliniske fund er mere nyttige ved at kunne afkræfte ACS, når de *ikke er til stede*, end de er til at kunne bekræfte ACS, når de *er til stede*.

TABLE 2. *Sensitivity, specificity, and predictive values of clinical findings*

	Pain	Paresthesia	PPS	Paresis
Sensitivity	0.19	0.13	0.19	0.13
Specificity	0.97	0.98	0.97	0.97
PPV	0.14	0.15	0.14	0.11
NPV	0.98	0.98	0.98	0.98

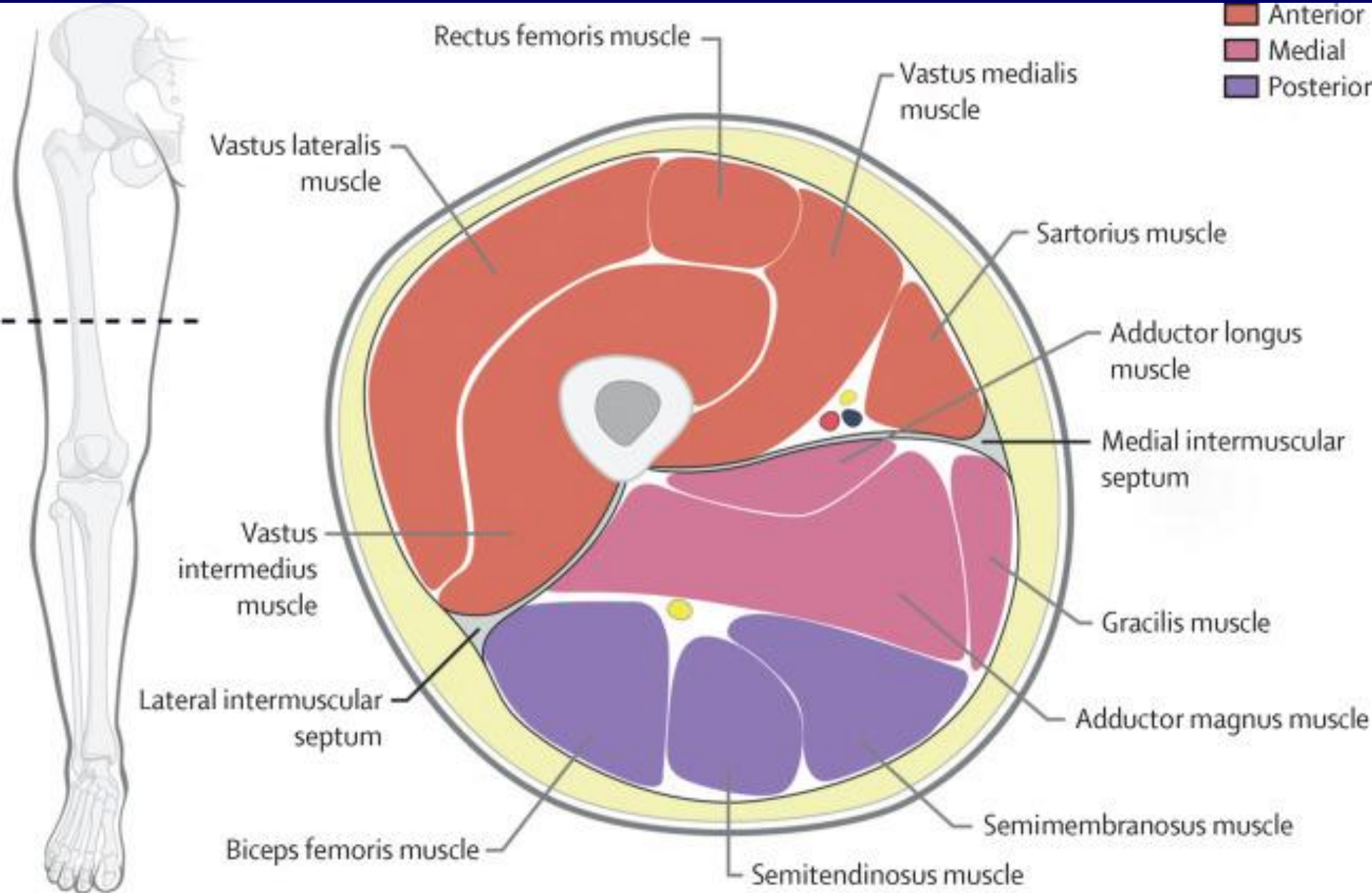
PPS, pain with passive stretch; PPV, positive predictive value; NPV, negative predictive value.

The Estimated Sensitivity and Specificity of Compartment Pressure Monitoring for Acute Compartment Syndrome

Margaret M. McQueen, MD, FRCSEd(Orth), Andrew D. Duckworth, MSc, MRCSEd, Stuart A. Aitken, MRCSEd, and Charles M. Court-Brown, MD, FRCSEd(Orth)

Investigation performed at the Edinburgh Orthopaedic Trauma Unit, Royal Infirmary of Edinburgh, Edinburgh, Scotland

With the currently available evidence, the clinical diagnosis of acute compartment syndrome should no longer be considered the gold standard and we believe that all patients with tibial fractures who are at risk for acute compartment syndrome should undergo continuous intracompartmental pressure monitoring.



Årsag

**Procentdel af patienter med
kompartiment (%)**

Tibial diaphyseal fracture	36.0
Soft tissue injury	23.2
Distal radius fracture	9.8
Crush syndrome	7.9
Diaphyseal fracture forearm	7.9
Femoral diaphyseal fracture	3.0
Tibial plateau fracture	3.0
Hand fracture(s)	2.5
Tibial pilon fractures	2.5
Foot fracture(s)	1.8
Ankle fracture	0.6
Elbow fracture dislocation	0.6
Pelvic fracture	0.6
Humeral diaphyseal fracture	0.6

Komplikationer

Korreleret til forløbet tid inden fasciotomi

- Neurologiske deficit
- Muskel-nekrose
- Iskæmisk kontraktur
- Infektion
- Forsinket frakturheling
- Amputation
- Akut nyresvigt pga. myoglobinuri
- Acidose og hyperkaliæmi => kardielle arytmier
- Død

Kompartiment syndrom

Ekstern kompression

stram gips / bandage

pneumatiske antishock bukser

Øget volumen af indhold

blødning

fraktur / bløddelskontusion

Manipulation af fraktur
(reponering / osteosyntese)

hæmofili / koagulationsdefekt

ødem

post-iskæmisk hyperperfusion
(a-ruptur / lejrings-skade)

Elektrisk skade

direkte væske

A-skopi tibia kondyl fraktur /
sprøjtælæsion

Patient-karakteristika

Table 1. Characteristics of patients with acute compartment syndrome (ACS) (n = 76)

Characteristic	No. (and %)*
Median age (range), yr	32 (1–80)
Traumatic etiology	62 (82) ←
Male gender	57 (75)
Associated fracture	40 (53) ←
Transferred from referring hospital	14 (18)
Alcohol or drug intoxication	12 (16) ←
Vascular disease present	11 (14)
Receiving anticoagulant medication	7 (9)
Injured while in hospital	7 (9)

*Unless otherwise indicated.

CJEM
2003

Quantifying delays in the recognition and management of acute compartment syndrome

CJEM • JCMU

January • janvier 2001; 3 (1)

Christian Vaillancourt, MD;* Ian Shrier, MD, PhD;†‡ Markus Falk, MSc, PhD;§
Michel Rossignol, MD;† Alan Vernece, MD;‡ Dan Somogyi, MD£

**Procentdel af patienter
med kompartment (%)**

**Procentdel af frakturer
hvor kompartment
opstår (%)**

Tibial diaphyseal fracture	36.0	8 (3 - 11)
Soft tissue injury	23.2	-
Distal radius fracture	9.8	0.25
Crush syndrome	7.9	-
Diaphyseal fracture forearm	7.9	3

Procentdel af
patienter med
kompartment (%)

Procentdel af frakturer
hvor kompartment
opstår (%)

Tibial diaphyseal fracture	36.0	8
Soft tissue injury	23.2	-
Distal radius fracture	9.8	0.25
Crush syndrome	7.9	-
Diaphyseal fracture forearm	7.9	3



Lidt hyppigere ved
lav-energi (lukkede)
end høj-energi
(åbne) frakturer

Procentdel af patienter med kompartment (%)

Procentdel af frakturer hvor kompartment opstår (%)

Tibial diaphyseal fracture	36.0	8
Soft tissue injury	23.2	-
Distal radius fracture	9.8	0.25
Crush syndrome	7.9	-
Diaphyseal fracture forearm	7.9	3



Hyppigere ved høj-energi frakturer

Procentdel af patienter med kompartment (%)

Procentdel af frakturer hvor kompartment opstår (%)

Tibial diaphyseal fracture	36.0	8
Soft tissue injury	23.2	-
Distal radius fracture	9.8	0.25
Crush syndrome	7.9	-
Diaphyseal fracture forearm	7.9	3



Ældre patienter

Medicinske lidelser
(AK-behandling)

Trykmåling

Supplement til klinikken - særligt hos

bevidstløse

intoxikerede

multiple skader

små børn

regional analgesi

usikker klinik

Tærskel: $\Delta P=30$ mmHg
(= forskel mellem diastolisk BT
og kompartment-tryk)

The effect of early versus late fasciotomy in the management of extremity trauma

Arthur B. Williams, MD, Fred A. Luchette, MD, Harry T. Papaconstantinou, MD, Edward L. ...
James M. Hurst, MD, Jay A. Johannigman, MD, and Kenneth Davis, Jr., MD, Cincinnati, Ohio

Surgery
1997

- Fasciotomi mest effektiv når den udføres tidligt
- MEN, når udført sent:
 - Samme chance for at redde benet sammenlignet med tidlig fasciotomi
 - MEN øget risiko for infektion
- Resultaterne støtter aggressiv brug af fasciotomi uanset tidspunkt for diagnose

Ultrasonic device for the noninvasive diagnosis of compartment syndrome

John E Lynch¹, Joseph S Heyman¹ and Alan R Hargens²

Physiol Meas
2004

Measurement of Intracompartmental Pressure with Use of a New Electronic Transducer-Tipped Catheter System*

BY CHRISTIAN WILLY, M.D.†, HEINZ GERNGROSS, M.D.†, AND JÜRGEN STERK, M.D.†, ULM, GERMANY

JBJS 1999

Noninvasive Measurements of Intramuscular Pressure Using Pulsed Phase-locked Loop Ultrasound for Detecting Compartment Syndromes

A Preliminary Report

John M. Wiemann, MD, Toshiaki Ueno, MD, PhD,† Bryan T. Leek, MD,† William T. Yost, PhD,‡ Alexandra K. Schwartz, MD,† and Alan R. Hargens, PhD†*

J Orthop
Trauma 2006

Akut kompartmentsyndrom

Øget volumen af indholdet
og/eller
Ekstern kompression

Øget tryk

Kompression af muskler, nerver og blodkar

Nedsat blodflow

Iskæmi og nekrose

