PLEASE CLICK ON THE FOLLOWING LINK TO WATCH THE LECTURE ONLINE:-

HTTPS://WWW.YOUTUBE.COM/WATCH?V=LRIIJJE3ZKI&LIST=PLUBRB5B7FA_D_ITKXTB-KQYUUSX0C1S_X&INDEX=13

Acute Compartment Syndrome

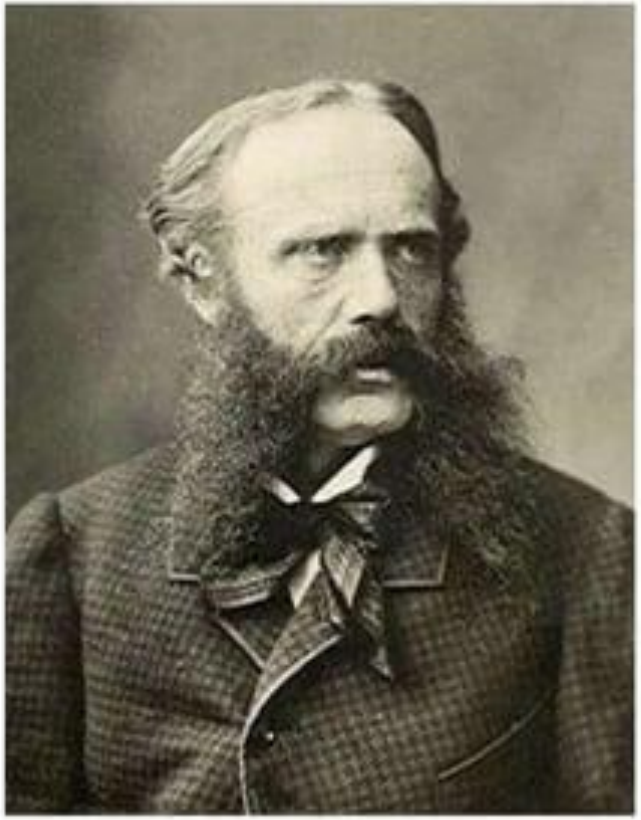
Dr. Abdelhadi Almomani MD

Compartment Syndromes

- Definition
- Types
- Pathophysiology
- Etiology
- Clinical evaluation
- Diagnosis
- Management
- Complications

History

Richard von Volkmann



Volkmann 1881

- Richard von Volkmann published an article in which he attempted to describe the condition of irreversible contractures of the flexor muscles of the hand to ischemic processes occurring in the forearm
- Application of restrictive dressing to an injured limb

History

Hildebrand 1906

- First used the term Volkmann ischemic contracture to describe the final result of any untreated compartment syndrome, and was the first to suggest that elevated tissue pressure may be related to ischemic contracture.

History

Thomas 1909

- Reviewed the 112 published cases of Volkmann ischemic contracture and found fractures to be the predominant cause. Also, noted that tight bandages, an arterial embolus, or arterial insufficiency could also lead to the problem

Murphy 1914

- First to suggest that fasciotomy might prevent the contracture. Also, suggested that tissue pressure and fasciotomy were related to the development of contracture

Definition

Acute compartment syndrome (ACS) the elevation of intracompartmental pressure (ICP) to a level and for a duration that without decompression will cause tissue ischemia and necrosis.

Devastating condition where an osteo-fascial compartment pressure rises to a level that decreases perfusion . may lead to irreversible muscle and nerve damage .

It is a TRUE orthopedic emergency

WHAT IS A COMPARTMENT ?

A closed area of muscle group , nerves and blood vessels surrounded by fascia .

Muscles are arranged in different compartments and surrounded by one fascia , this arrangement is called osteo-fascial compartment

Sites for compartment syndrome

Etiology

↓ Compartment Size

- Tight dressing; Bandage/Cast
- Localised external pressure; lying on limb
- Closure of fascial defects

↑ Compartment Content

- Bleeding; Fractures, vascular inj, bleeding disorders
- Increased Capillary Permeability:
  Ischemia / Trauma / Burns / Exercise / Snake Bite / Drug Injection / IVF

Conditions Increasing the Volume of Compartment Contents

Fracture

Soft tissue injury

Crush syndrome (including use of the lithotomy position)[84]

Revascularization

Exercise[94]

Bleeding diathesis/anticoagulants[66,124]

Fluid infusion (including arthroscopy)[10,132]

Arterial puncture[133]

Ruptured ganglia/cysts[30]

Osteotomy[45]

Snake bite[152]

Nephrotic syndrome[146]

Leukemic infiltration[151]

Viral myositis[78]

Acute hematogenous osteomyelitis[144]

Conditions Reducing Compartment Volume

Burns

Repair of muscle hernia[4]

Medical Comorbidity

Diabetes[21]

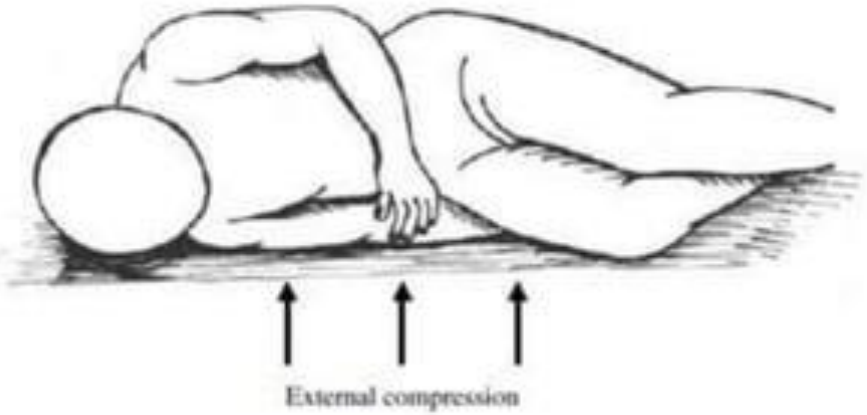
Hypothyroidism[67]

Fracture

- The most common cause
- Incidence of accompanying compartment syndrome of 9.1%
- The incidence is directly proportional to the degree of injury to soft tissue and bone

Blick et al JBJS 1986

Blunt Trauma-2nd MC cause



Hematoma after arterial puncture resulting in CS

Mannitol extravasation during partial nephrectomy leading to forarm compartment syndrome

Incidence

Acute compartment syndrome

WHO IS AT RISK?

M. M. McQueen, P. Gaston, C. M. Court-Brown
From the Royal Infirmary of Edinburgh, Scotland

McQueen et al:JBJS 2000

- 164 pts with CS
- 149 M, 15 F
- Most pts were under 35 yrs
- 69% with associated fx
  - Tibial shaft fx 36% (incidence in the range of 1% to 10%)
  - Distal radius fx 9.8 %
- 23% Soft tissue injury without fx

We have analy patients wit whom we treated there was an asso were of the tibial usually under 35 syndrome of the the distal end of t commonly in you without fracture, of the syndrome bleeding disorder We found that yo risk of acute com When treating su should be made pressure.

J Bone Joint Surg [Br]
Received 12 January 19

The most importa acute compartment nosis.[1-5] The complications are usually disabling and include infection, contracture and amputation. One of the main causes of delay may be insufficient awareness of the condition. While it is acknowledged that children, because of difficulty in assessment, and hypotensive patients are at risk, most adults who develop acute compartment syndrome are not hypotensive. Awareness of the risk of the syndrome may reduce delay in diagnosis. Continuous monitoring of compartment pressure may allow the diagnosis to

e minimised.[5,6] readily available ere at risk and ment pressure.

s with a recog- came to our nd 1995, inclu- a population of of capture. We te compartment vascular unit. d. iagnosed either t pressure. We than 30 mmHg lood pressure as nosis was con- asciotomy. The Gustilo[2,9] were chi-squared test with Yates' correction was used for comparison of age incidences.

Results

There were 164 patients with an acute compartment syndrome, 149 men and 15 women, with a mean age of 32 years (14 to 88). The mean age for men was 30 years and for women, 44 years. The average annual incidence was 7.3

There are Various risk factors related to compartment syndrome and age is one of the important factors.

Younger patients are more prone to get ACS as compared to elderly patients with the same nature of trauma

. Closed tibial shaft fracture is the most common cause of compartment syndrome and is comprised of one-third of all cases of ACS.

One-fourth of the cases result from blunt and crushed soft tissue limb trauma while radius ulna shaft fractures are responsible for 20 percent of the cases.

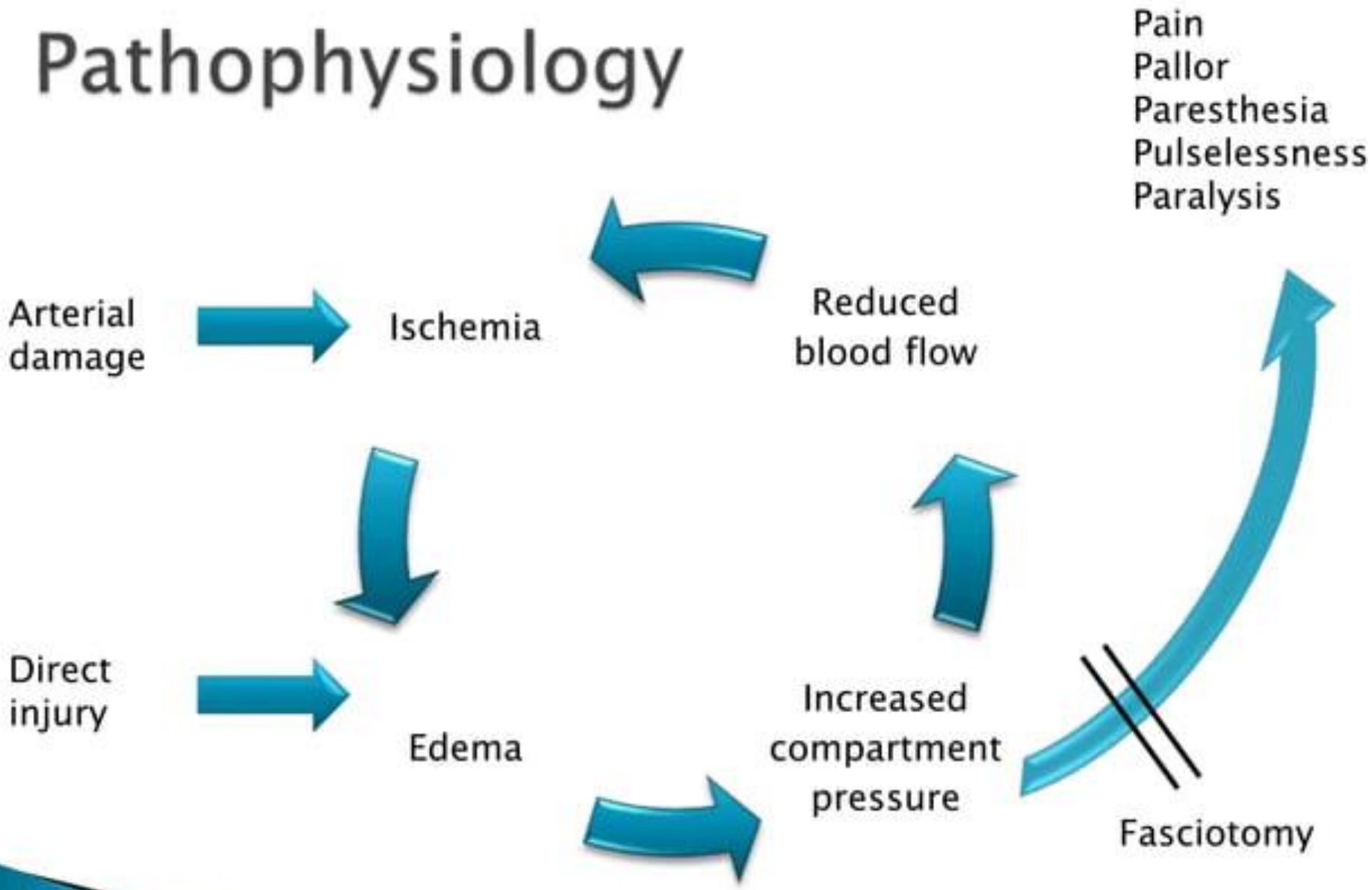
Foot injuries in road traffic accidents account for 6% of all cases of ACS

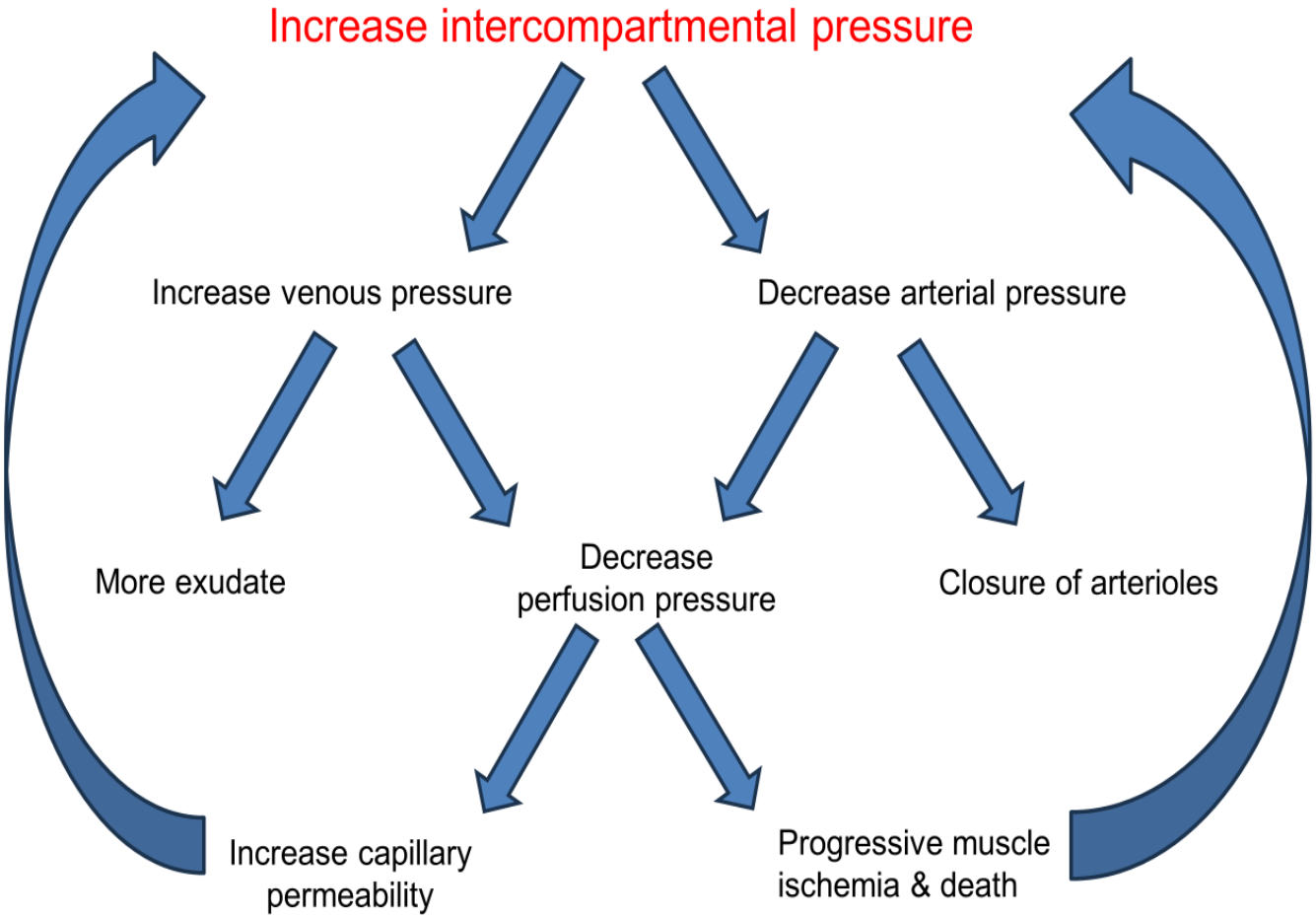
Types of compartment syndrome

- Acute compartment syndrome
  - Medical emergency
  - Requires urgent intervention to correct
  - Can lead to permanent muscle and nerve damage and can result in the loss of function of the limb.

- Chronic compartment syndrome
  - Also known as exertional compartment syndrome
  - Not a medical emergency
  - Most often caused by athletic exertion

Pathophysiology




Increase intercompartmental pressure
Increase venous pressure
Decrease arterial pressure
More exudate
Decrease perfusion pressure
Closure of arterioles
Increase capillary permeability
Progressive muscle ischemia & death

cascade of events includes :

- local trauma and soft tissue destruction
- bleeding and edema
- increased interstitial pressure
- vascular occlusion (decreased venous outflow relative to arterial inflow)
- myoneural ischemia

Pathophysiology

- Normal tissue pressure
  - 0–4 mm Hg
  - 8–10 with exertion
- Absolute pressure theory
  - 30 mm Hg – Mubarak
  - 45 mm Hg – Matsen
- Pressure gradient theory
  - < 20 mm Hg of diastolic pressure – Whitesides et al

$$\Delta P = DBP - ICP$$

Delta pressure, currently used to diagnose acute compartment syndrome, is less than or equal to 30 mmHg.

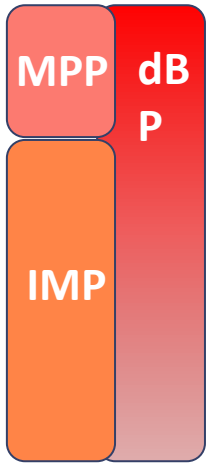
What's the normal Muscle Perfusion Pressure (MPP)?

MPP is the diastolic Blood Pressure (dBP)

minus

the IntraMuscular Pressure (IMP)

If MPP is below 30 mm mercury (Hg), muscle hypoxia will occur



PATHOPHYSIOLOGY

- In normal tissue, there is a steady state of flow between the high-pressure arterial and low-pressure venous systems
- An injury such as a fracture, a burn, or anything that damages the soft tissue can disrupt this gradient and “tilt the seesaw”

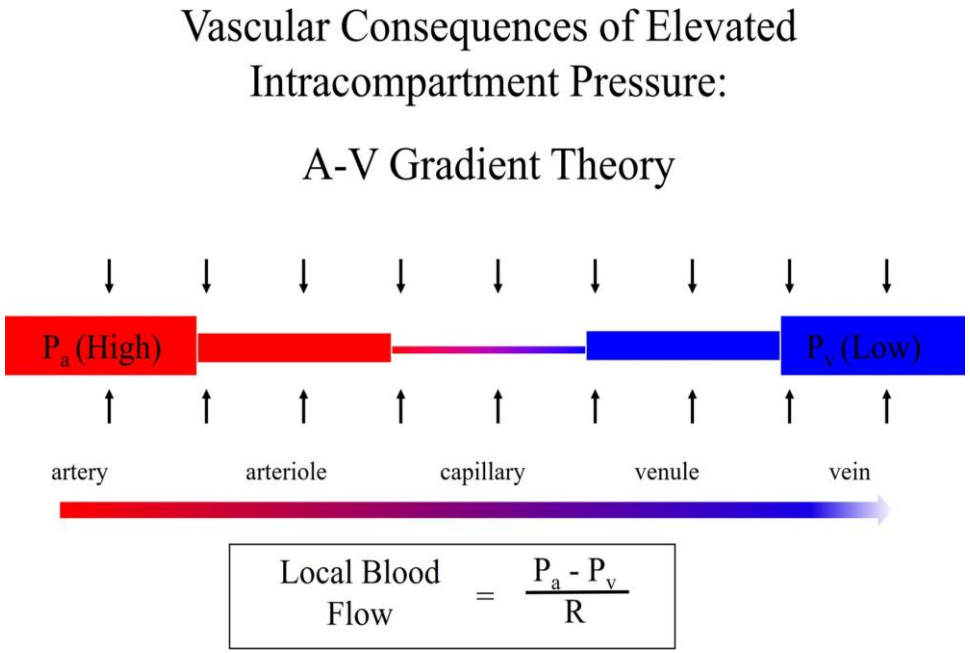
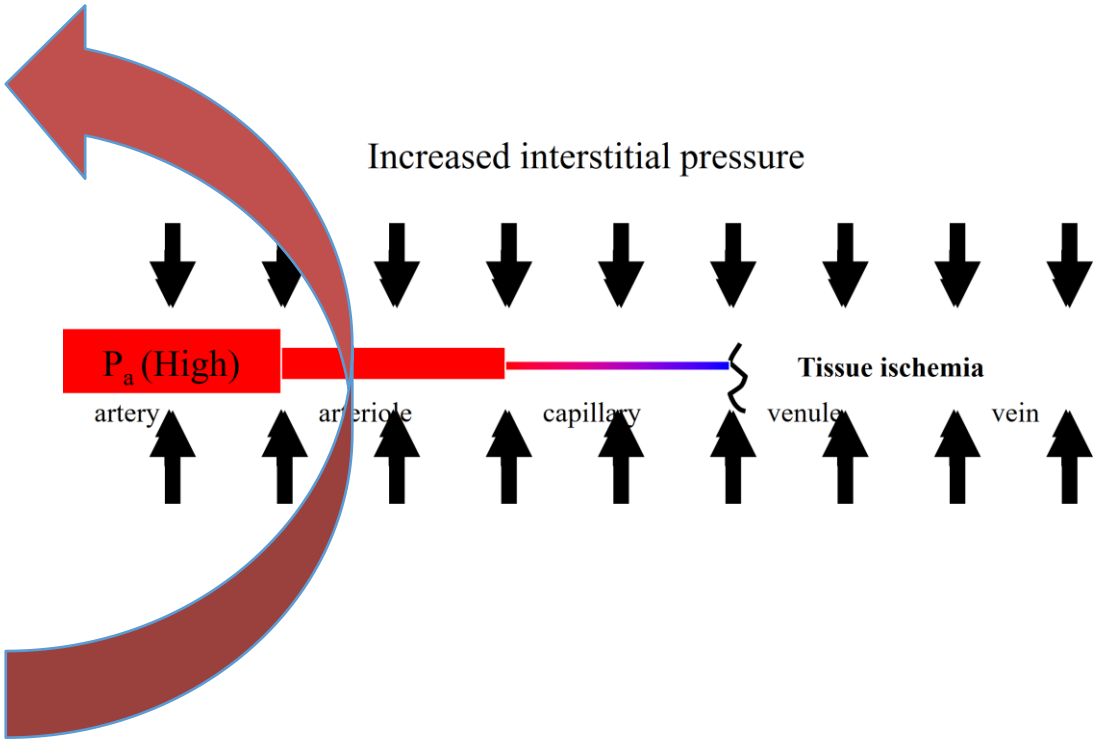


Image: Schmidt, OTA core curriculum presentation acute compartment syndrome 2018

PATHOPHYSIOLOGY

- In damaged tissue, rising pressure→reduction in flow to muscle
- Reduction in flow→tissue ischemia
- Tissue ischemia→More cellular injury and release of osmotically active cellular contents into interstitial fluid
- Release of fluid → further increase in pressure



Tissue survival

- Muscle
  - 3–4 hours – reversible changes
  - 6 hours – variable damage
  - 8 hours – irreversible changes
- Nerve
  - 2 hours – looses nerve conduction
  - 4 hours – neuropraxia
  - 8 hours – irreversible changes

Diagnosis

"Pain and the aggravation of pain by passive stretching of the muscles in the compartment in question are the most sensitive (and generally the only) clinical finding before the onset of ischemic dysfunction in the nerves and muscles."

Whitesides AAOS

History- Tightness of compartment, local pain,duration

Clinical examination: the P's

- Pain out of proportion
- Palpably tense compartment
- Pain with passive stretch

Most reliable

- Paresthesia/hypoesthesia
- Paralysis
- Pulselessness/Pallor

Compartment pressures- Objective parameter

Lab tests: CPK, Urine myoglobin

Pulse oximetry

- Is helpful in identifying limb hypoperfusion
- Is not sensitive enough to exclude compartment syndrome.

Clinical parameters

Pain

- First symptom
- Classically out of proportion to injury
- Exaggerated with passive stretch of involved muscles in compartment
- Earliest symptom but inconsistent, minimal in deep post. compartment
- Not applicable in unconscious/obtunded patient

Tense compartment

- Early finding
- Compared to other side

Paresthesia

- Peripheral nerve tissue is more sensitive than muscle to ischemia.
- Difficult to interpret
- Will progress to anesthesia if pressure not relieved

Paralysis

- Very late finding

  Irreversible nerve and muscle damage present.

- Paresis may be present early

  Difficult to evaluate because of pain

  If motor deficit develops, full recovery is rare

Pallor and Pulselessness

- Rarely present

Indicates direct damage to vessels rather than compartment syndrome (therefore arteriography indicated)

Vascular injury may be more of contributing factor to syndrome rather than result.

Signs of compartment syndrome (5 Ps and 3 As)	
5 Ps	**3 As**
*P*ain	Increased *A*nalgesic requirement
*P*aresthesia	*A*nxiety
*P*allor	*A*gitation
*P*aralysis	
*P*ulselessness	

Data from Bae DS, Kadivala RK, Waters PM. Acute

Compartment Pressure Monitoring

- Raised tissue pressure is primary event in compartment syndrome and changes in ICP precede the clinical signs and symptoms.

- When to monitor ?
- Where to monitor ?
- Threshold for diagnosis of Compartment syndrome and fasciotomy ?

Compartment Pressure Monitoring

- When ?
  - Suspected compartment syndrome
  - Equivocal or unreliable examination findings
  - Obtunded patient with tight compartments
  - Vascular injury
  - Regional anesthetia
  - Clinical adjunct

- Contraindication
  - Clinically evident compartment syndrome

Continuous compartment pressure monitoring for tibia fractures: does it influence outcome?

J Trauma. 2006 Jun;60(6):1330-5; discussion 1335.

Continuous compartment pressure monitoring for tibia fractures: does it influence outcome?

Harris IA[1], Kadir A, Donald G.

Author i

Abstract

BACKGRO leads to sign compartmer monitoring c

METHODS: monitored g observation between cor were assess

RESULTS: compartmer sequelae in none of whc significantly

CONCLUSI

Harris et al, J Trauma

- Randomized 200 acute extra articular tibia fractures
  - Monitored – 36 hrs continuous pressure monitoring
  - Nonmonitored – Usual post operative observation
- Patients were followed up for a minimum of 6 months or till fracture union

Results

- 5 cases of CS in nonmonitored group and 0 cases in monitored group
- Monitored group18 patients had $\Delta P < 30$ mm Hg, none of them developed CS or late sequelae

Conclusion

In awake and alert pt. dx of CS using clinical signs in appropriate time is possible and continuous compartment pressure monitoring is not indicated.

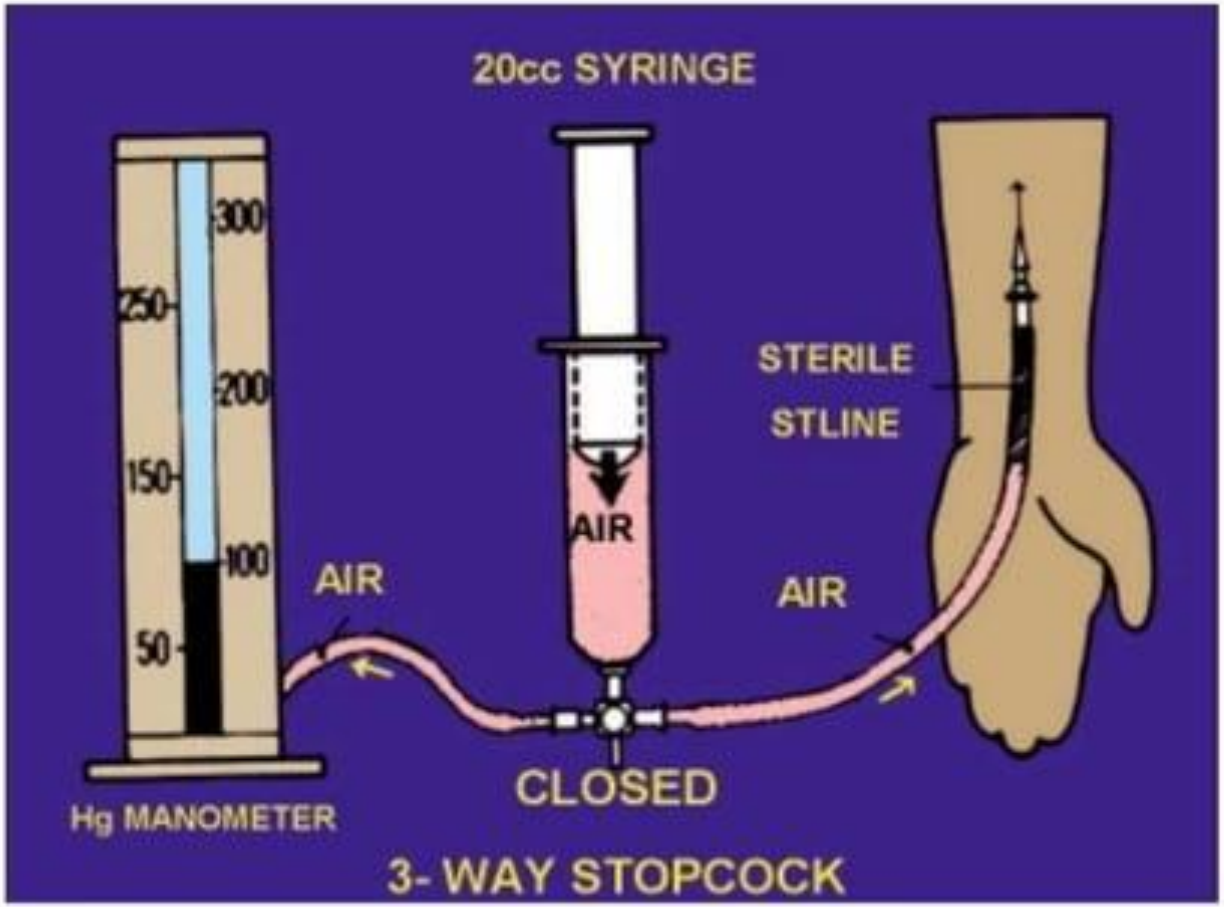
Injury
Volume 52, Issue 10, October 2021, Pages 3111-3116

Tibial shaft fractures – to monitor or not? a multi-centre 2 year comparative study assessing the diagnosis of compartment syndrome in patients with tibial diaphyseal fractures

Matilda FR Powell-Bowns [a], Joseph E Littlechild [b], Liam Z Yapp [a], Alastair C Faulkner [c], Timothy O White [a], Margaret M McQueen [a], Andrew D Duckworth [a d]

- No difference in the complications for monitored vs non-monitored patients with a tibial shaft fracture.
- Continuous compartment pressure monitoring appears to be a safe with no increase in the rate of fasciotomies performed.
- There was a trend towards reduced time to fasciotomy and a reduced rate of split skin grafting for wound closure with CCPM

Pressure Measurements



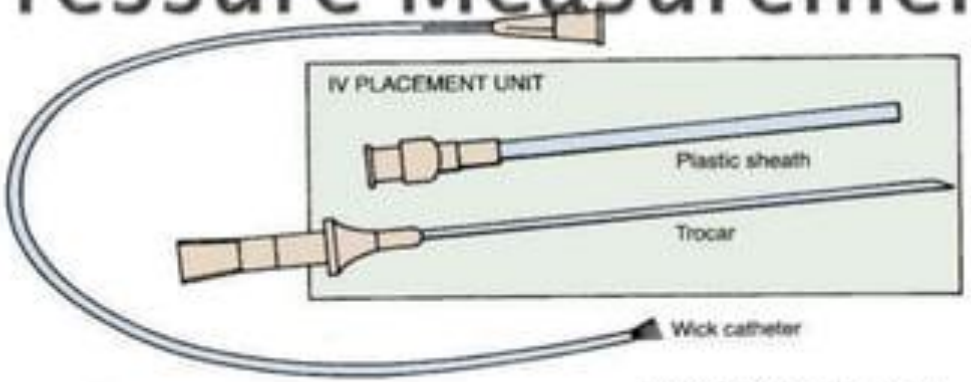
Infusion Technique

- Designed by Whitesides
- Consits of-
- Simple
- Can be used for intermittent recordings

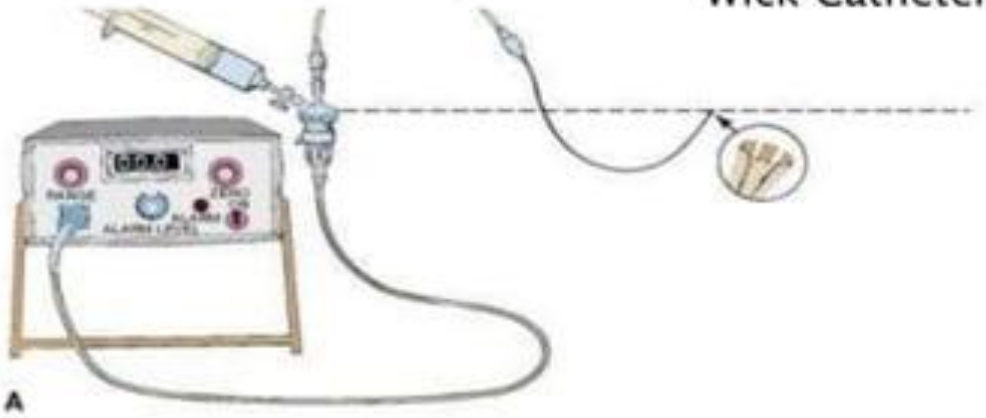
Disadvantage-

- Not suitable for continuous monitoring
- Required injection of saline into the compartment and in this way could aggravate impending syndrome

Pressure Measurements

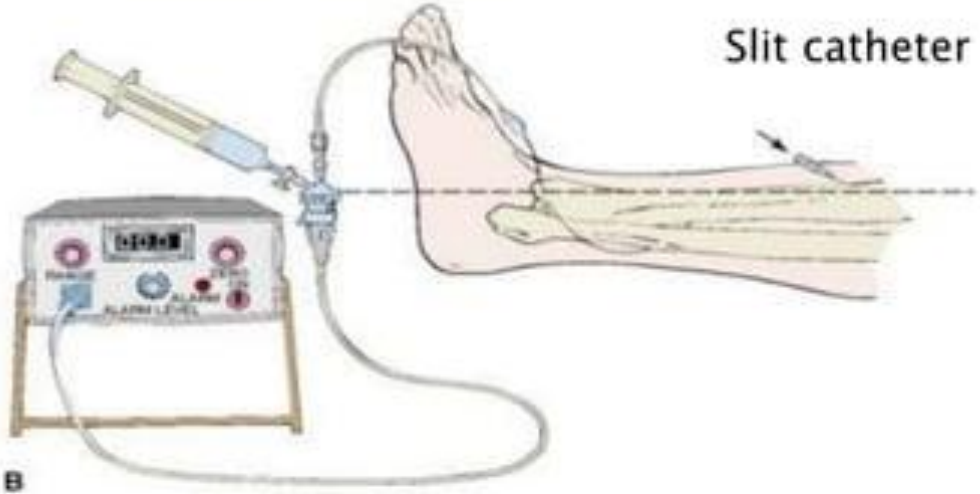


Wick Catheter



A

Slit catheter



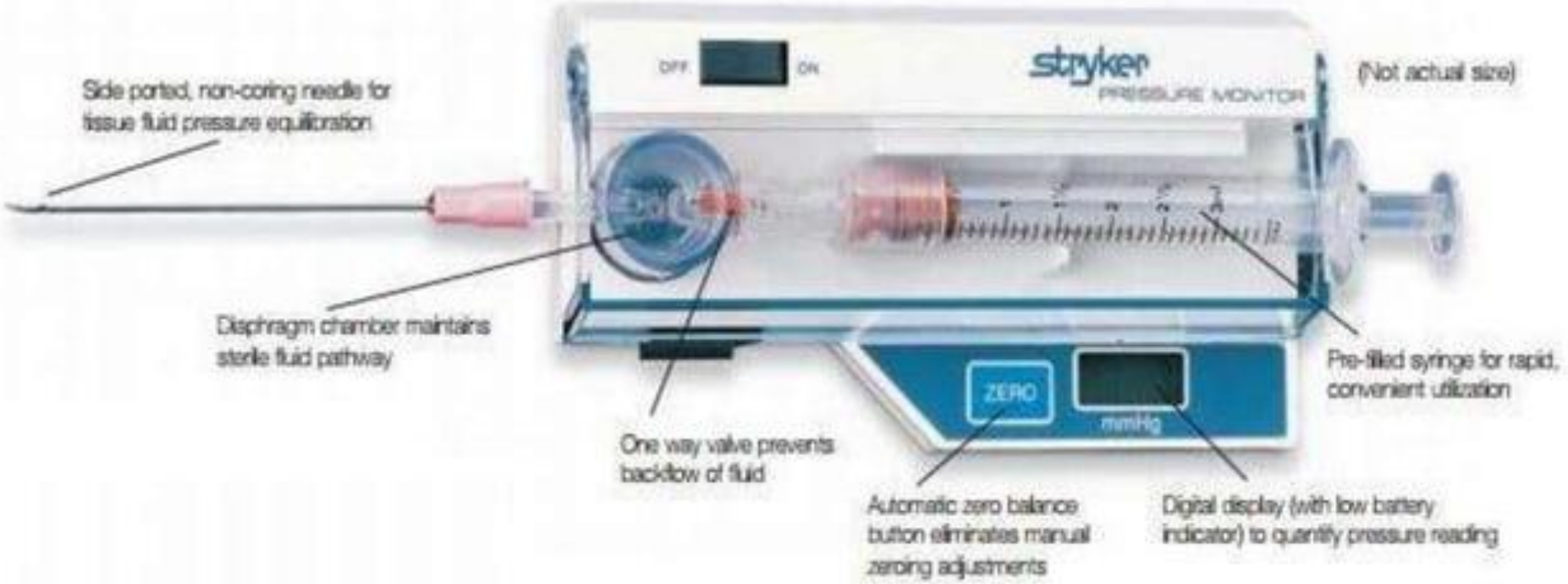
B

Slit and wick Catheters

- Requires bubble free column of saline
- The transducer dome should be level with the insertion site
- More accurate
- Can be used for continuous monitoring

Disadvantage –Tip of the catheter may become blocked by a blood clot.

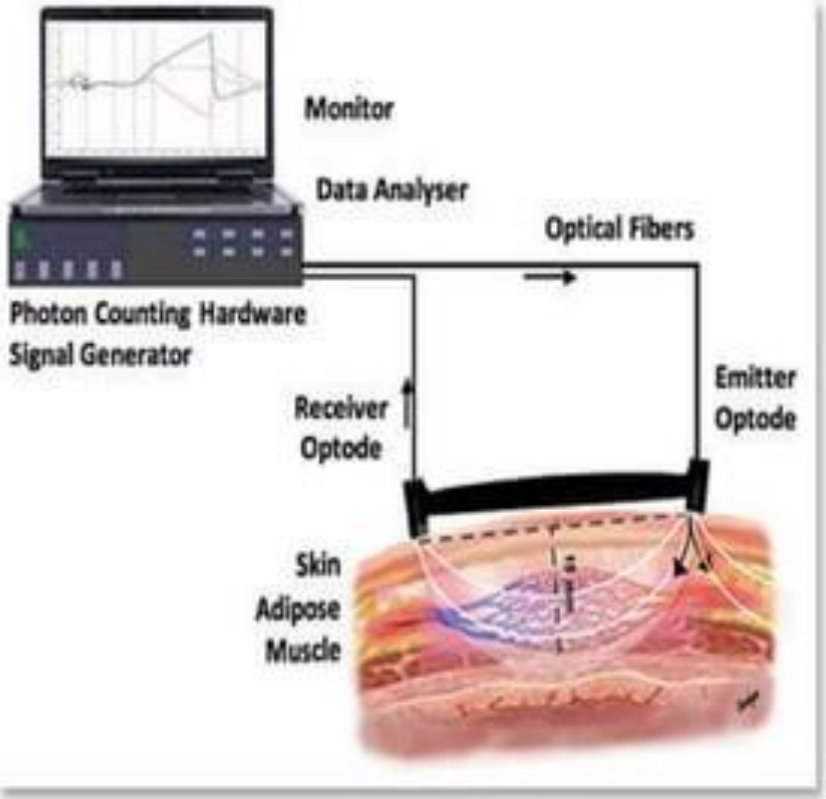
Pressure Measurements



Stryker STIC catheter system

- Hand-held device
- Easy to use
- Measure acute compartment pressure quickly
- Can be carried in pocket
- More accurate
- Can be used for continuous monitoring

Pressure Measurements

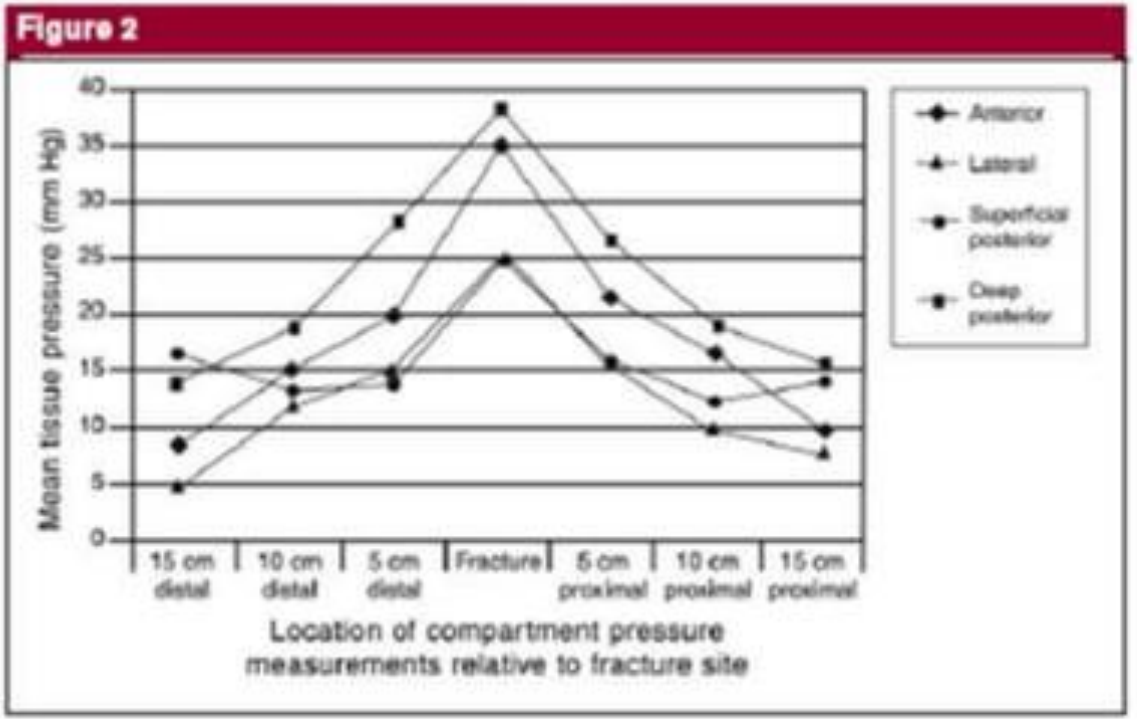


Near infrared spectroscopy (NIRS)

- Non-invasive method of detecting variations in the level of muscle haemoglobin and myoglobin.
- Has good predictive power in Chronic exertional CS
- Diagnostic value in acute compartment syndrome is limited since changes in relative oxygenation may have already occurred .

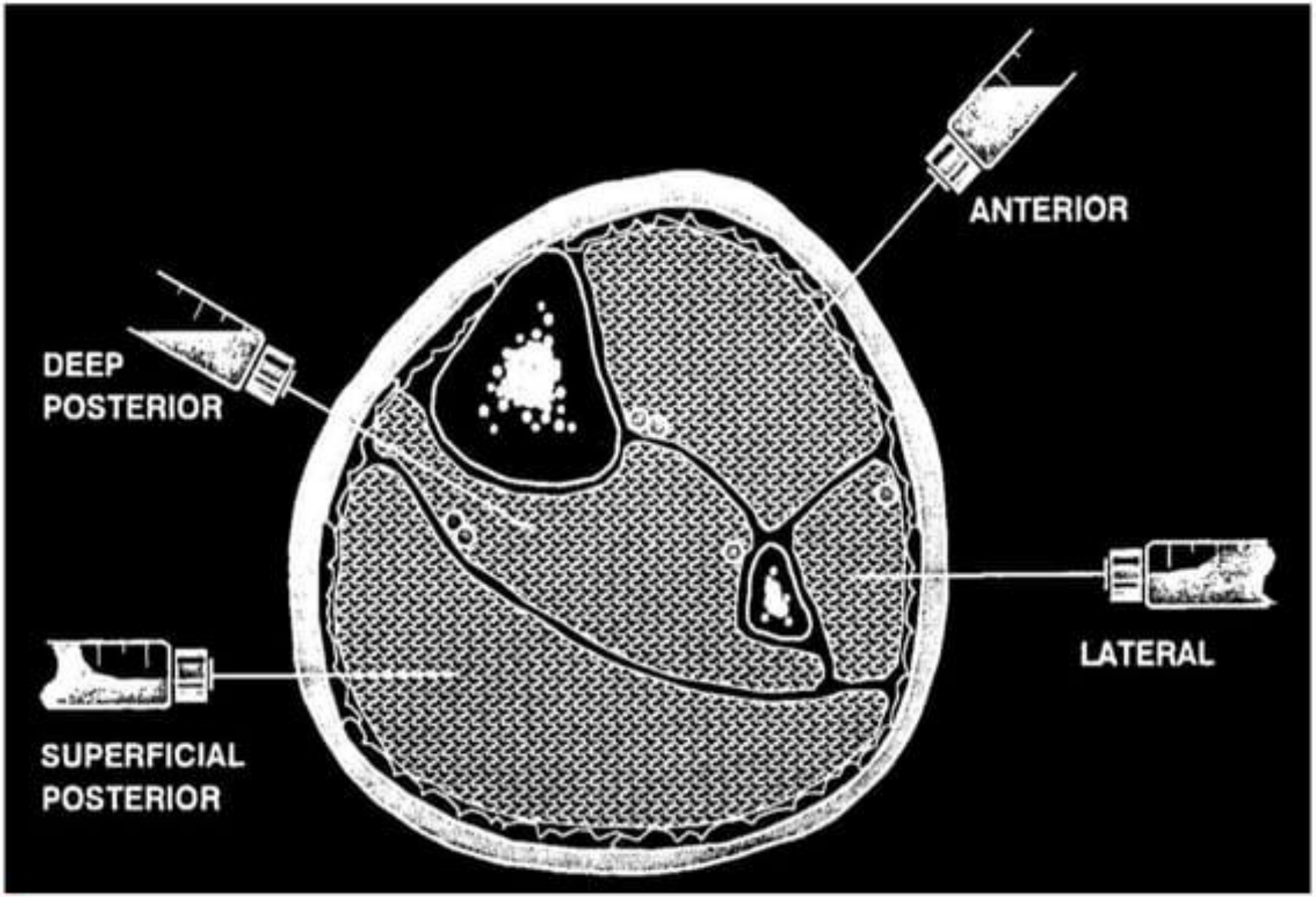
Pressure Measurements

- Measurements must be made in all compartments
- Highest pressure usually seen in Anterior or deep posterior compartment
- Measurement made within 5 cm of fractures
- Marginal readings must be followed with repeat physical exam and repeat compartment pressure measurement
- Highest figure should be used in deciding the need for fasciotomies.



Distance from fracture affects pressure

Heckman, Whitesides JBJS


ANTERIOR
DEEP
POSTERIOR
LATERAL
SUPERFICIAL
POSTERIOR

Pressure Threshold for Fasciotomy

McQueen, Court-Brown JBJS Br 1996

- 116 pts with tibial diaphyseal fx had continuous monitoring of anterior compartment pressure for 24 hours
  - 53 pts had ICP over 30 mmHg
  - 30 pts had ICP over 40 mmHg
  - 4 pts had ICP over 50 mmHg
- Only 3 had Δ P (DBP-ICP) of < 30, they had fasciotomy
- None of the patients had any sequelae of the compartment syndrome
- Decompression should be performed if the differential pressure level drops to under 30 mmHg

INTRAOPERATIVE PRESSURE MEASUREMENT

Diastolic Blood Pressure in Patients With Tibia Fractures Under Anaesthesia: Implications for the Diagnosis of Compartment Syndrome

Sanjeev Kakar, MD, MRCS Eng, Reza Firoozabadi, MD,† Jason McKean, MD,‡ and Paul Tornetta III, MD**

- This was a prospective cohort study in a level 1 trauma center, with a consecutive series of 242 patients with a tibia fracture.
- Measured diastolic blood pressure preoperatively, intraoperatively and postoperatively
- Found ~20 mmhg (lower) difference in intraop pressures

notes that the delta p may be spuriously low intraoperatively, and with tibial nailing, it is safe to assume the delta p will return to a higher level postoperatively.

They recommended continued monitoring in the postoperative period with clinical examination and measurements as needed

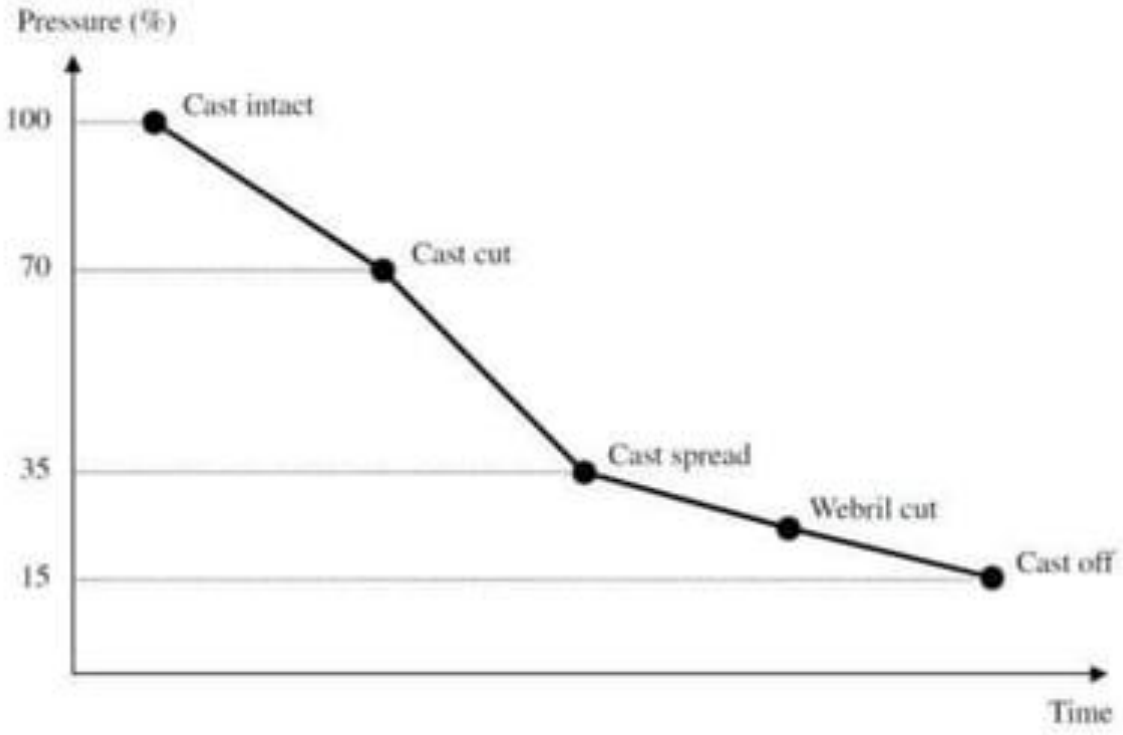
for the diagnosis of compartment syndrome. J Orthop Trauma. 2007 Feb;21(2):99-103

Emergent Treatment

- **Remove** cast or dressing
- Place **at level of heart**
  (DO NOT ELEVATE as elevation reduces the arterial inflow and the arterio-venous pressure gradient on which perfusion depends.
  Perfusion pressure = $P_a - P_v$
- **Alert** OR and Anesthesia
- Medical treatment- **Supplemental oxygen administration**
- Ensure patient is normotensive, as hypotension reduces perfusion pressure and facilitates further tissue injury.

Removal of circumferential Casts

- Compartmental pressure falls by 30% when cast is split on one side
- Falls by 65% when the cast is spread after splitting.
- Splitting the padding reduces it by a further 10% and complete removal of cast by another 15%
- Total of 85-90% reduction by just taking off the plaster!



Surgical Treatment

- Fasciotomy
  Fasciotomy
  Fasciotomy
- All Compartments

Surgical Treatment

Fasciotomy

- Prophylactic release of pressure before permanent damage occurs
- Does not reverse the damage present but can prevent secondary sequelae of the CS
- Look for direct injury to vessels and nerves, should be repaired, if these exist.
- Fracture care- stabilise
  - Plating
  - Intramedullary nailing or
  - External fixator

Provisional stabilization of fractures associated with compartment syndrome with an external fixator.

Indications for fasciotomy

- Unequivocal positive clinical findings
- Pressure within 15-20 mm hg of DBP
- Rising tissue pressure
- Significant tissue injury or high risk pt
- > 6 hours of total limb ischemia
- Injury at high risk of compartment syndrome

CONTRAINDICATION -

Missed compartment syndrome (>24-48 hrs)

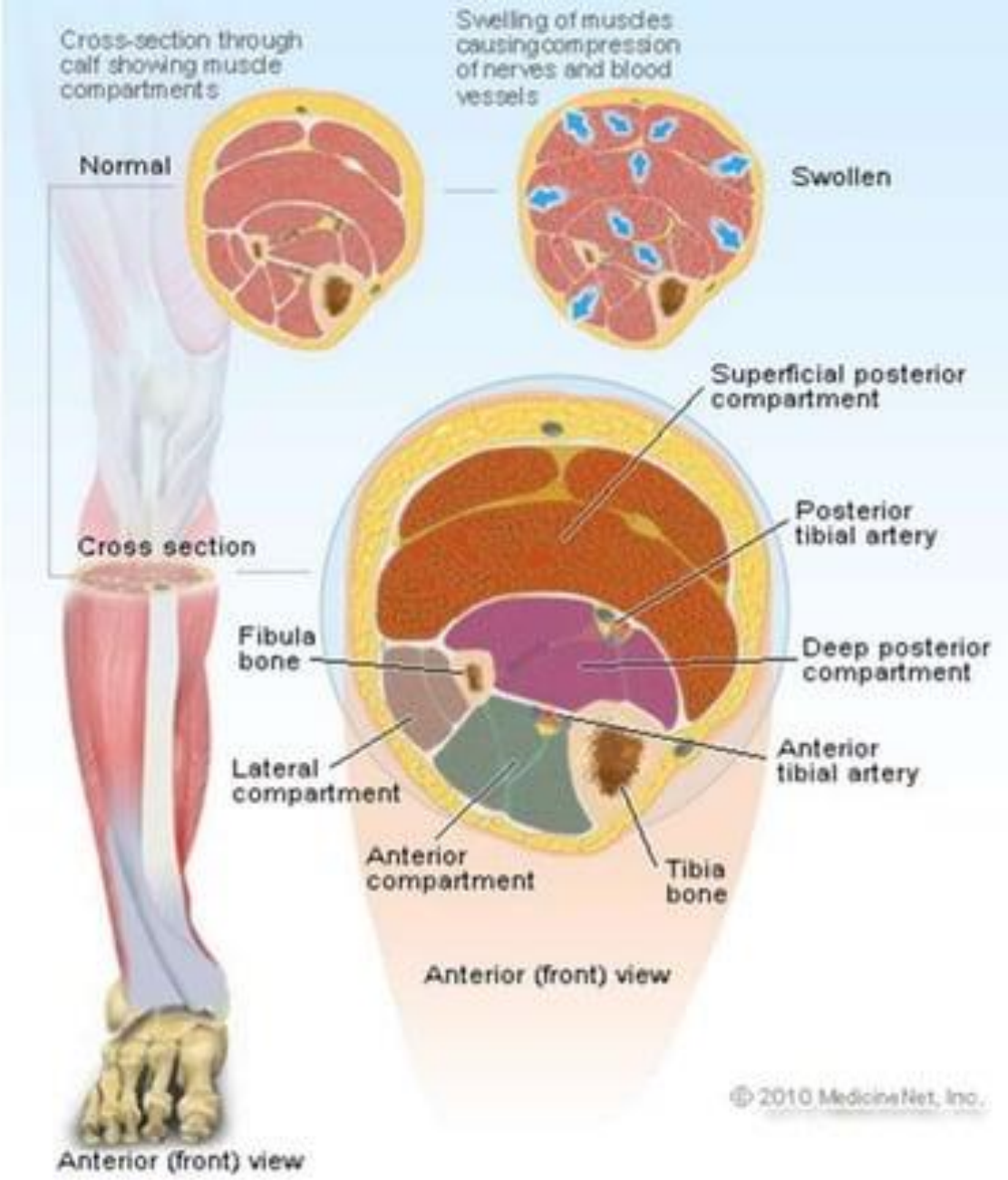
(Sheridan and Matsen reported an infection rate of 46 % and an amputation rate of 21 % after late fasciotomy.)

Fasciotomy Principles

- Make early diagnosis
- Long extensile incisions
- Release all fascial compartments
- Preserve neurovascular structures
- Debride necrotic tissues
- Coverage within 7-10 days

Lower leg

- 4 compartments
  - Lateral: Peroneus longus and brevis
  - Anterior: EHL, EDL, Tibialis anterior, Peroneus tertius
  - Supeficial posterior- Gastrocnemius, plantaris,Soleus
  - Deep posterior- Tibialis posterior, FHL, FDL



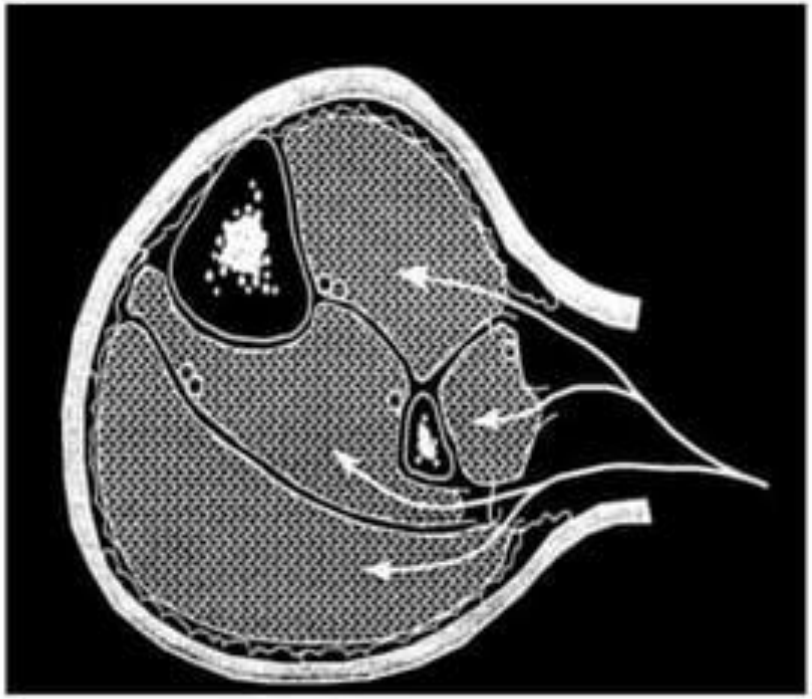
Compartment syndrome of Leg

- Three decompression techniques
  - Fibulectomy
  - Perifibular fasciotomy
  - Double-incision fasciotomy

- Fibulectomy
  - Described by Patman and Thompson
  - Is unnecessary and too radical
  - Obsolete now

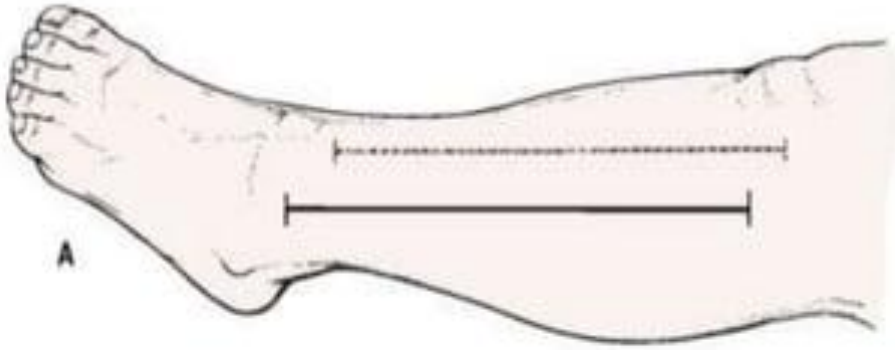
Perifibular Fasciotomy

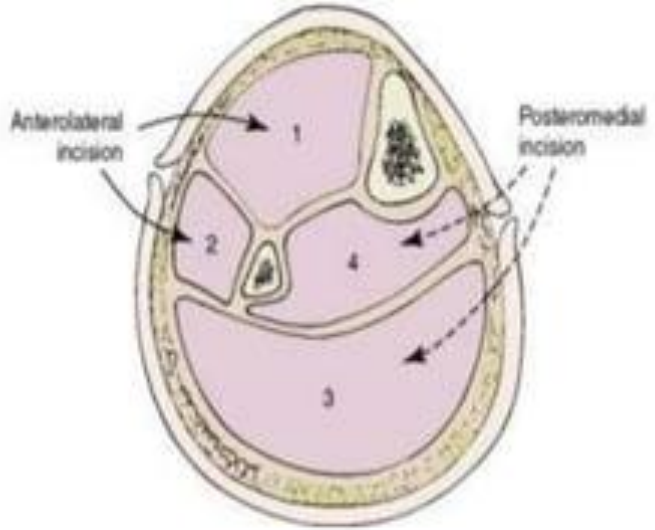
- Matsen et al (1980)
- Single lateral incision just posterior to fibula (extends proximally from the head of the fibula and distally to the ankle)
- Expose and protect Common Peroneal Nerve proximally
- More difficult for decompression of deep compartment



Double incision Fasciotomy

- In most instances it affords better exposure of the four compartments
- Two vertical incisions extending from knee to ankle separated by minimum 8 cm
- One incision over interval between anterior and lateral compartments
  - Superficial peroneal nerve
- Other incision located 1–2 cm behind posteromedial aspect of tibia
  - Saphenous nerve and vein





Double incision Fasciotomy

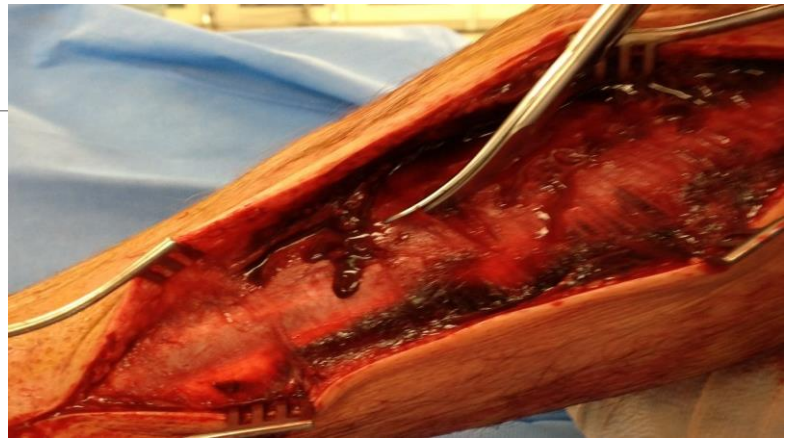
- The use of **generous skin incisions** is supported
- Lengthening the skin incisions to an average of 16 cm decreases intra compartmental pressures significantly

LEG FASCIOTOMY

- Draw all anticipated surgical incisions – do not place implants through a fasciotomy incision that is left open
  - Infection Risk
- Planned plateau incision

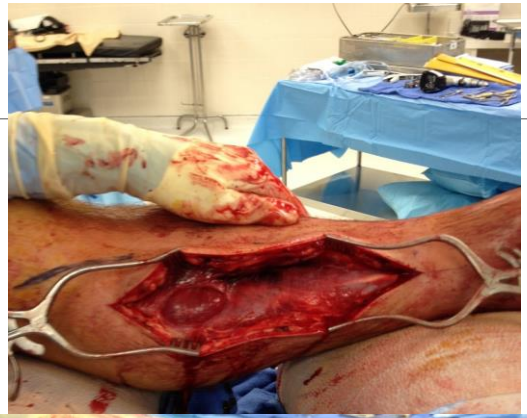
LEG FASCIOTOMY

- Dual Incision
  - Incision over the lateral leg with two deep fascial incisions using scissors (anterior and lateral compartments)
  - Identification of superficial peroneal nerve in the lateral compartment



LEG FASCIOTOMY

- Dual Incision
  - Incision posterior to the posteromedial tibia with release of superficial and deep posterior compartments
  - Find the soleal bridge and enter the deep posterior compartment off the back of the tibia



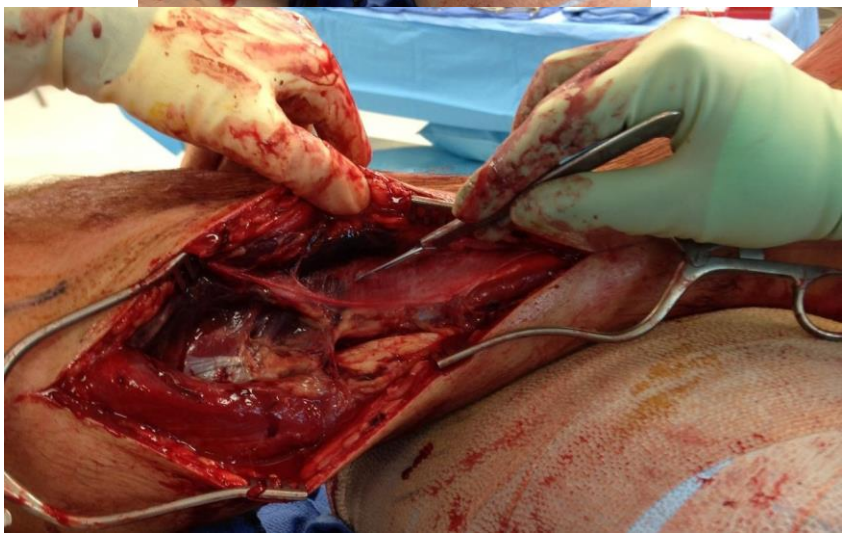
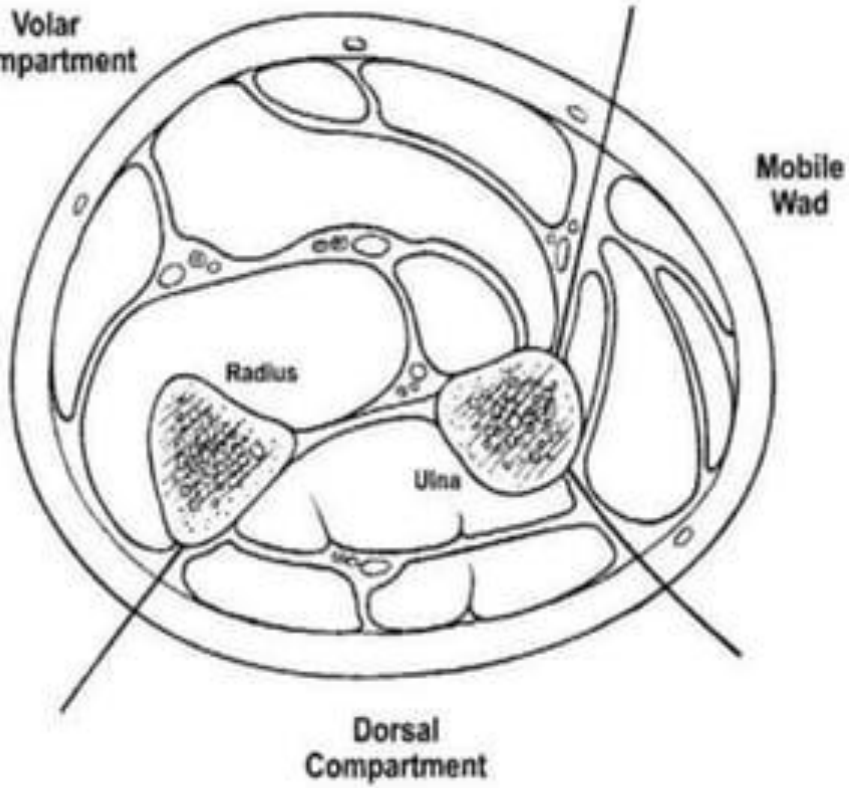


Image provided by Lisa Cannada MD

Forearm

- Anatomy-3 compartments
  - Mobile wad-BR,ECRL,ECRB
  - Volar-Superficial and deep flexors
  - Dorsal-Extensors
  - Pronator quadratus described as a separate compartment



Forearm Fasciotomy

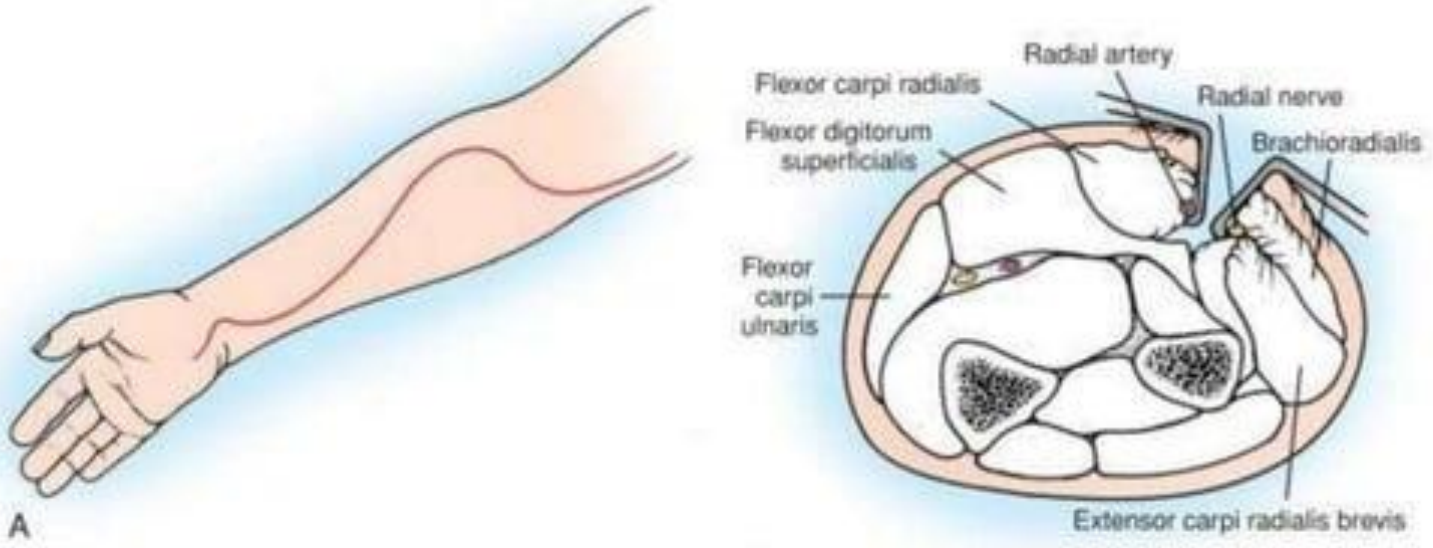
Fasciotomies of volar flexor compartment-

- Volar Henry Approach or
- Volar ulnar approach

Fasciotomy of dorsal compartment

- Thompson exposure

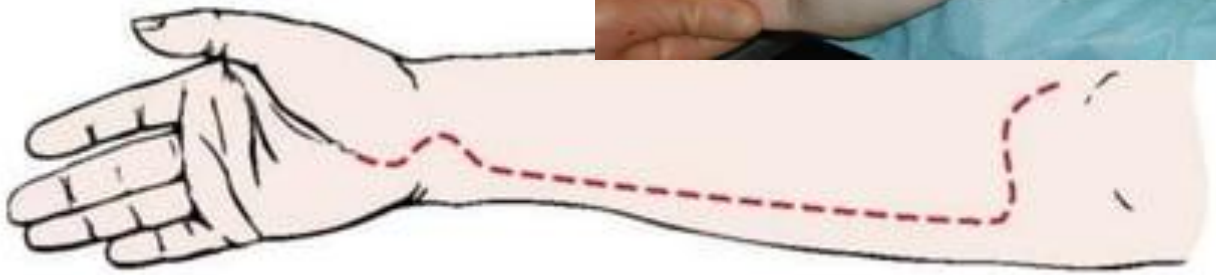
No tourniquet should be used.



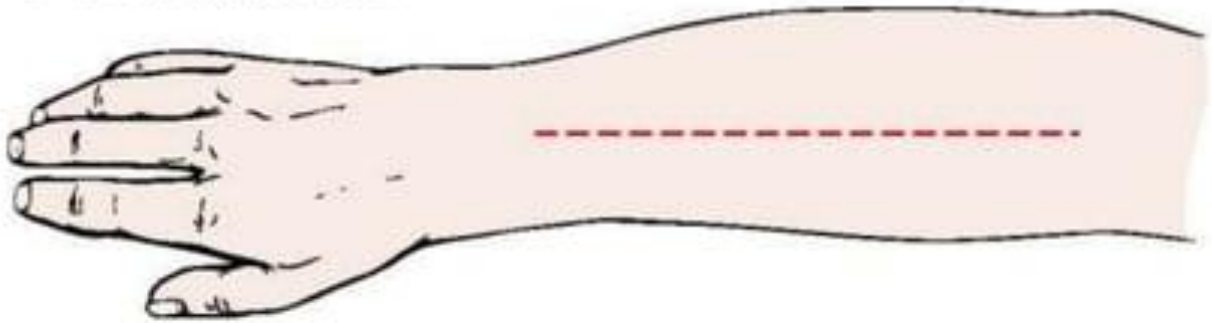
Volar Henry approach

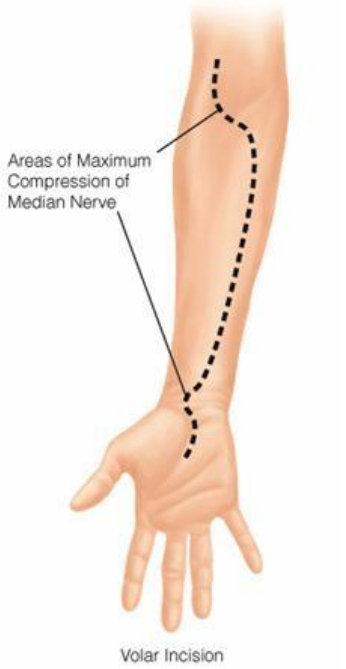
Forearm Fasciotomy

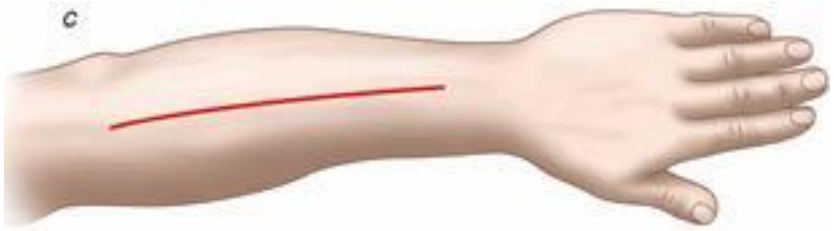
Volar ulnar approach



Dorsal approach



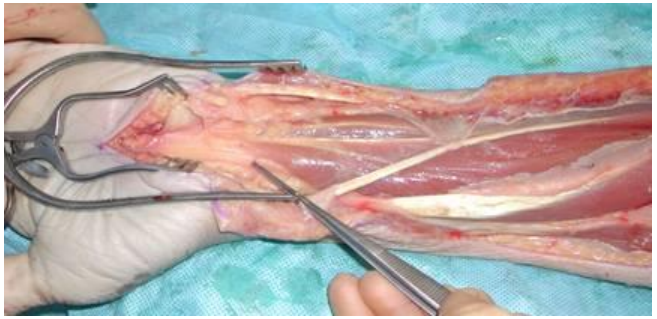

Areas of Maximum
Compression of
Median Nerve
Volar Incision


C

Forearm Fasciotomy

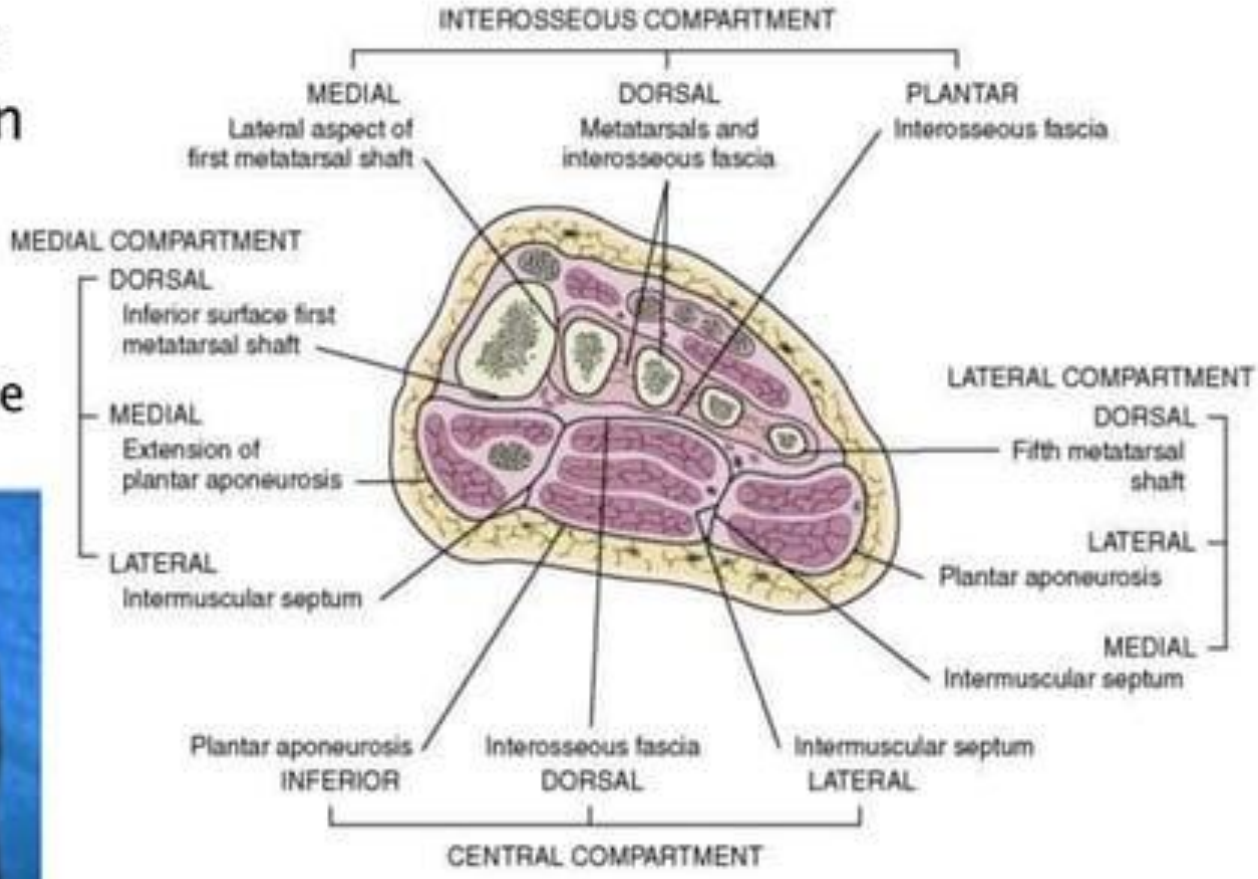
Protect median nerve, brachial artery and tendons after release

Consider dorsal release



Foot

- 9 compartments
- Clinical suspicion with
  - Lisfranc fracture dislocation
  - Calcaneal fracture



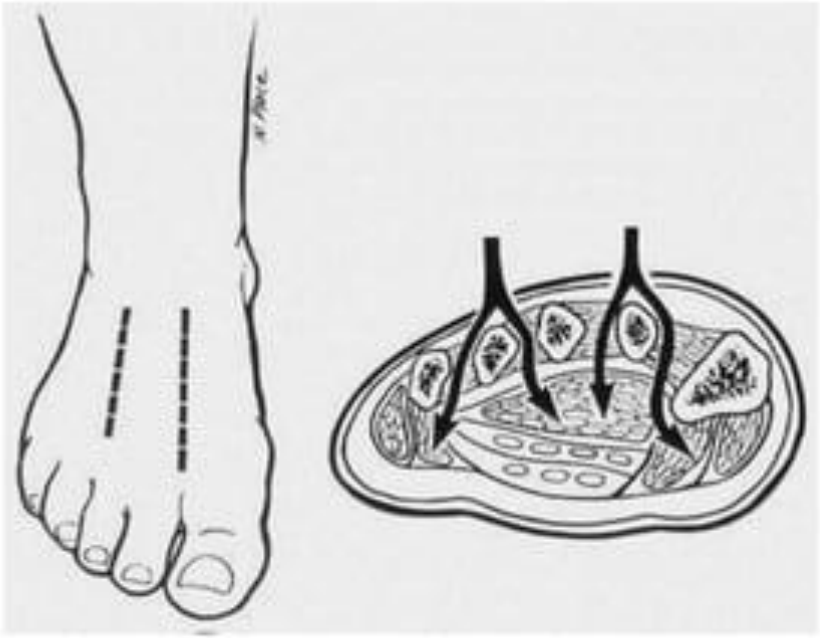
COMPARTMENTS OF THE FOOT

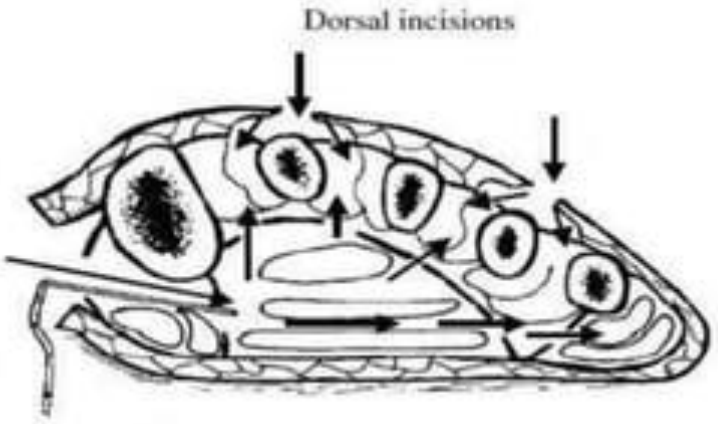
9 main compartments (controversial)

- medial
  - abductor hallucis
  - flexor hallucis brevis
- lateral
  - abductor digiti minimi
  - flexor digiti minimi brevis
- interosseous (x4)
- central (x3)
  - superficial
    - flexor digitorum brevis
  - central
    - quadratus plantae
  - deep
    - adductor hallucis
    - posterior tibial neurovascular bundle

Fasciotomy of Foot

- Two approaches
  - **Dorsal incision**–to release the interosseous and adductor
  - **Medial incision**–to release the medial, superficial ,lateral and calcaneal compartments





FOOT COMPARTMENT SYNDROME CONTROVERSY

Failure or delay to diagnose acute compartment syndrome may lead to irreparable soft-tissue damage and poor long-term function .Controversy exists regarding acute versus delayed management of FCS. Limited data exists regarding long-term outcomes of patients who develop an acute FCS. Many authors advocate toward emergent fasciotomy in attempts to improve blood flow by decreasing intra-compartmental pressures and prevent nerve-based pain; however, this belief is not universally shared due to the inherent risks of these procedures. Techniques for compartment release are inconsistent in the literature, likely arising from the debate regarding the number of foot compartments that exist and the compartments that are clinically relevant for decompression

Near two-thirds of patients who underwent decompressive fasciotomy complained of pain, discomfort, and stiffness with ambulation at 1-year follow-up..

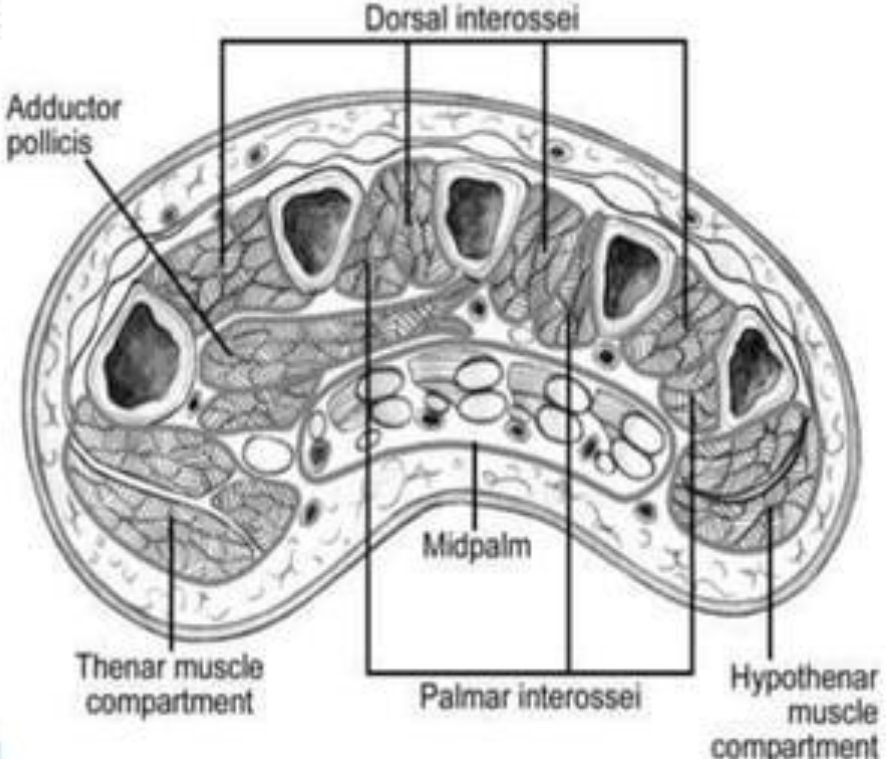
Patients must be counseled on the reported outcomes and potential complications of both surgical compartment release and nonsurgical management, thus allowing the patient to make an informed decision regarding treatment.

Hand

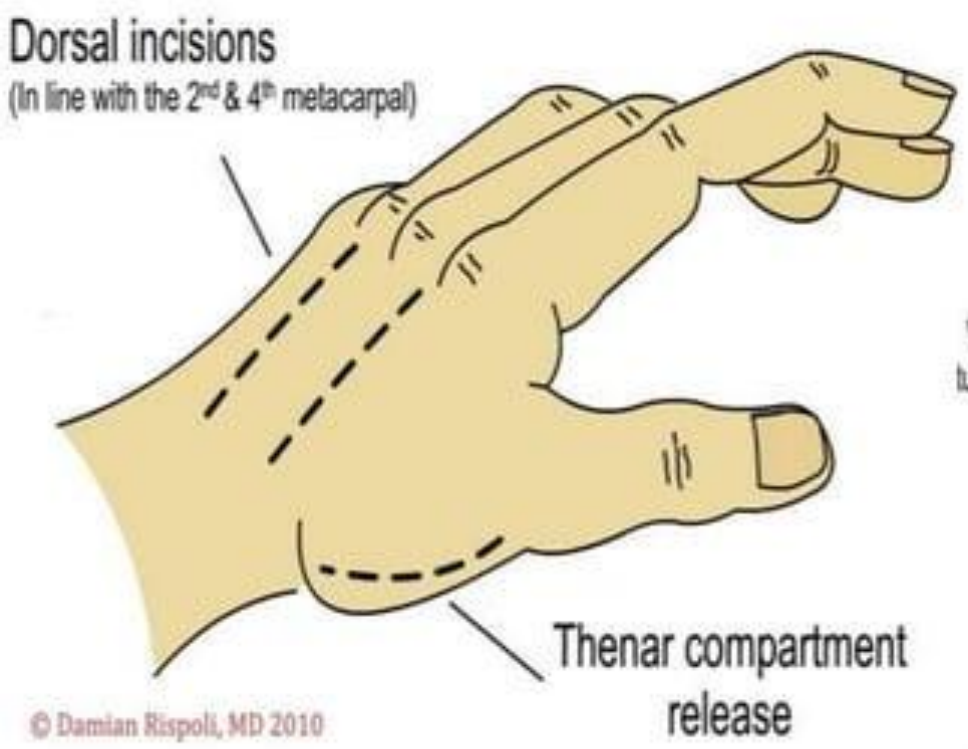
- CS of hand are rare
- About half also have simultaneous forearm CS
- Difficult to measure tissue pressure

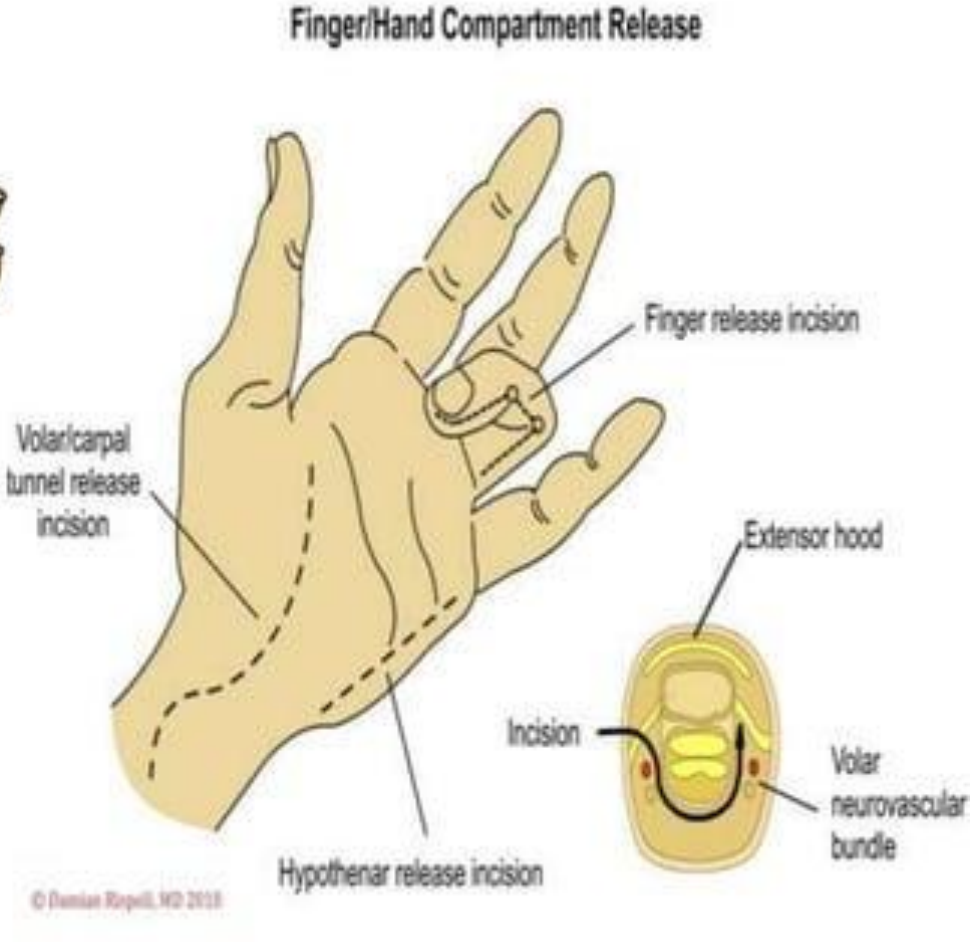
10 compartments

- Dorsal interossei (4)
- Palmar interossei (3)
- Thenar and Hypothenar
- Adductor pollicis



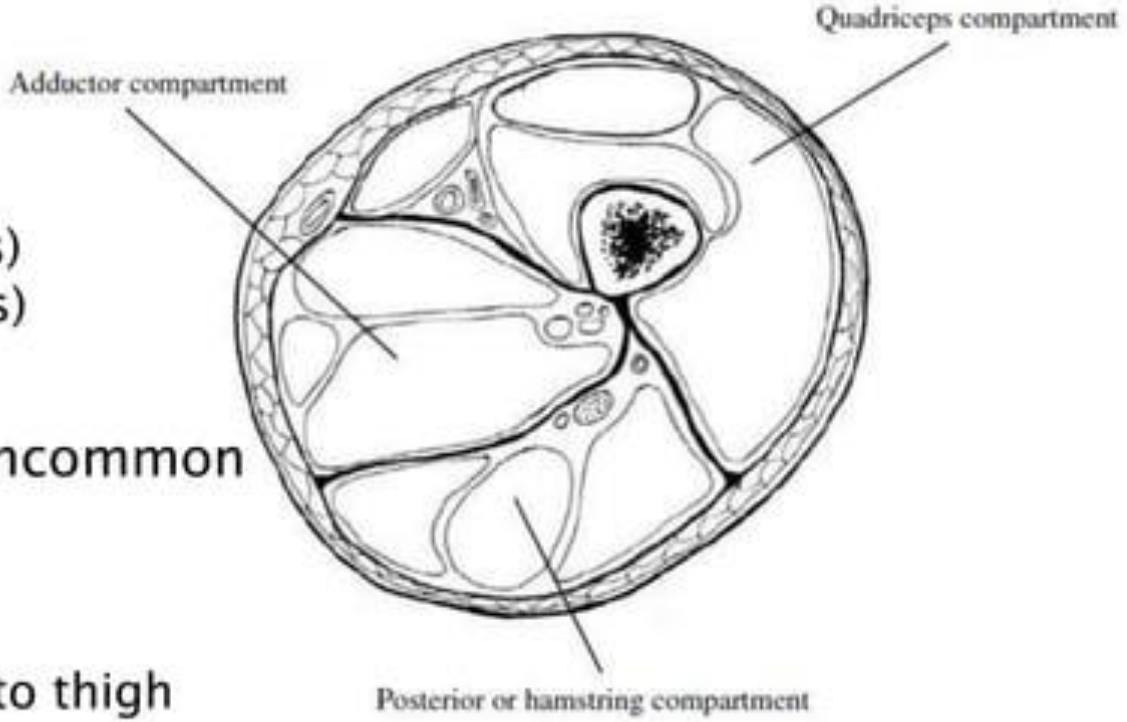
Hand Fasciotomy



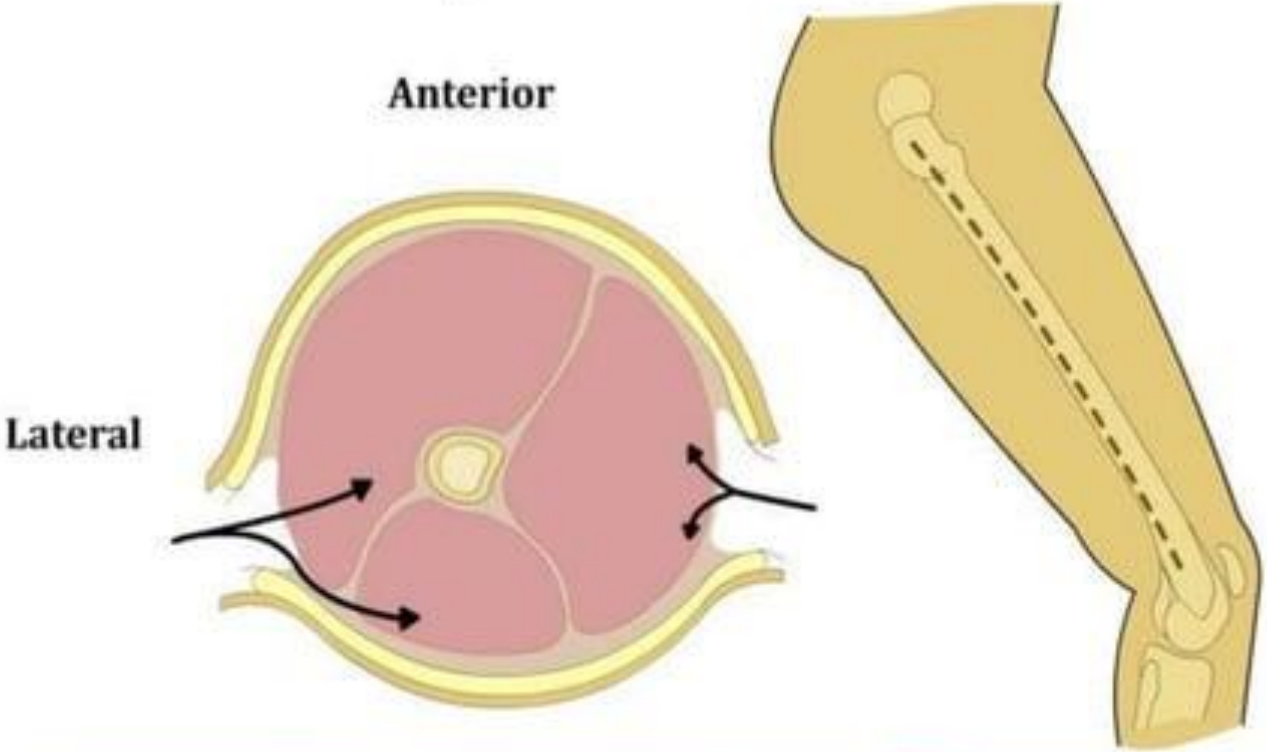


Thigh

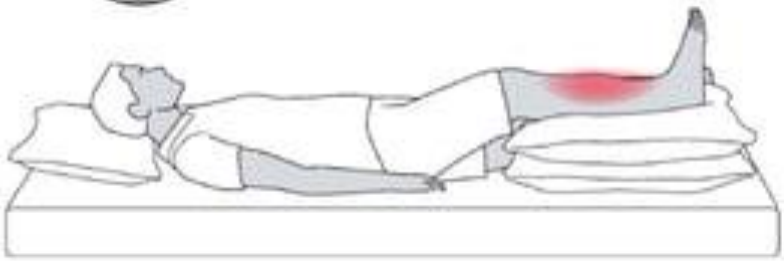
- 3 Compartments
  - Anterior (Quadriceps)
  - Posterior (Hamstrings)
  - Medial (Adductors)
- Acute CS of thigh is uncommon
- Risk factors
  - Polytrauma
  - Severe blunt trauma to thigh
  - Vascular injury
  - Prolonged external compression
  - Over lengthening with skeletal traction



Fasciotomy of Thigh



Delayed Fasciotomy Is it Safe?



- Limited evidence
- Infection rate of 46% and amputation rate of 21% after a delay of 12 hours (Sheridan, Matsen.JBJS 1976)
- Finkelstein et al. J Trauma 1996
  - 5 pts, nine fasciotomies in lower limbs
  - Avg delay 56 h. (35-96 hrs).
  - 1 pt died of septicaemia and multi organ failure, the others required amputations
- Recommendations
  - If the CS has existed for more than 8-10 hrs, supportive treatment of acute renal failure should be considered.
  - Routine fasciotomy may not be successful in delayed cases and the decision to perform fasciotomy requires judgment by the most experienced surgeon available.

MISSED COMPARTMENT SYNDROME

Managing missed lower extremity compartment syndrome in the physiologically stable patient: A systematic review and lessons from a Level I trauma center

Graeme E. Glass, PhD, FRCS(Plast), Robert M.T. Staruch, MBBS, MRCS, Jonathan Simmons, MSc, FRCS(Plast), Graham Lawton, MD, FRCS(Plast), Jagdeep Nanchahal, PhD, FRCS(Plast), FRACS, Abhilash Jain, MSc, PhD, FRCS(Plast), *and* Shehan P. Hettiaratchy, MA(Oxon), DM, FRCS(Plast), *Oxford, United Kingdom*

- No high quality literature in guiding treatment
- Classic findings show 46% infection and 21% amputation
- Multiple authors recommend close monitoring of renal and metabolic function with nonop treatment
- Late decompression and fasciotomy associated with high amputation rate

Wound Management

- After the fasciotomy, wound must be debrided of all devitalized tissue.
- Wound is not closed at initial surgery.
- Bulky compression dressing and a splint are applied.
- "VAC" (Vacuum Assisted Closure) can be used
- Foot and ankle should be placed in neutral to prevent equinus contracture.
- Incision for the fasciotomy usually can be closed after three to five days
- After 48 hours, the wound is inspected and any further necrotic tissue is removed.

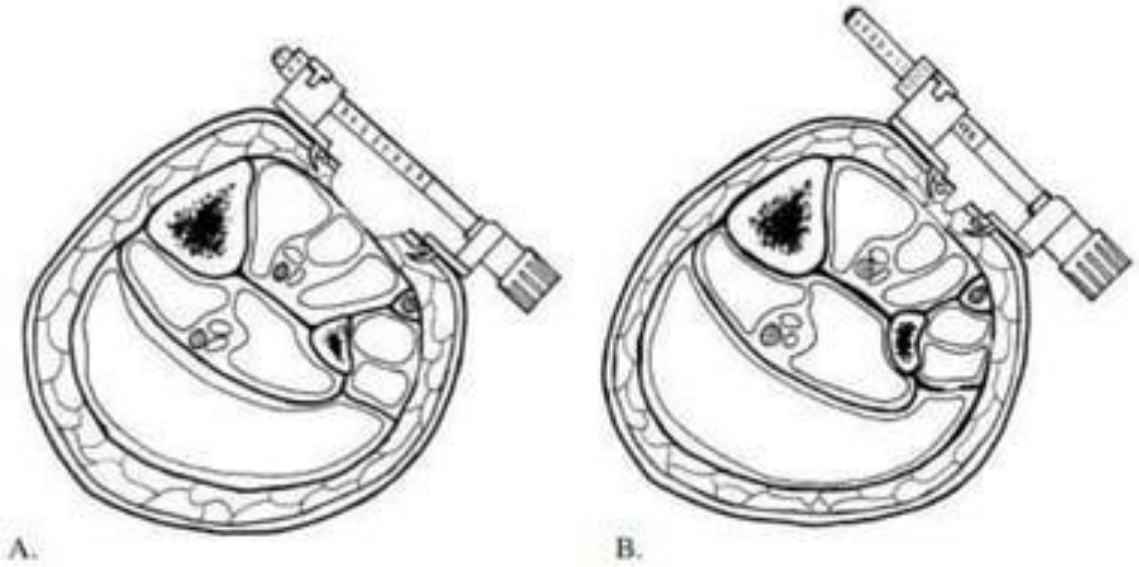
Wound Management

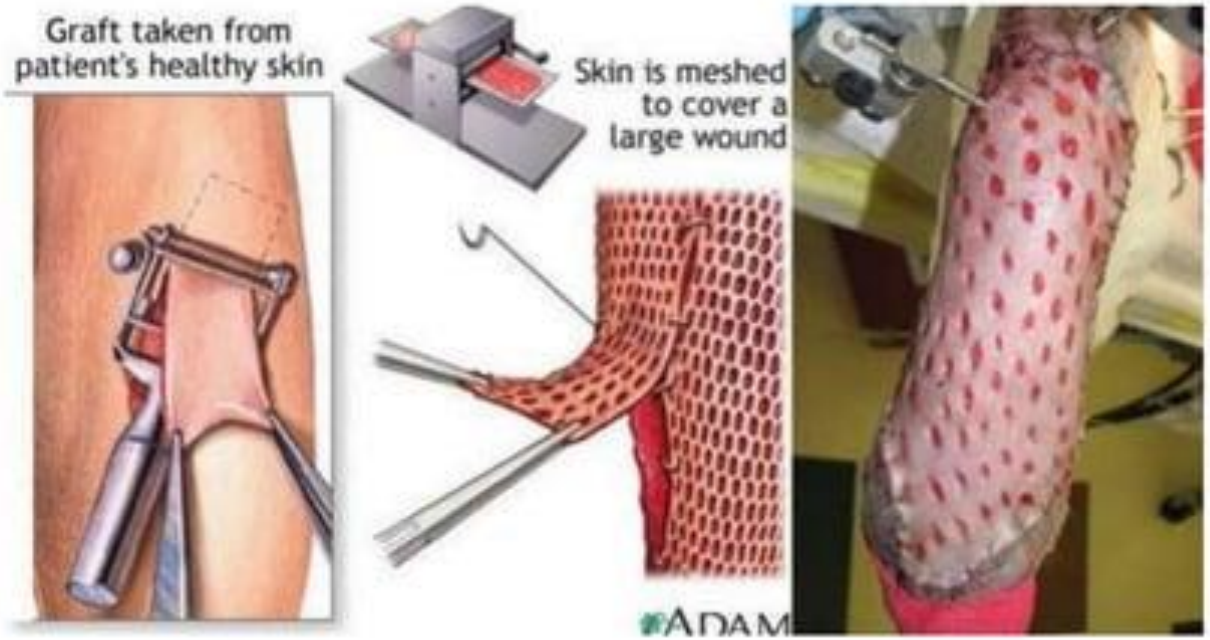
- After 48-72 hours, the wound is inspected and any further necrotic tissue is removed.
  - Limb should not be at risk for further swelling
  - Pt should be adequately stabilized
  - *Usually requires skin graft*
  - Delayed primary closure is possible if residual swelling is minimal
  - Flap coverage needed if nerves, vessels, or bone exposed
- Goal is to obtain definitive coverage within 7-10 days
- Several techniques are available
  - Progressive closure by wire sutures or tape
  - ETE(External Tissue Extender) tension bands
  - Dermatotraction by Sure-Closure®
  - Rod-tensioning device
  - Skin grafting

(A)

(B)

(C)


A.
B.


Graft taken from patient's healthy skin
Skin is meshed to cover a large wound
A.D.A.M.

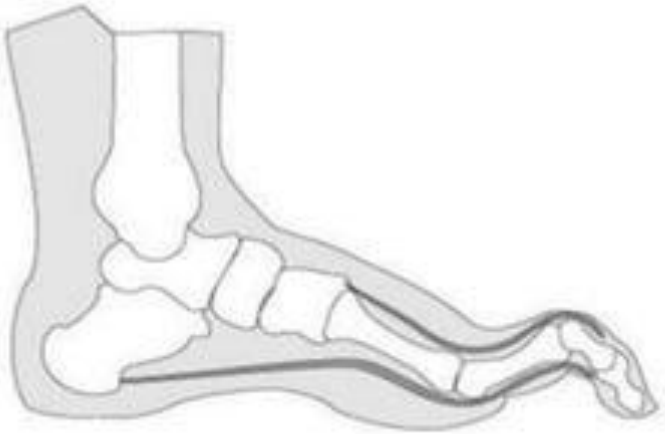

C-ARMOR
C-ARMOR

Complications Related to Fasciotomies

- Altered sensation within the margins of the wound (77%)
- Dry, scaly skin (40%)
- Pruritus (33%)
- Discolored wounds (30%)
- Swollen limbs (25%)
- Tethered scars (26%)
- Recurrent ulceration (13%)
- Muscle herniation (13%)
- Pain related to the wound (10%)
- Tethered tendons (7%)

Complications related to CS

- Volkmann's contracture
- Weak dorsiflexors
- Claw toes
- Sensory loss
- Chronic pain
- Amputation



Get a good Consent in written / recorded on video

Need for fasciotomy

May lose the limb even after fasciotomy

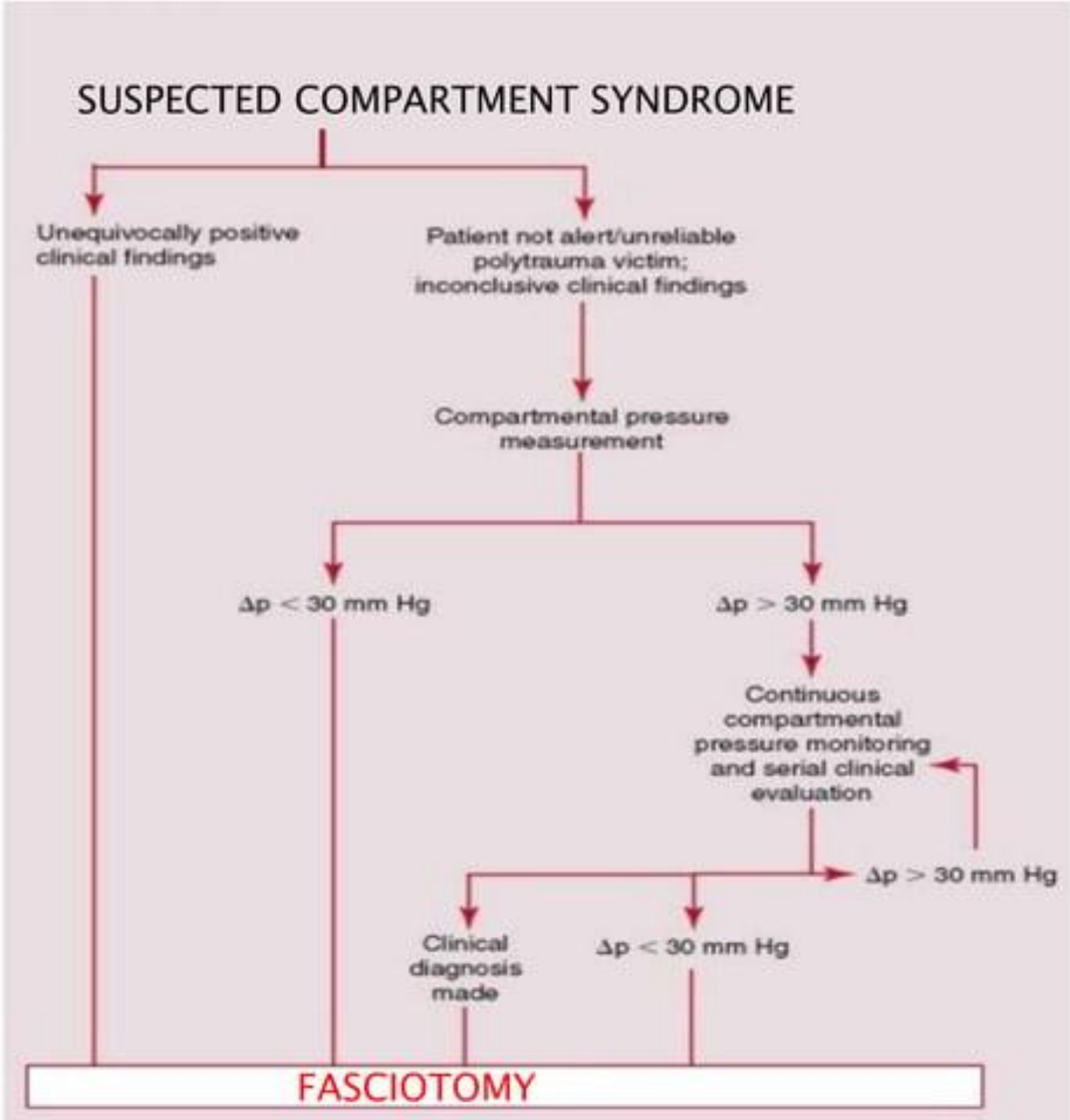
Even if it survives, there may be loss of part

Will require secondary surgery for the wound created

Scar formation

May need secondary surgery for correcting the problems already caused by ischemia

- 2 major studies show that greater than 50%cases decided against doctors.


SUSPECTED COMPARTMENT SYNDROME
Unequivocally positive clinical findings
Patient not alert/unreliable polytrauma victim; inconclusive clinical findings
Compartmental pressure measurement
Δp < 30 mm Hg
Δp > 30 mm Hg
Continuous compartmental pressure monitoring and serial clinical evaluation
Δp > 30 mm Hg
Clinical diagnosis made
Δp < 30 mm Hg
FASCIOTOMY

Take home message

- Keep a high index of suspicion
- Treat as soon as you suspect CS
- If clinically evident, do not measure
- Always get a get a good Consent
- Fasciotomy is
  - Reliable, safe, and effective
  - The only treatment for compartment syndrome, *when performed in time*

KEY REFERENCES

- Al-Dadah OQ, Darrah C, Cooper A, Donell ST, Patel AD. Continuous compartment pressure monitoring vs. clinical monitoring in tibial diaphyseal fractures. *Injury*. 2008;39(10):1204-1209. doi:10.1016/j.injury.2008.03.029
- Duckworth AD, McQueen MM. The Diagnosis of Acute Compartment Syndrome: A Critical Analysis Review. JBJS Rev. 2017 Dec;5(12):e1. doi: 10.2106/JBJS.RVW.17.00016. PMID: 29206684.
- Kakar S, Firoozabadi R, McKean J, Tornetta P 3rd. Diastolic blood pressure in patients with tibia fractures under anaesthesia: implications for the diagnosis of compartment syndrome. J Orthop Trauma. 2007 Feb;21(2):99-103. doi: 10.1097/BOT.0b013e318032c4f4. PMID: 17304064.
- McQueen, MM., Duckworth, AD. (2020). *Acute Compartment Syndrome.* Tornetta, P.; Ricci, W.; Ostrum, W.; McQueen, M.; McKee, M.; Court-Brown, C. Rockwood And Green's Fractures in Adults, 9th Edition. LWW.
- McQueen MM, Duckworth AD, Aitken SA, Sharma RA, Court-Brown CM. Predictors of Compartment Syndrome After Tibial Fracture. J Orthop Trauma. 2015 Oct;29(10):451-5. doi: 10.1097/BOT.0000000000000347. PMID: 25882967.
- McQueen MM, Duckworth AD, Aitken SA, Court-Brown CM. The estimated sensitivity and specificity of compartment pressure monitoring for acute compartment syndrome. *J Bone Joint Surg Am*. 2013;95(8):673-677. doi:10.2106/JBJS.K.01731
- O'Toole RV, Whitney A, Merchant N, et al. Variation in diagnosis of compartment syndrome by surgeons treating tibial shaft fractures. *J Trauma*. 2009;67(4):735-741. doi:10.1097/TA.0b013e3181a74613
- Schmidt AH, Di J, Zipunnikov V, Frey KP, Scharfstein DO, O'Toole RV, Bosse MJ, Obremskey WT, Stinner DJ, Hayda R, Karunakar MA, Hak DJ, Carroll EA, Collins SCJ, MacKenzie EJ; METRC. Perfusion Pressure Lacks Diagnostic Specificity for the Diagnosis of Acute Compartment Syndrome. J Orthop Trauma. 2020 Jun;34(6):287-293. doi: 10.1097/BOT.0000000000001719. PMID: 32332336.
- *Ulmer T. The clinical diagnosis of compartment syndrome of the lower leg: are clinical findings predictive of the disorder?. J Orthop Trauma. 2002;16(8):572-577. doi:10.1097/00005131-200209000-00006*
- Whitesides TE, Haney TC, Morimoto K, Harada H. Tissue pressure measurements as a determinant for the need of fasciotomy. Clin Orthop Relat Res. 1975 Nov-Dec;(113):43-51. doi: 10.1097/00003086-197511000-00007. PMID: 1192674.
- Whitney A, O'Toole RV, Hui E, et al. Do one-time intracompartmental pressure measurements have a high false-positive rate in diagnosing compartment syndrome?. *J Trauma Acute Care Surg*. 2014;76(2):479-483. doi:10.1097/TA.0b013e3182aaa63e