Tibia Fractures and Compartment Syndrome: When to Definitively Fix

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McCAIG INSTITUTE
FOR BONE AND JOINT HEALTH

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Disclosures

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  - Johnson & Johnson
- **Associate Editor**
  - Canadian Journal of Surgery

Objectives

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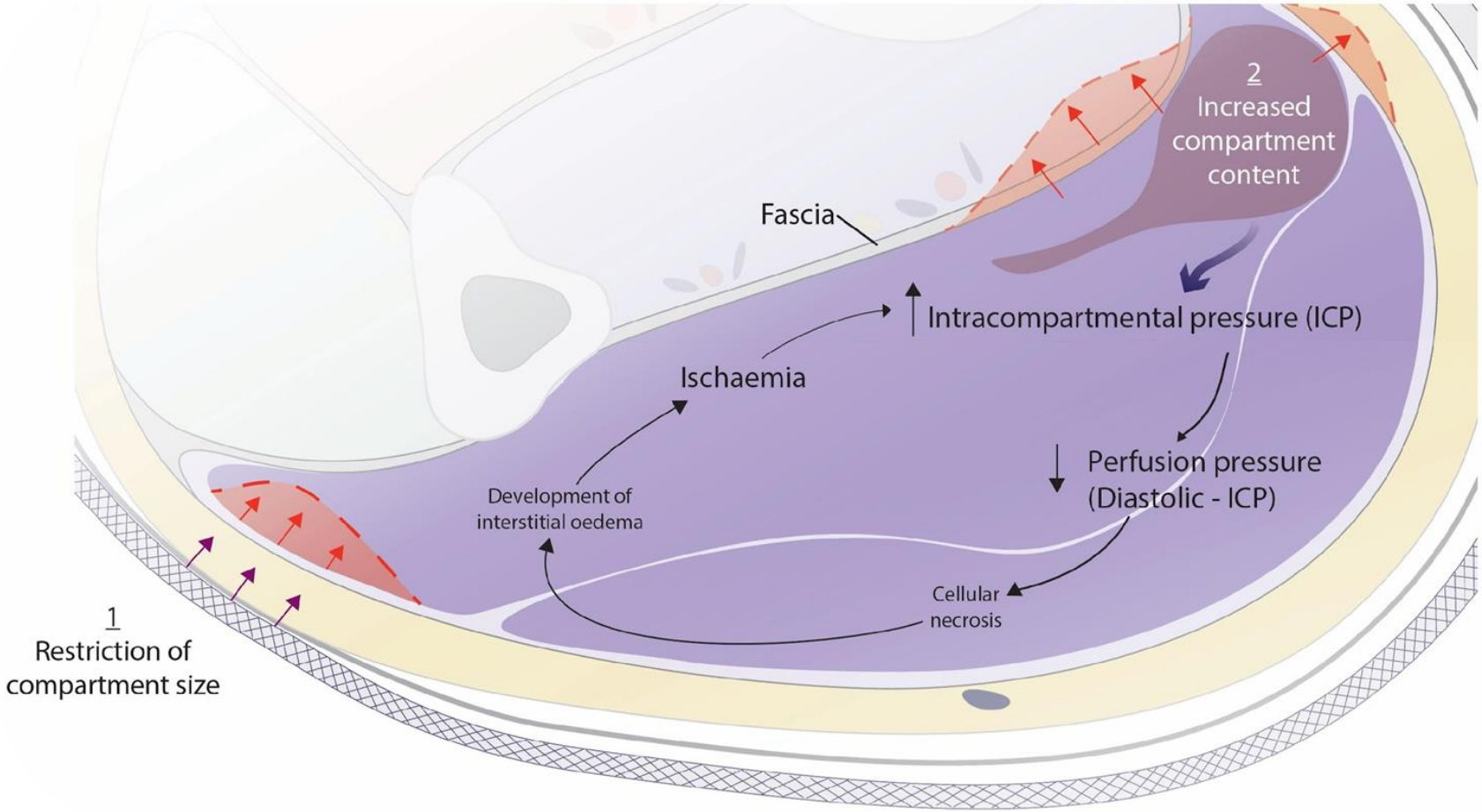
1. Does the type of tibia fracture matter?
2. When is timing for definitive fixation best?
3. What surgical decisions matter the most?
4. Is there a role for continuous compartment pressure monitoring?

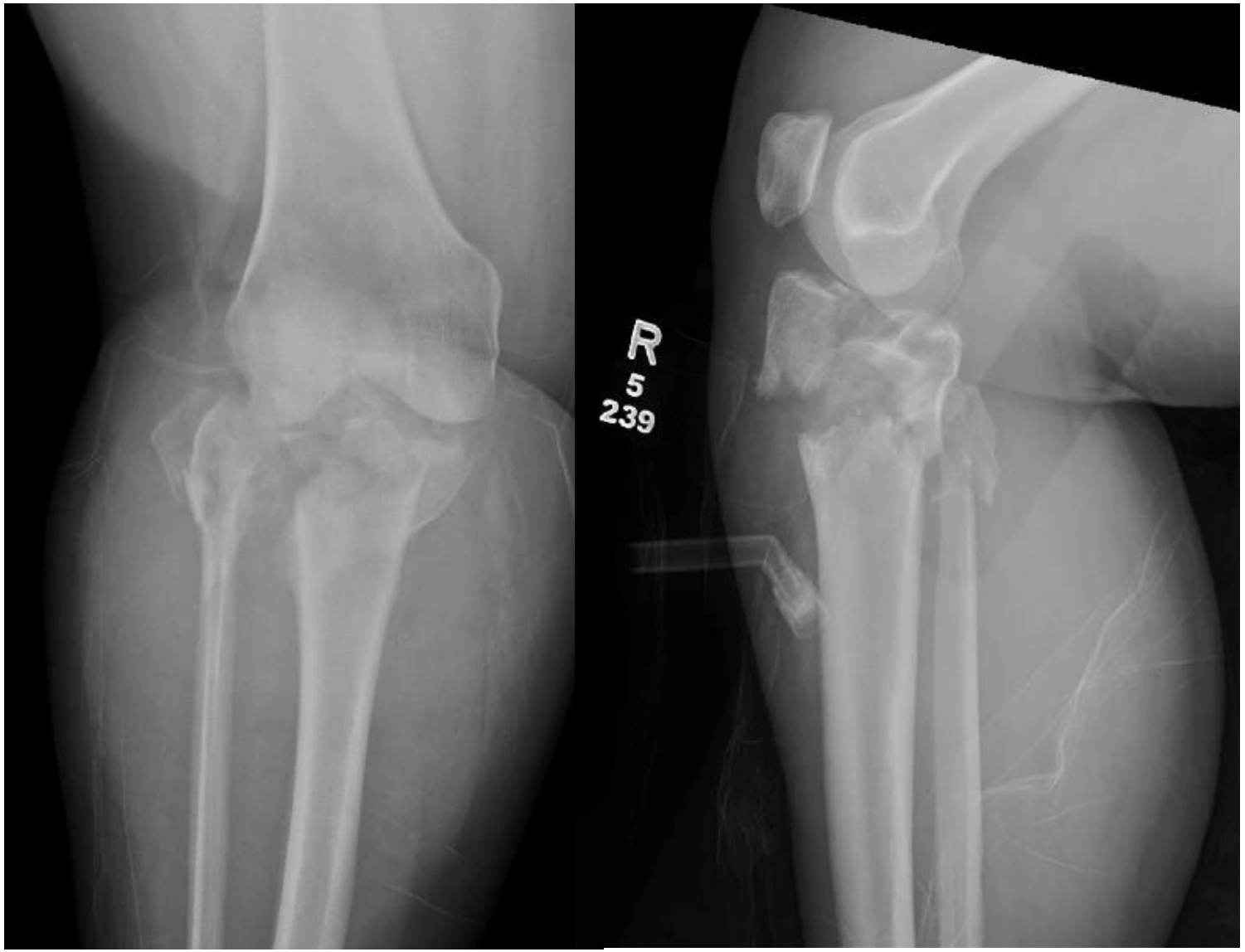
Acute Compartment Syndrome

Pathophysiology



Case 1

- 27yo male
- 10ft fall from ladder
- Isolated, closed injury
- Paresthesia
- Increasing analgesia requirements



Case 2

- 36 years old male
- Pedestrian vs car
- 2 cm wound over the anterior tibia
- Pain with ankle/EHL passive ROM

Continuous Pressure Monitoring

Contents lists available at ScienceDirect

Injury

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

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

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[b] Raigmore Hospital, Inverness, Scotland
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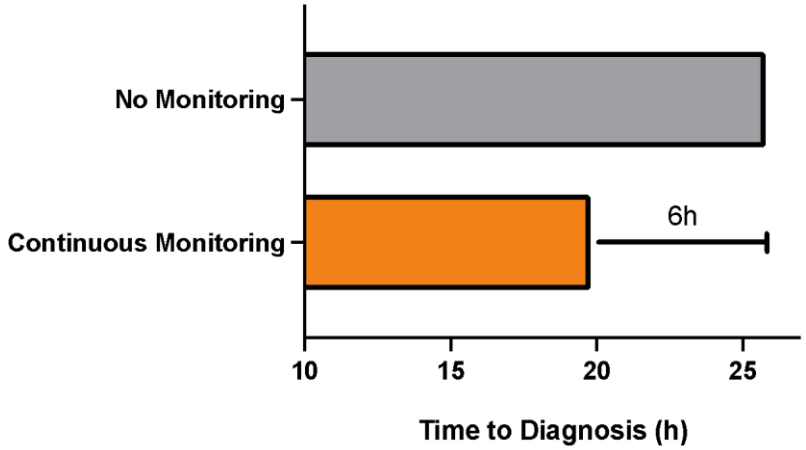


Reduction of time to diagnosis by **6 hours**, without increasing the rate of false positives

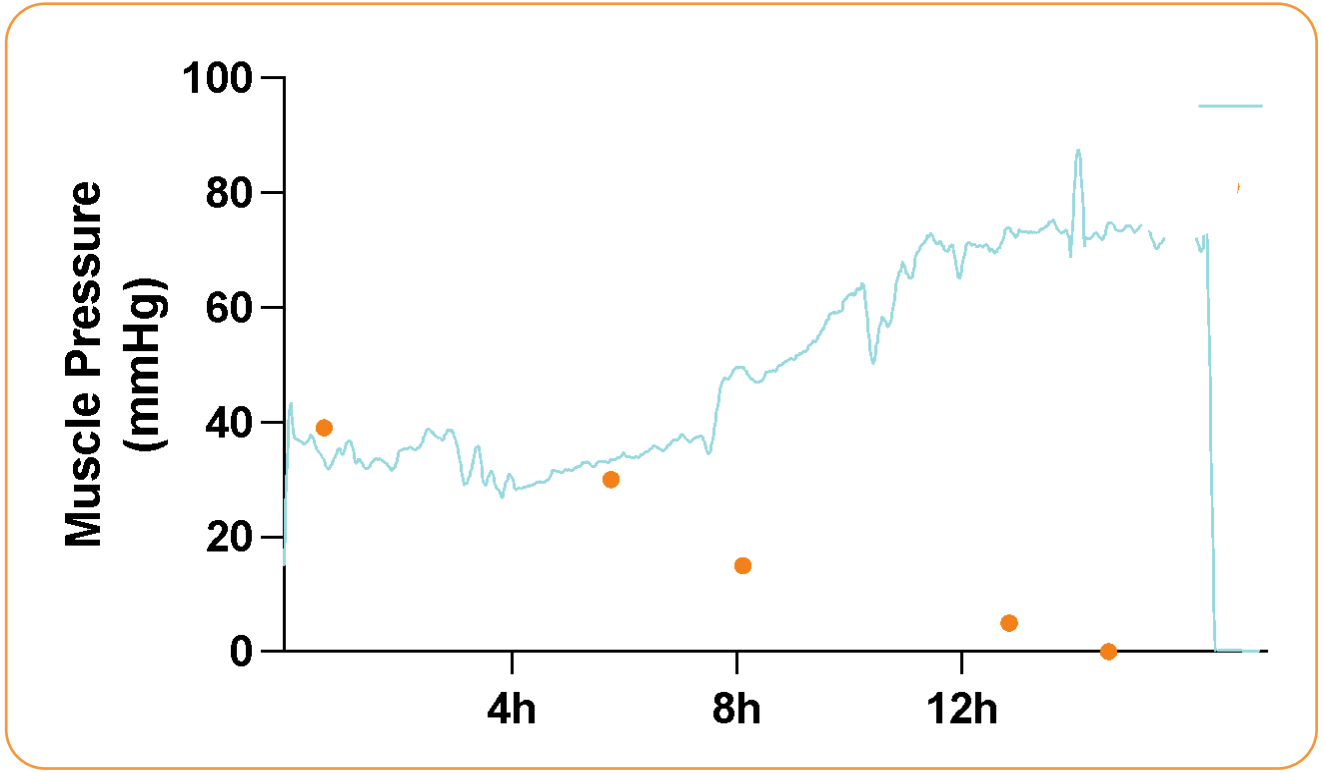
ACS was diagnosed early before the start of the clinical signs

Case Information: Age: 21 | Sex: Male | Injury: Tibial Midshaft Fracture (OTA: 42A3)

Case Study Report ACS confirmed

Clinical Course

- Device was inserted pre-op
- Planned for fixation in the following morning, as no clinical signs initially
- Compartments were firm and he started to have progressive increasing pain as he was brought to the OR



Big data insights into predictors of acute compartment syndrome

Yasser Bouklouch[a], Andrew H Schmidt[b], William T Obremskey[c], Mitchell Bernstein[a,d], Nicole Gamburg[a], Edward J Harvey[a,d,*]

Injury 53 (2022) 2557–2561

- 203,500 tibia fractures

- **Proximal and midshaft tibial fractures:** Highest likelihood of ACS
- **Open fractures:** Twice as likely to have ACS
- **Increased likelihood of ACS:**
  - Complex fracture ($p<0.0001$)
  - Substance abuse disorder ($p<0.0002$)
  - Cirrhosis ($p=0.002$)
  - Smoker ($p<0.0051$)
  - Age **decreased** the likelihood by 1% per year after age 18

Big data insights into predictors of acute compartment syndrome

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- Hypertension is protective
- Amputation resulted after 5.4% of fasciotomies
- 17% fasciotomies with ACS had some necrosis
- Fasciotomy-related infection 13% (30% in some previous studies)
- Fasciotomies done 6 fold vs. rate of diagnosed ACS

Clinical Dilemma

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Fasciotomy and External Fixation

- Soft tissue access challenging
- Decreased initial resource required
- ?Decreased technical demand
- Coordinated care for coverage

Fasciotomy and Definitive Fixation

- Improved access for soft tissue coverage
- Increased time/resource at first stage
- Increased technical demand
- Coordinated care for coverage

Early Definitive Fixation for Tibial Plateaus

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Is the timing of fixation associated with fracture-related infection among tibial plateau fracture patients with compartment syndrome? A multicenter retrospective cohort study of 729 patients

Injury 53 (2022) 3814–3819

- Retrospective cohort study of tibial plateau fractures and an ipsilateral 4-compartment fasciotomy (n=729)
- ORIF timing relative to fasciotomy closure was categorized as:
  - ORIF before, at the same time as, or after fasciotomy
- 19.6% surgical site infection
- ORIF at the same time as fasciotomy closure demonstrated a 91% probability of being superior to before closure

Early Definitive Fixation for Tibial Diaphysis

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Tibial Shaft Fractures Complicated by Compartment Syndrome: Treatment with Immediate Fasciotomy and Locked Unreamed Nailing

Georgiadis, G. (1995). *The Journal of Trauma: Injury, Infection, and Critical Care, 38* (3), 448-452.

- 11 consecutive patients with tibial diaphyseal fractures and ACS
- Four compartment fasciotomies performed
- Open fractures were debrided as needed, and a locked unreamed intermedullary nail was inserted
- Report good union rates and functional recovery

What surgical decisions matter the most?

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- **Assessment of Evolution of Soft Tissues**
- **Placement of Fasciotomy Incisions**
- **If Staged Approach, Plan Placement of External Fixator**
- **If Definitively Fixing, Obtain Anatomic Reduction and Stable Fixation**
- **Coordinated Care with Trauma and/or Plastic Surgery**

Evolution of Soft Tissues

Google Images

Placement of Fasciotomy Incisions

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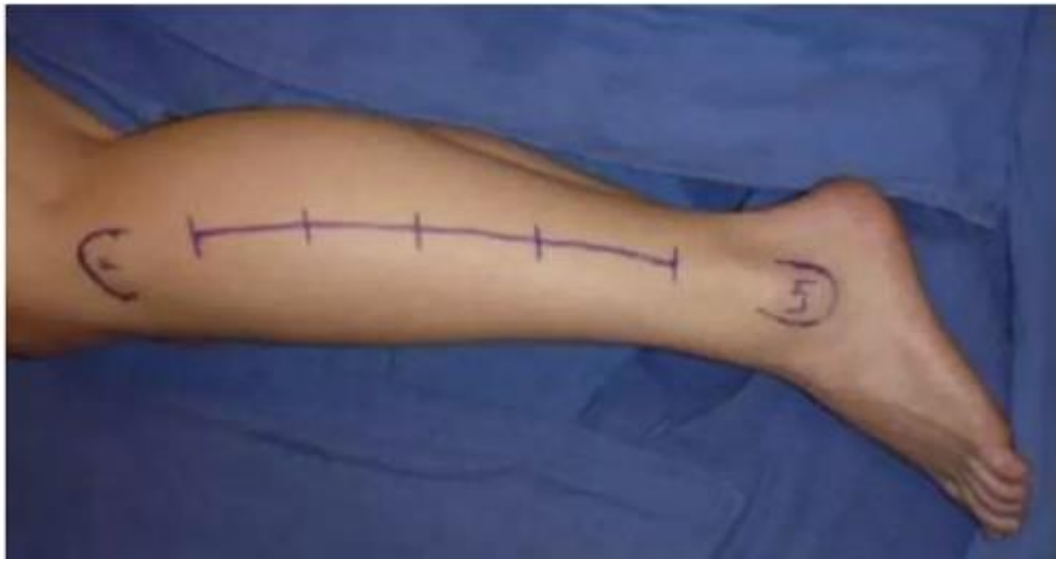
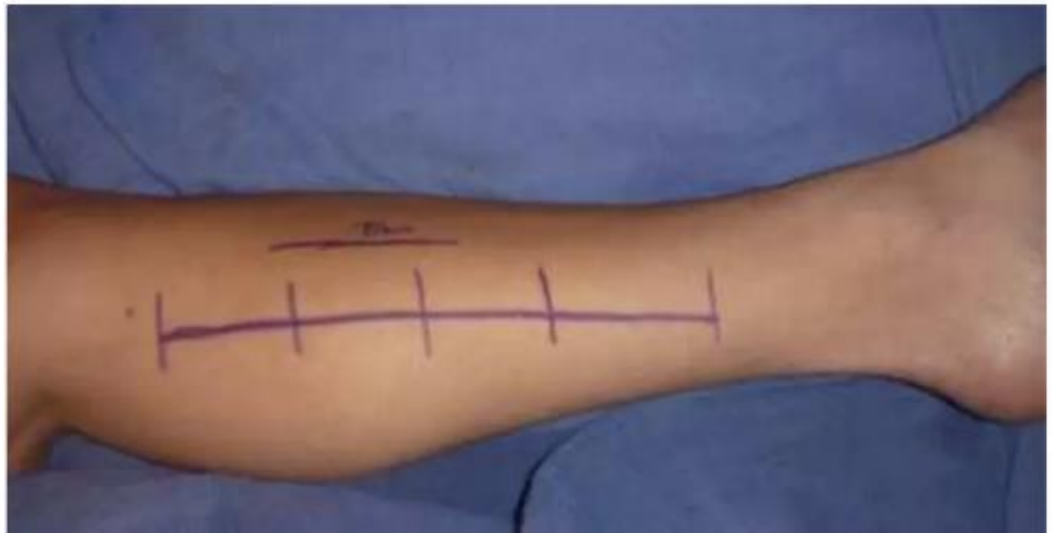
15 to 18cm



Minimum 8cm skin bridge



Placement of Fasciotomy Incisions

Benjamin, E., & Bardes, J. (2020). Lower Extremity Fasciotomies. In D. Demetriades, K. Inaba, & G. Velmahos (Eds.), *Atlas of Surgical Techniques in Trauma* (pp. 400-412). Cambridge: Cambridge University Press.

Placement of External Fixator

- Out of the zone of injury
- Stable construct
- Coordinated care with plastics

Obtain Anatomic Reduction, Stable Fixation

Patient referred for subluxation post-ORIF

Obtain Anatomic Reduction, Stable Fixation

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Coordinated Care

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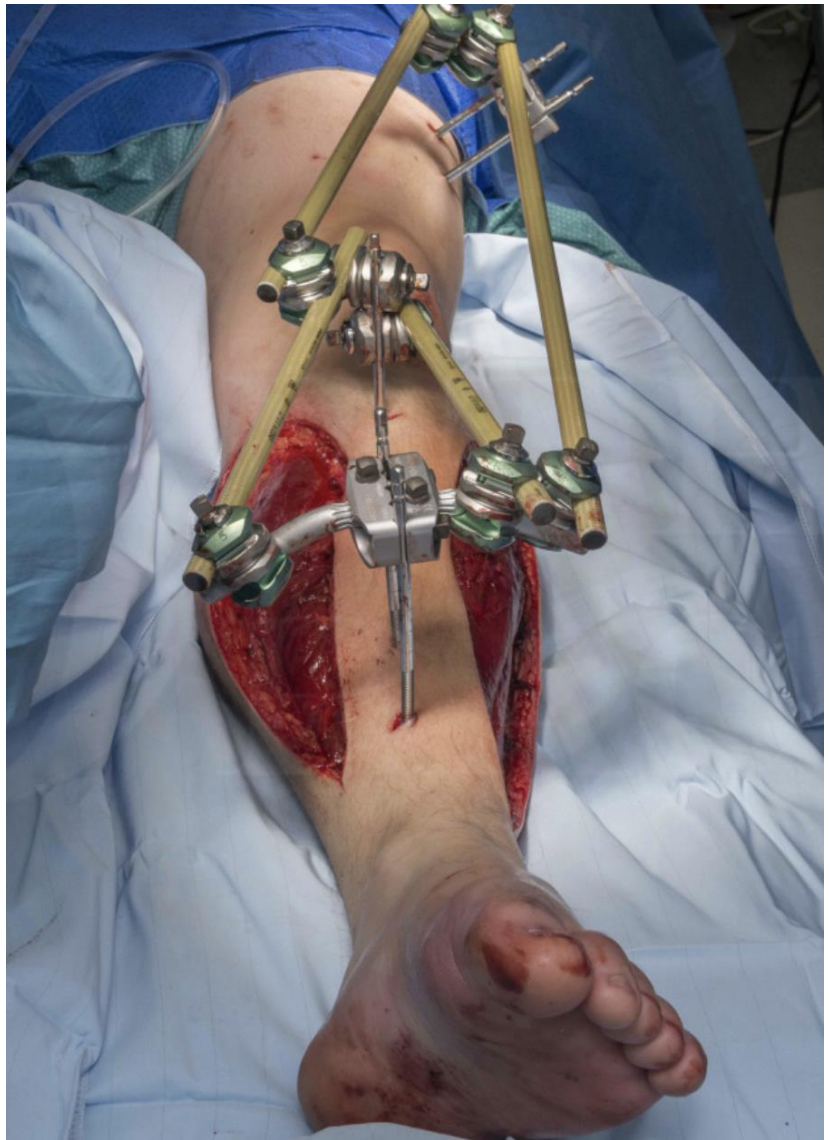
Communicate early and often with plastic surgery



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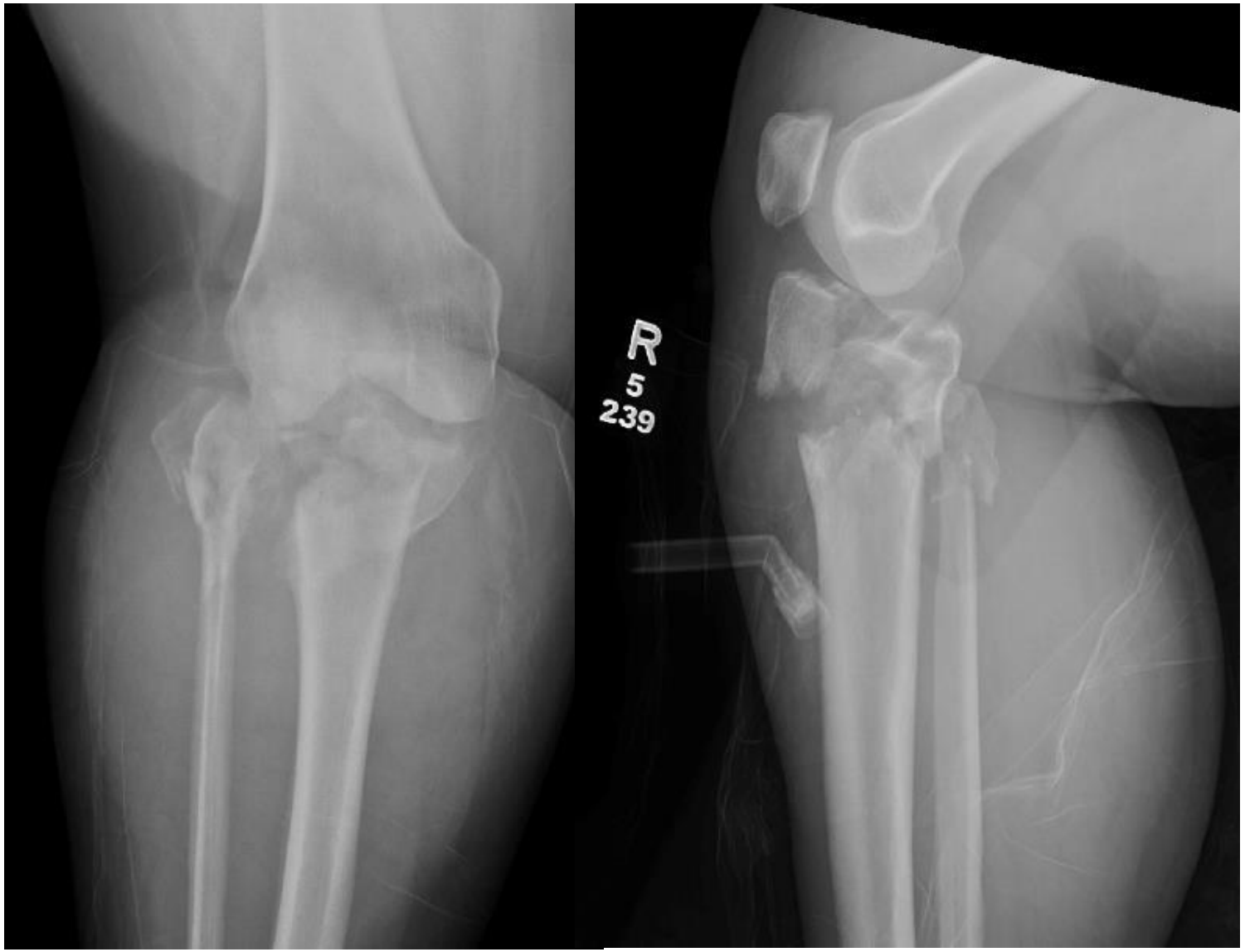
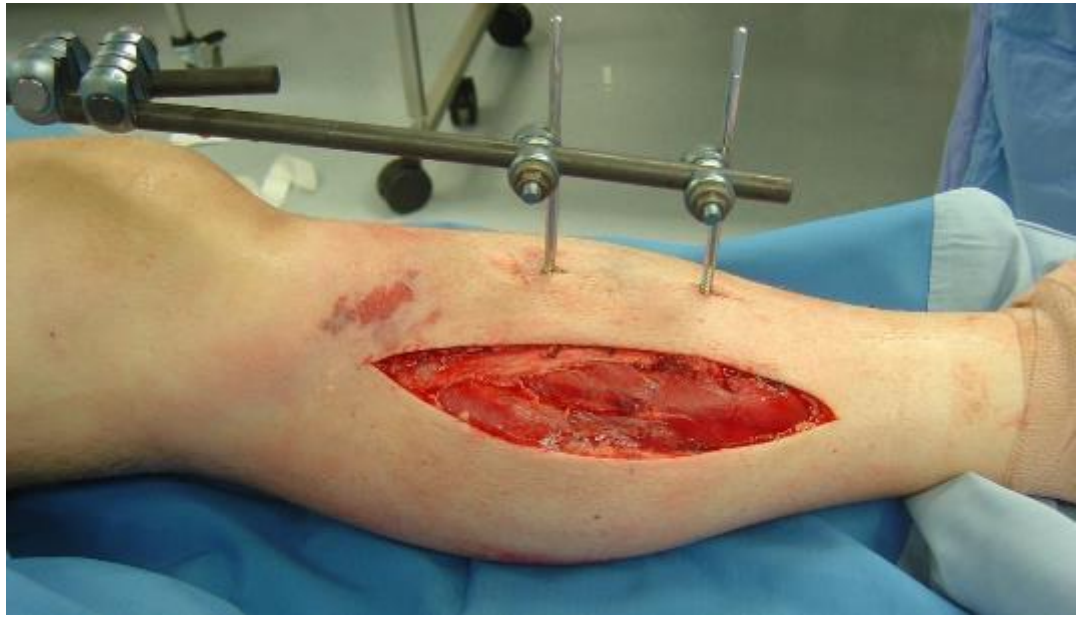


- OR emergently
- External-fixator
- Fasciotomies



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4 compartment fasciotomy

Definitive fixation

Pragmatic Approach

Last AAOS Practice Management Guidelines 2007

– *A practical, pragmatic approach needs to also be considered*

- Condition of patient
- Surgeon experience
- Surgeon preference
- Resources available

Objectives

1. Does the type of tibia fracture matter?

   Proximal and midshaft tibial fractures are highest risk, open fractures are twice as likely to have ACS

2. When is timing for definitive fixation best?

   Definitive fixation should match the nature of each fracture pattern with the goals of always respecting the soft tissues

3. What surgical decisions matter the most?

   Assessment of Evolution of Soft Tissues, Obtaining Anatomic Reduction, Stable Fixation, Placement of Fasciotomy Incisions, Coordinated Care Plastic Surgery

4. Is there a role for continuous compartment pressure monitoring?

   Growing evidence to support the utility of objective data to help diagnose ACS

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