



**Atrium Health**  
Musculoskeletal Institute

# Open Fractures

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Extremities in the Carolinas – Trauma for General Orthopedics

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# Objectives

1. Understand the classification of open fractures
2. Direct emergent management
3. Create an appropriate operative plan

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# Classification

- Why?
  - Communication
  - Prognosis
  - Treatment



# Classification

Prevention of Infection in the Treatment of One Thousand and Twenty-five Open Fractures of Long Bones

RETROSPECTIVE AND PROSPECTIVE ANALYSES

BY RAMON B. GUSTILO, M.D.\*, AND JOHN T. ANDERSON, M.D.†, MINNEAPOLIS, MINNESOTA

Type	
I	Wound < 1cm, Clean
II	Wound > 1cm, without extensive soft-tissue damage
III	Extensive soft-tissue damage

# Classification

Type	
I	Wound < 1cm, Clean
II	Wound > 1cm, without extensive soft-tissue damage
III	Extensive soft-tissue damage
	IIIA Adequate soft tissue coverage
	IIIB Inadequate soft tissue coverage, massive contamination
	IIIC Vascular injury requiring repair

Prevention of Infection in the Treatment of One Thousand and Twenty-five Open Fractures of Long Bones

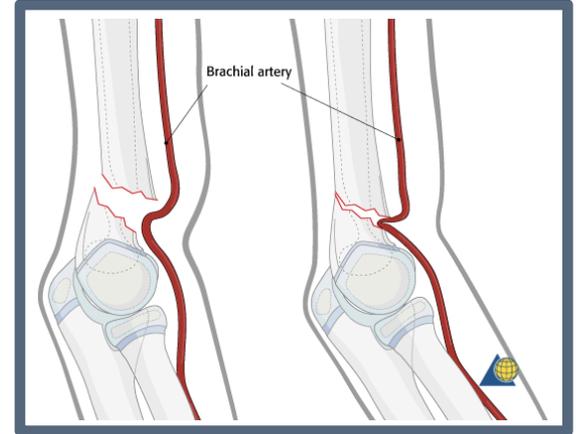
RETROSPECTIVE AND PROSPECTIVE ANALYSES

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Problems in the Management of Type III (Severe) Open Fractures: A New Classification of Type III Open Fractures

RAMON B. GUSTILO, M.D.,\* REX M. MENDOZA, M.D.,\* AND DAVID N. WILLIAMS, M.D.†

# Classification



I

II

IIIA

IIIB

IIIC

# Classification



I

II

IIIA

IIIB

IIIC

# Objectives

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# Emergent Management

- Examine the patient
- Picture
- Neurovascular status
- Remove gross debris
- Superficial irrigation
- Reduce and splint
- Tetanus
- Antibiotics



# Antibiotics

- Timing

## Factors Influencing Infection Rate in Open Fracture Wounds

MICHAEL J. PATZAKIS, M.D., AND JEANETTE WILKINS, M.D.

## Time to Initial Operative Treatment Following Open Fracture Does Not Impact Development of Deep Infection: A Prospective Cohort Study of 736 Subjects

Donald Weber, MD, FRCS,\* Sukhdeep K. Dulai, MD, MSc, FRCS,\* Joseph Bergman, MD, FRCS,\*  
Richard Buckley, MD, FRCS,† and Lauren A. Beaupre, PT, PhD\*

## Type III Open Tibia Fractures: Immediate Antibiotic Prophylaxis Minimizes Infection

William D. Lack, MD,\* Madhav A. Karunakar, MD,† Marc R. Angerame, MD,†  
Rachel B. Seymour, PhD,† Stephen Sims, MD,† James F. Kellam, MD,† and Michael J. Bosse, MD†

- Mixed Results
- Earlier is Never worse
- Do it ASAP

# Antibiotics

- Drug Choice

Classification	Antibiotic
Type I & II	Cefazolin (2gm q8h)
Type III	Add Gentamycin (1mg/kg q8h)
Gross contamination	Add Penicillin (10mil units q24h) or Add Metronidazole (500mg q8h)

# Antibiotics

Evidence-based protocol for prophylactic antibiotics in open fractures: Improved antibiotic stewardship with no increase in infection rates

Lauren Rodriguez, MD, Hee Soo Jung, MD, James A. Goulet, MD, Ashley Cicalo, David A. Machado-Aranda, MD, and Lena M. Napolitano, MD, Ann Arbor, Michigan

- Drug Choice

Classification	Antibiotic
Type I & II	Cefazolin (2gm q8h)
Type III	Ceftriaxone (2gm/24h)
Gross contamination	Add Metronidazole (500mg q8h)

# Antibiotics

- Duration of Antibiotics

Evidence-based protocol for prophylactic antibiotics in open fractures: Improved antibiotic stewardship with no increase in infection rates

Lauren Rodriguez, MD, Hee Soo Jung, MD, James A. Goulet, MD, Ashley Cicalo, David A. Machado-Aranda, MD, and Lena M. Napolitano, MD, Ann Arbor, Michigan

Classification	Duration
Type I & II	24h after closure
Type III	48hours or 24h after closure
Gross contamination	48hours after closure

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# Operative Treatment

- Timing
- Debridement
- Irrigation
- Stability
- Closure

# Operative Treatment - Timing

## The Relationship Between Time to Surgical Débridement and Incidence of Infection After Open High-Energy Lower Extremity Trauma

By Andrew N. Pollak, MD, Alan L. Jones, MD, Renan C. Castillo, MS, Michael J. Bosse, MD, Ellen J. MacKenzie, PhD, and the LEAP Study Group

## Does Timing to Operative Débridement Affect Infectious Complications in Open Long-Bone Fractures?

A Systematic Review

Mara L. Schenker, MD, Sarah Yannascoli, MD, Keith D. Baldwin, MD, MSPT, MPH, Jaimo Ahn, MD, PhD, and Samir Mehta, MD

## Time to Initial Operative Treatment Following Open Fracture Does Not Impact Development of Deep Infection: A Prospective Cohort Study of 736 Subjects

Donald Weber, MD, FRCS,\* Sukhdeep K. Dulai, MD, MSc, FRCS,\* Joseph Bergman, MD, FRCS,\* Richard Buckley, MD, FRCS,† and Lauren A. Beaupre, PT, PhD\*

- Time NOT correlated with infection
- BUT nearly all patients treated within 12 hours

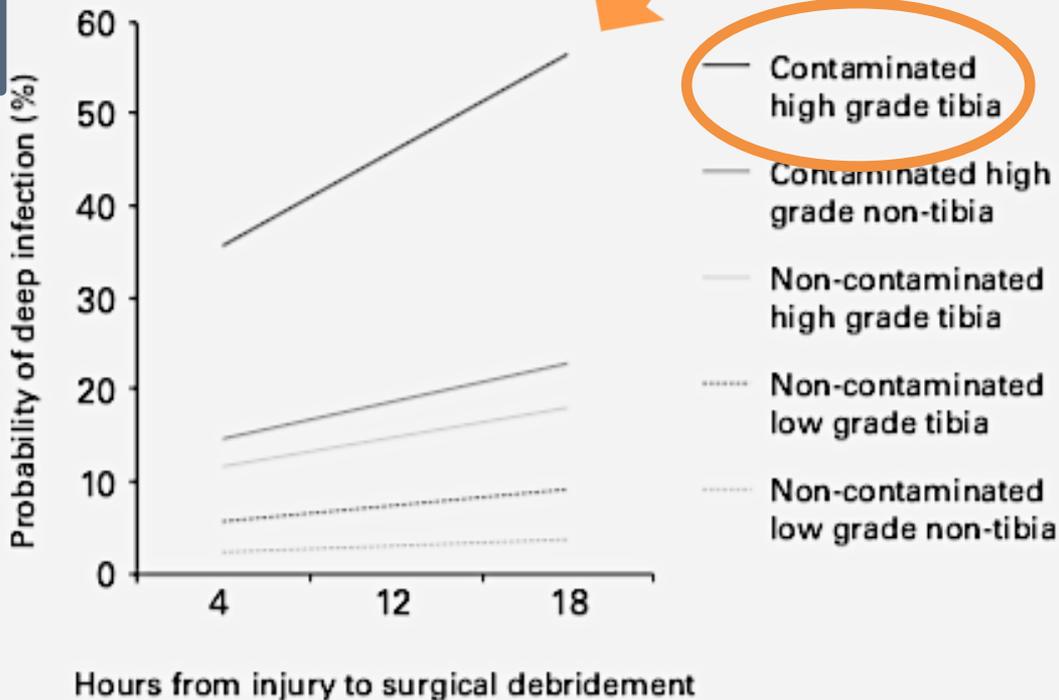
# Operative Treatment - Timing



## ■ TRAUMA

Delayed debridement of severe open fractures is associated with a higher rate of deep infection

- Large cohort
- At least some fractures are at higher risk with delay



# Operative Treatment

- Timing
  - Debridement
  - Irrigation
  - Stability
  - Closure
- 
- Use judgement

# Operative Treatment - Debridement

- Systematic
- Extensile
- Zone of injury



# Operative Treatment

- Timing  Use judgement
- Debridement  Be thorough
- Irrigation
- Stability
- Closure

# Operative Treatment - Irrigation

## A Trial of Wound Irrigation in the Initial Management of Open Fracture Wounds

The FLOW Investigators\*

- Soap vs. No soap
  - 3.2% absolute risk increase with soap
- High vs. Low vs. Very low pressure
  - No difference
  - Cost?

# Operative Treatment

- Timing  Use judgement
- Debridement  Be thorough
- Irrigation  Use saline
- Stability
- Closure

# Operative Treatment

- Timing  Use judgement
- Debridement  Be thorough
- Irrigation  Use saline
- Stability  The rest of this conference
- Closure

# Operative Treatment - Closure

- Cover as soon as possible
  - Temporary
    - VAC
    - Bead pouch
  - Definitive
    - Primary closure
    - Flaps
    - <5days ideal



# Operative Treatment

- Timing  Use judgement
- Debridement  Be thorough
- Irrigation  Use saline
- Stability  The rest of this conference
- Closure  ASAP

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