Open Fracture Management: Where Are We In 2024?

Daniel J. Stinner, MD, PhD & Donald M. Adams, DO
PAOS Annual Meeting
Nashville, TN
3 September 2024

Blanchfield Army Community Hospital
Vanderbilt University Medical Center
Morristown Medical Center

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Open Fractures

- Emergency Room
  - Antibiotics
  - Wound / Reduction / Splint
- Operating Room
  - Debridement
  - Skeletal Stability
  - Wound management / Coverage

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Open Fractures

- Fractures with direct communication to the external environment
  - Require Immediate IV antibiotics and Urgent irrigation and debridement
  - Tibial / Phalanx most common
  - Higher energy – additional injuries (30%) / Compartment syndrome*

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Physical Exam

- Consider Saline Load
  - Knee
    - 175 cc (99%)
    - 155 cc (95%)
    - 145 cc (90%)
    - 110 cc (75%)
- CT Scan
  - 100% Sensitivity & Specificity
  - SLT 92% sensitivity

Konda SR, Davidovitch, Egol KA – JOT 2013

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ER Management

- Wound
  - ***Start Antibiotics / Tetanus***
  - Examine Once
  - Take Pictures
  - Remove any gross debris manually
  - Irrigate
  - Reduce fracture/dislocation
  - Apply moist sterile dressing
  - Splint
  - Re-assess NV status

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Compartment Syndrome in Open Tibial Fractures*†

BY SAMUEL S. BLICK, M.D.‡, ROBERT J. BRUMBACK, M.D.§, ATTILA POKA, M.D.§, ANDREW R. BURGESS, M.D.§, AND NABIL A. EBRAHEIM, M.D.#, BALTIMORE, MARYLAND

From the Shock Trauma Center, Maryland Institute for Emergency Medical Services Systems, Baltimore

- Shock trauma – 1986
- Retrospective
- 180 patients in 198 open tibial fracture
- 9% had compartment syndrome despite open compartment

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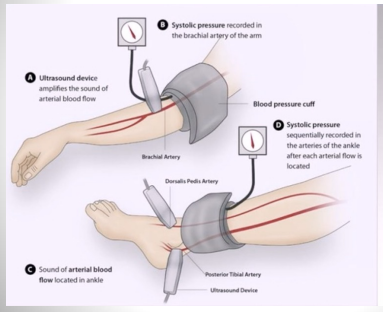
ABI



NORMAL:

0.95 – 1.2

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Infection

- Incidence: 0.1 – 7% of orthopaedic procedures
- 500,000 Surgical Site Infections / year in US
- Cost: $7 – 10 Billion / year

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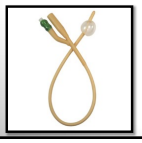
Infection

- CMS (Medicare) will not reimburse hospitals for certain infections (10/2008)
  - CA-UTIs
  - CVC-associated bloodstream infection
  - SSI following spine, neck, shoulder, or elbow procedures



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Transparency?

Legacy Code	Operative Procedure	Description	Surveillance
AMP	Limb Amputation	Total or partial amputation or disarticulation of the upper or lower limbs, including digits	Superficial – 30 day Deep – 30 day
FUSN	Spinal Fusion	Immobilization of spinal column	Superficial – 30 day Deep - 90
FX	Open Reduction of Fracture	Open reduction of fracture or dislocation of long bones with or without internal or external fixation; does not include placement of joint prosthesis	Superficial – 30 day Deep - 90
HPRO	Hip Prosthesis	Arthroplasty of hip	Superficial – 30 day Deep - 90
KPRO	Knee Prosthesis	Arthroplasty of knee	Superficial – 30 day Deep - 90
LAM	Laminectomy	Exploration or decompression of spinal cord through excision or incision into vertebral structures	Superficial – 30 day Deep – 30 day
RFUSN	Refusion of spine	Refusion of spine	Superficial – 30 day Deep - 90

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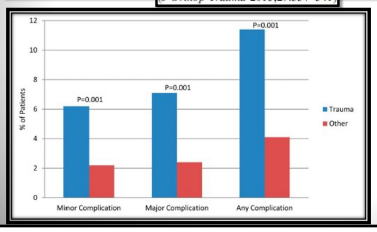
What About Trauma Patients?

Adverse Events in Orthopaedics: Is Trauma More Risky? An Analysis of the NSQIP Data

Vasanth Sathiyakumar, BA, Rachel V. Thakore, BS, Sarah E. Greenberg, BA, Paul S. Whiting, MD, Cesar S. Molina, MD, William T. Obremskey, MD, MPH, MMHC, and Manish K. Sethi, MD

(*J Orthop Trauma* 2015;29:337–341)



Minor Complication
Superficial wound infection

Major Complication
Deep wound infection

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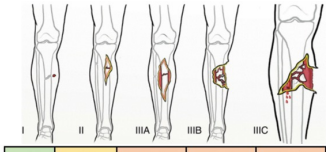
Gustilo-Anderson Classification



	I	II	III-A	III-B	III-C
Energy of mechanism	Low	Moderate	High	High	High
Wound size	<1 cm	>1 cm	Usually >10 cm	Usually >10 cm	Usually >10 cm
Soft tissue injury	Low	Moderate	Extensive	Extensive	Extensive
Contamination	NO	Low	Severe	Variable	Variable
Conminution/ Fracture pattern	No/ Simple	Some/ Simple	Severe/ Complex	Severe/ Complex	Severe/ Complex
Soft tissue coverage	Yes	Yes	Yes	No, requires reconstructive procedure	Variable
Vacular injury injury	No	No	No	No	Yes, require reparation

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Gustilo-Anderson 1976


THE JOURNAL OF BONE & JOINT SURGERY

JB&JS

This is an enhanced PDF from The Journal of Bone and Joint Surgery

The PDF of the article you requested follows this cover page.

Prevention of infection in the treatment of one thousand and twenty-five open fractures of long bones: retrospective and prospective analyses

RB Gustilo and JT Anderson
J Bone Joint Surg Am. 1976;58:453-458.

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Gustilo-Anderson 1976

- 1955 to 1960 (**12%** infection Rate)
  - Debridement and Copious Irrigation (10 - 14L)
  - Primary Closure whenever possible regardless of severity
  - Post-operative Antibiotics
- 1961 to 1968 (**5%** infection Rate)
  - Pre-operative Abx for 7-10 days)
- 1969 to 1973 (**2.5 %** infection Rate)
  - **New Guideline**
    - Primary closure (Type I & II injuries)
    - Delayed closure in type III

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Gustilo 1984

0022-5282/84/2408-0742$02.00/0
THE JOURNAL OF TRAUMA
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Vol. 24, No. 8
Printed in U.S.A.

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.†

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Gustilo 1984

- 1976 to 1979 patients with type III fractures experienced increased morbidity prompting an expansion of the classification
- **Expanded Type III classification**
  - **IIIA** – Adequate soft-tissue coverage of a fracture despite soft-tissue laceration or flaps
  - **IIIB** – Extensive soft-tissue loss with bone exposure and periosteal stripping (Massive contamination)
  - **IIIC** – Arterial Injury requiring repair
  - Increase in Gram negative infection (24% to 77%) prompted the addition of an **aminoglycoside** to cephalosporins in type III injuries
    - Wound Sepsis Rates were 4%, 52%, and 42% respectively
    - Amputation Rates were 0%, 4%, and 5% Respectively

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Antibiotic Coverage 1984

- Gustilo Type I & II
  - **1st generation cephalosporin** for gram (+)
  - Clinda vs Vanco if Allergy
    - Until **24 hours** after closure
- Gustilo Type III
  - **Add Aminoglycoside** for gram (–) coverage (Weight & Kidney)
    - **24-72 hours** after last debridement procedure
  - **Penicillin** should be added for potential anaerobic
    - Farm (Soil)/Bowel contamination - clostridia – Gas Gangrene
- Other Considerations
  - **Fluoroquinolones** for fresh water or salt-water wounds to cover Pseudomonas and Vibrio resp

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Why Are Antibiotics Important?

- When should abx be given?
  - Gustilo, Arch Surg 1979
    - #1 reduction infection risk → **Early abx**
  - Patzakis, CORR 1989
    - >3hrs → 7.4% deep infection
    - <3hrs → 4.7%
  - Gillespie, Cochrane 2004
    - 8 studies, n=1106
    - Protective against early infection (relative risk .41)
    - Absolute risk reduction .08

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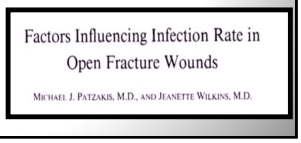
Antibiotics

- Cochrane Database – 2000
  - 8,307 participants in 22 studies
  - Single dose abx prophylaxis for treatment of closed fractures
    - Significant reduction in deep wound, superficial wound, urinary, and respiratory infections
- Patzakis, JBJS 1974
  - Infection rates
    - No abx (14%)
    - PCN/Streptomycin (9%)
    - 1st Gen Ceph (2.4%)


Factors Influencing Infection Rate in Open Fracture Wounds

Michael J. Patzakis, M.D., and Jeanette Wilkins, M.D.

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Antibiotics

- Cephalosporins
  - Cefazolin – GP coverage
  - Good tissue, muscle, bone penetration
  - Cheap
  - Safe

- Open Fractures?
  - Lack of evidence to support use of aminoglycosides or PCN

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Antibiotics

- Beta-Lactam Allergy?
  - Serious cross reactivity with cephalosporins is rare
  - PCN skin test
  - Alternatives: Vancomycin or Clindamycin

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Why Are Antibiotics Important?

- When should antibiotics be given?
  - Lack, JOT 2015
    - Abx < 66 min, wound coverage < 5 days
      Univariate predictors of decreased infection
  - Penn-Barwell, JBJS 2012
    - Delaying debridement up to 24 hrs no statistical significant increase in infection rate

ASAP!!!

Early ABX >>> Early OR

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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†*

- JOT 2015
- Retrospective, 137 Type III Open Fracture
- Age, Smoking, DM, ISS, type 3A vs 3B/C, time to debridement were **NOT** associated with infection
- Time from injury
  - to Antibiotics (>66 minutes)
  - to wound coverage (>5 days) independently predict infection of Type III open tibia fractures

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Why Are Antibiotics Important?

- When should abx be given?
  - ACS Trauma Center Certification
    - Abx compliance rate
    - Time to **Abx <1hr**

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Administration of intravenous antibiotics in patients with open fractures is dependent on emergency room triaging

Katharine D. Harper[1]*, Courtney Quinn[1], Joshua Eccles[2], Frederick Ramsey[3], Saqib Rehman[1]

- PLOS One, 2018
- 117 Patients with open fractures
- Standard open fracture protocol
- Cefazolin given within 17 minutes (14 for trauma patients, 53 minutes for non-trauma)
- Gentamicin given within 180 minutes (Weight based, not-immediately available)

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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

JBJS 2010

- LEAP Study – 2010
- Administration of Abx ASAP
  - Infection Highly correlated with time from injury to arrival to the ED (Surrogate for Abx)

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Standardizing ER Antibiotics

- Automated Dispensing Machines in ED stocked w/ pre-mixed Zosyn and Ceftriaxone

	Preprotocol (n = 72)	Postprotocol (n = 24)	*P*
Time to antibiotic, mean ± SD	87.9 ± 104.6	22.2 ± 12.8	**0.001**
Time to antibiotic under 60 min, n (%)	38 (53)	23 (96)	**<0.00**
AKI (KDIGO), n (%)	4 (5.6)	0 (0)	0.569
Auditory changes, n (%)	0 (0)	0 (0)	—
Surgical site infection postoperatively, n (%)	4 (5.6)	0 (0)	0.569
MDR isolates, n (%)	0 (0)	0 (0)	—
Clostridium difficile infection within 30 d, n (%)	1 (1.4)	0 (0)	0.569

Maximizing Adherence and Minimizing Time to Antibiotics: A Multidisciplinary Institutional Trauma Bay Protocol for Single Antibiotic Prophylaxis in Open Fractures

Erick Heiman, DO,[a] Joss Delaune, PharmD,[b] Ian S. Hong, MD,[a] Matthew Lamb, PharmD,[b] Marissa Fisher, MHI,[c] Bruno Molino, MD,[c] Sandy Moreau, PharmD,[b] Maria Devivo, PharmD,[b] Frank A. Liporace, MD,[c] Richard S. Yoon, MD,[a] and Jaclyn M. Jankowski, DO[a]

J Orthop Trauma • Volume 38, Number 6, June 2024

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Decreasing Perioperative Infection Risk

- Operative Factors
  - Antibiotics
    - Type
    - Timing
    - Duration
  - Skin Prep
  - Drapes
  - Shaving
  - Drains?
  - Wound Closure
  - NPWT

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Skin Prep

Mechanism and Spectrum of Activity of Antiseptic Agents Commonly Used for Preoperative Skin Preparation and Surgical Scrubs

Agent	Mechanism of Action	Gram-Positive Bacteria	Gram-Negative Bacteria	Mtb	Fungi	Virus	Rapidity of Action	Residual Activity	Toxicity	Uses
Alcohol	Denature proteins	E	E	G	G	G	Most rapid	None	Drying, volatile	SP, SS
Chlorhexidine	Disrupt cell membrane	E	G	P	F	G	Intermediate	E	Ototoxicity, keratitis	SP, SS
Iodine/Iodophors	Oxidation/substitution by free iodine	E	G	G	G	G	Intermediate	Minimal	Absorption from skin with possible toxicity, skin irritation	SP, SS
PCMX	Disrupt cell wall	G	F*	F	F	F	Intermediate	G	More data needed	SS
Triclosan	Disrupt cell wall	G	G	G	P	U	Intermediate	E	More data needed	SS

Abbreviations: E, excellent; F, fair; G, good; Mtb, *Mycobacterium tuberculosis*; P, poor; PCMX, parachloro-metaxylenol; SP, skin preparation; SS, surgical scrubs; U, unknown.
Data from Larson E.[19]
* Fair, except for *Pseudomonas* spp.; activity improved by addition of chelating agent such as EDTA.

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Skin Prep

Mechanism and Spectrum of Activity of Antiseptic Agents Commonly Used for Preoperative Skin Preparation and Surgical Scrubs

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Alcohol	Denature proteins	E	E	G	G	G	Most rapid	None	Drying, volatile	SP, SS
Chlorhexidine	Disrupt cell membrane	E	G	P	F	G	Intermediate	E	Ototoxicity, keratitis	SP, SS
Iodine/Iodophors	Oxidation/substitution by free iodine	E	G	G	G	G	Intermediate	Minimal	Absorption from skin with possible toxicity, skin irritation	SP, SS
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Data from Larson E.[18]
* Fair, except for *Pseudomonas* spp.; activity improved by addition of chelating agent such as EDTA.

Time-dependent effect of chlorhexidine surgical prep

D.J. Stinner*, C.A. Krueger, B.D. Masini, J.C. Wenke
United States Army Institute of Surgical Research, Department of Regenerative Medicine, Fort Sam Houston, TX, USA

Journal of Hospital Infection 79 (2011) 313–316

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Skin Prep

- CHG appears superior to PVI

Preoperative skin antiseptics for preventing surgical wound infections after clean surgery (Review)

Dumville JC, McFarlane E, Edwards P, Lipp A, Holmes A

- PCMX and Triclosan
  - Inferior to either CHG or PVI
- CHG
  - Slower than PVI, but sustained longer
  - Less toxic to wounds
  - Less skin irritation

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Skin Prep – PREP-IT 2022

- 14 hospitals in Canada, Spain, and the USA
- Open fractures
  - Aqueous 10% povidone-iodine
  - Aqueous 4% chlorhexidine
- **either can be selected** for skin antisepsis on the basis of solution availability, patient contraindications, or product cost

Randomized Controlled Trial > Lancet. 2022 Oct 15;400(10360):1334-1344.
doi: 10.1016/S0140-6736(22)01652-X.

Aqueous skin antisepsis before surgical fixation of open fractures (Aqueous-PREP): a multiple-period, cluster-randomised, crossover trial

PREP-IT Investigators

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Skin Prep – PREP-IT Trial

- Cluster Randomized Control 25 US hospitals
- Closed fractures – SSI 2.4% (Duraprep) vs 3.3% (Chloraprep)
- **Open Fractures no difference**

Skin Antisepsis before Surgical Fixation of Extremity Fractures

Author: The PREP-IT Investigators* Author Info & Affiliations

Published January 31, 2024 | N Engl J Med 2024;390:409-420 | DOI: 10.1056/NEJMoa2307679

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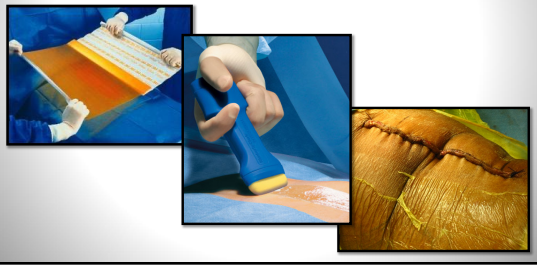
Drapes/Skin Sealants?

- Ioban™
  - CDC – Insufficient evidence to support use



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Shaving

- Increased risk of SSI if shave night before
- CDC – if hair must be removed, use clippers

Preoperative hair removal to reduce surgical site infection (Review)

Tanner J, Norrie P, Melen K

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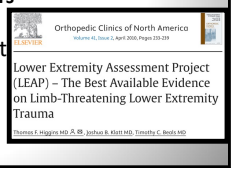
Debridement - Timing

- Controversial
- 6 hour dogma historically
- Multiple recent studies do not corroborate
- Leap Study – No correlation with timing
  - **in the absence of life-threatening injuries, there is no clinical advantage to performing surgery within 6 hours of injury versus 6-24 hours**
- No study advocates waiting
- Dirt, debris and devitalized soft tissues increase the risk of infection/complications


Orthopedic Clinics of North America
Volume 41, Issue 2, April 2010, Pages 233-239

Lower Extremity Assessment Project (LEAP) – The Best Available Evidence on Limb-Threatening Lower Extremity Trauma

Thomas F. Higgins MD, Joshua B. Klatt MD, Timothy C. Beals MD

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

A Systematic Review

JBJS 2012

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

Investigation performed at the Department of Orthopaedic Surgery, University of Pennsylvania, Philadelphia, Pennsylvania

- Data did not indicate an association between delayed debridement and higher infection rates for
  - All infections
  - Deep infections
  - Higher grade open fractures

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Debridement - Timing

- Difficult to assess wounds outside OR
- Urgency depends on
  - Contamination
  - Periosteal Stripping
  - OR availability
  - Patient Resuscitation

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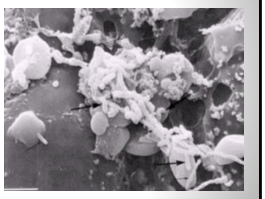
Debridement - Timing

- Want to avoid bacterial adhesion and colonization
- Time Dependent*
- Longer time = increased colonization



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Debridement - Timing

- Debridement most critical
- Extend the wound
- Foreign material and necrotic tissue nidus for bacteria

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Debridement

- Systematic
  - Layer by layer
  - Excise necrotic skin & sub Q
  - Ground in particulate debris
- Muscle (4 C's)
  - Incise fascia
  - Expose longitudinally (Consider future incisions)
  - Excise non-viable muscle
- Bone
  - Expose and Debride canal
  - Remove free cortical fragments
  - Retain articular fragments when possible

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Debridement

- Repeat q48-72 hours
- Stabilize fracture definitively when wound stable

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FLOW Trial

- NEJM 2015
- Castile soap vs normal saline and high vs low pressure irrigation
- 2447 patients randomized in 41 centers around the world
- Similar rates of reoperation with high vs low
- Higher rates of reoperation with soap vs saline (14.8% vs 11.6%)
- **Take Home - Use low pressure saline**

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

The FLOW Investigators*

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Irrigation Additives?

- JOT 1995
- Should we use Antiseptics?
- Betadine?
  - Studies have shown it to be cytotoxic to fibroblasts, osteoblasts & leukocytes
- Controversial
- Conflicting Data

Toxic Effects of Wound Irrigation Solutions on Cultured Tibiae and Osteoblasts

Kathleen K. Kaysinger, Natalie C. Nicholson, Warren K. Ramp, and James F. Kellam

Baxter Orthopaedic Research Laboratory, Department of Orthopaedic Surgery, Carolinas Medical Center, Charlotte, North Carolina, U.S.A.

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Drains

- No evidence supports use in clean cases

Closed Fractures:

	Group 1: Drain (n = 138)	Group 2: No drain (n = 149)	p
Deep infection	4 (2.9%)	1 (0.7%)	0.37
Wound revision surgery	6 (4.3%)	1 (0.7%)	0.10
Wound dehiscence	0	3 (2.0%)	0.25
Hematoma	7 (5%)	15 (10%)	0.20

Hip Fractures Fractures:

	Drainage (N = 100)	Non-drainage (N = 100)
Hematoma		
None	60	52
Moderate	25	24
Large	17	24
Hematoma at discharge		
None	82	80
Moderate	15	13
Large	3	7
Infection		
None	92	87
Superficial	6	10
Deep	2	3

Is There a Benefit to Drains With a Kocher-Langenbeck Approach? A Prospective Randomized Pilot Study

Joseph R. Hsu, MD, Daniel J. Stinner, MD, Seth D. Rosenzweig, MD, Jose Salinas, PhD, and Kyle F. Dickson, MD

(*J Trauma.* 2010;69: 1222–1225)

Conclusion: With the numbers available in this pilot study, we showed no benefit to the use of drains for acetabular surgery performed through a Kocher-Langenbeck approach.

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Wound Coverage

- Primary closure acceptable if:
  - Adequate, thorough debridement
  - Tension-free closure

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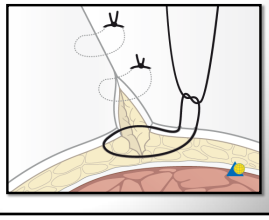
Wound Coverage

- Consider layered closure for dead space management
- Allgower-Donati least effect on skin blood flow
  - Laser Doppler



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Wound Coverage

- Early is better
  - Flap failure rate much higher > 7 days
- Older concepts:
  - Loose approximation
- NPWT
  - May decrease infection / need for flap



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NPWT

Negative Pressure Wound Therapy to Treat Hematomas and Surgical Incisions Following High-Energy Trauma

James P. Stannard, MD, James T. Robinson, BS, E. Ratcliffe Anderson, MD, Gerald McGwin, Jr, PhD, David A. Volgas, MD, and Jorge E. Alonso, MD

J Trauma 2006

- A) 44 pts in hematoma/draining wound
  - Drainage > 5 days →pressure dressing vs. NPWT
- B) 44 pts high-energy trauma (dressing v. NPWT)
- Results:
  - A) +3.1 d (dressing) vs. 1.6 d (NPWT), p=0.03
  - B) +4.8 d (dressing) vs. 1.8 d (NPWT), p=0.02
  - No difference in infection or dehiscence

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NPWT

Incisional Negative Pressure Wound Therapy After High-Risk Lower Extremity Fractures

James P. Stannard, MD, David A. Volgas, MD,† Gerald McGwin III, PhD,‡ Rena L. Stewart, MD,† William Obremskey, MD,§ Thomas Moore, MD,‖ and Jeffrey O. Anglen, MD¶*

J Orthop Trauma 2012

- 249 patients with high-energy tibial plateau, pilon, and calcaneus fractures randomized to:
  - Standard post-op dressing (control)
  - Incisional NPWT
    - 125mmHg, changed q1-2 days
- Results:
  - Time to d/c: No difference
  - Infection: NPWT (10%) vs. control (19%), p=0.049
  - Wound Dehiscence: NPWT (8.6%) vs. control (16.5%), p=0.044

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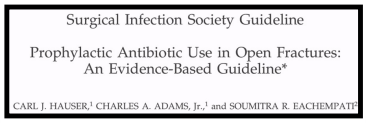
Antibiotics

- How long should abx be given?
  - Benirschke, Arch Surg 1988
    - Grade 1 fx – 1st Gen Ceph equal at 24 hrs vs 5 days


Surgical Infection Society Guideline

Prophylactic Antibiotic Use in Open Fractures: An Evidence-Based Guideline*

CARL J. HAUSER,[1] CHARLES A. ADAMS, Jr.,[1] and SOUMITRA R. EACHEMPATI[2]

    - Grade I: 24-48 hrs
    - Grade II&III: 48 hrs

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Antibiotics

- Timing
  - Within 60 minutes of skin incision
  - ≥ 10 minutes prior to tourniquet inflation (if used)
- Re-dosing
  - Cefazolin – q 2-5 hrs
  - Clindamycin – q 3-6 hrs
  - Vancomycin – q 6-12 hrs

My practice: Re-dose q 4 hrs

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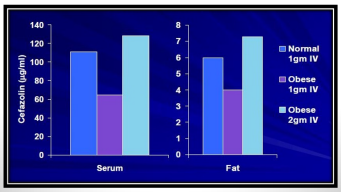
Antibiotics

- Duration
  - No benefit to continuing > 24 hrs post-op
- Dosing
  - 2 grams Ancef (Vanc/Clinda based on BMI)



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Decreasing Perioperative Infection Risk

- Patient-related Factors
  - Age
  - Nutrition status
  - Diabetes
  - Smoking history
  - Obesity

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Patient Factors

- Glucose optimization
  - Stress hyperglycemia associated with increased risk of infection in trauma patients

Stress hyperglycemia and surgical site infection in stable nondiabetic adults with orthopedic injuries

(*J Trauma Acute Care Surg.* 2014;76: 1070–1075.

Justin E. Richards, MD, Julie Hutchinson, ACNP, Kaushik Mukherjee, MD, MSCI, Amir Alex Jahangir, MD, Hassan R. Mir, MD, Jason M. Evans, MD, Aaron M. Perdue, MD, William T. Obremskey, MD, MPH, Manish K. Sethi, MD, *and* Addison K. May, MD, *Nashville, Tennessee*

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Patient Factors

- Oxygenation
  - Decreased rates of SSI in colorectal/GS pts
  - METRC

Oxygen Study

Supplemental Perioperative Oxygen to Reduce Surgical Site Infection After High-energy Fracture Surgery.

Principal Investigator: Dr. Robert O'Toole

The primary objective of this study is to assess the efficacy of supplemental perioperative oxygen in the prevention of surgical site infections. The secondary objectives are to 1) compare species and antibacterial sensitivities of the bacteria in the patients who develop surgical site infections in study patients treated with supplemental oxygen compared to those who were not treated with supplemental oxygen; 2) validate the previously developed risk prediction site infections after fracture surgery; and 3) measure and compare resou surgical site infection in study patients treated with supplemental oxygen c with supplemental oxygen.

This study is being funded by the D (W81XWH-09-2-0108).

METRC

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Patient Factors

- Hypothermia → Bad
  - Hypothermia in OR associated with increased risk of SSI
  - Keep patients warm in the OR

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Patient Factors

- Nutrition
  - Any sign of malnutrition according to MUST more than 2 times likely to get infection, DVT, respiratory failure or other reason for readmission
  - Supplement when needed

Does Risk for Malnutrition in Patients Presenting With Fractures Predict Lower Quality Measures?

James H. Lee, ME, Lorraine H. Hutzler, BA, Brandon S. Shulman, MD, Raj J. Karia, MPH, and Kenneth A. Egol, MD

J Orthop Trauma 2015;29:373-378)

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Patient Factors

- Smoking
  - Wound healing/infection risk

- Transfusions
  - Independent risk factor for infection

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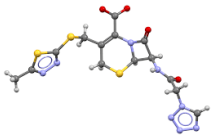
Summary

- Plenty of room for errors
- Do not take shortcuts
- Optimize patient outcomes



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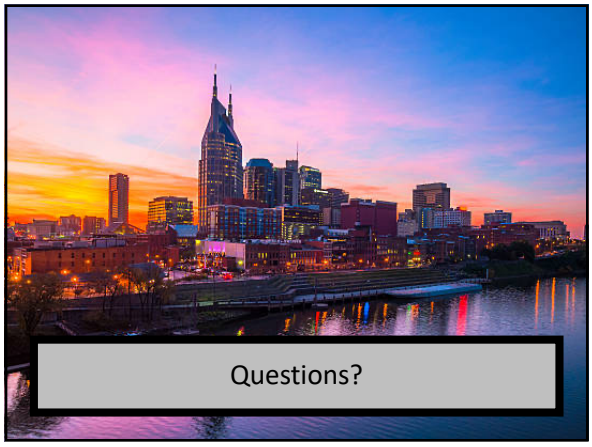

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Thank You

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