

Debridment, Irrigation, and Timing of Fixation



Disclosures

• Publications:

- ◆ Rockwood and Green, ed; *Operative Techniques in Ortho Surgery* assoc ed; Tornetta and Einhorn; *Subspecialty series, Court-Brown, Tornetta; Trauma, AAOS; OKU Trauma, ICL Trauma, Minimally Invasive Surgery Series, ed; OTA Slide project*
- ◆ Journals: JOT; Deputy editor, CORR, JBJS, JAAOS; Reviewer

• Research

- ◆ NIH, OTA, FOT, OREF, AIOD

• Consultant / Designer:

- ◆ Smith Nephew, Kinespring

OTA Evidence Group

Current Practice in the Management of Open Fractures Among Orthopaedic Trauma Surgeons. Part A: Initial Management. A Survey of Orthopaedic Trauma Surgeons

William Obrensky, MD, MPH, Cesar Molina, MD,* Cory Collinge, MD,† Arvind Nana, MD,‡ Paul Tornetta III, MD,‡ Claude Sagi, MD,§ Andrew Schmidt, MD,|| Robert Probst, MD,¶ Jaimo Ahn, MD, PhD,** and Bruce D. Browner, MD,†† for the Evidence-Based Quality Value and Safety Committee—Orthopaedic Trauma Association, Writing Committee*

Infection

- Time to antibiotics
- Time to debridement
- Soft tissue injury
 - Implant timing?
- Time to coverage
- Type of fixation?



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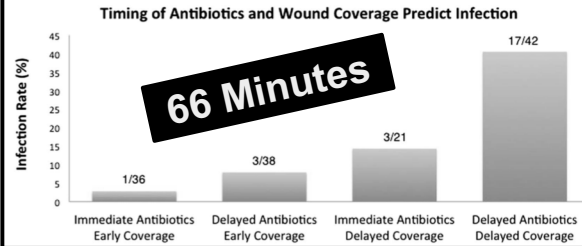


Antibiotics



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†

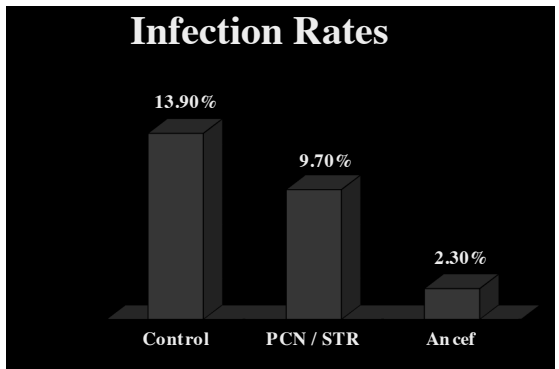


Patzakis

- Randomized trial
- 10 Day course of Ab
 - ◆ Control group
 - ◆ PCN / Streptomycin
 - ◆ Cephalothin



Patzakis



Factors Affecting Infection

< 3 hours = 4.7% infection

> 3 hours = 7.4% infection

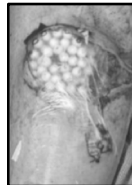
Local

- Henry, et al
- Bead pouch technique
 - ◊ PMMA + tobra
 - ◊ Elutes high levels of local Ab
 - ◊ Minimal systemic concentration
 - ◊ Bathes the fracture in Ab



Bead Pouch

- Tobramycin levels
 - ◊ Serum level = 0.3 - 1.6 MCG / ml
 - ◊ Local level = 7.2 - 258 MCG / ml
 - Avg. 50 MCG / ml
- Local environment
 - ◊ PO₂ = 69 mm Hg



Ostermann

- **Systemic Ab = 12% infection**
- **Bead pouch = 3.7% infection**
- **Acute infection less in 3B, 3C**
- **Osteomyelitis less in 2, 3B**

Antibiotic Choice

- ♦ **Seroma, granulation tissue, and bone**
- ♦ **Clindamycin (6gm / 40gm)**
 - **Best overall**
- ♦ **Tobramycin (9.8gm / 40 gm)**
 - **Best for seroma, tissue**
 - **Not as good for bone**
- ♦ **Vancomycin (4gm / 40 gm)**
 - **Not as good for seroma**

Injection

Local Injection of Aminoglycosides for Prophylaxis Against Infection in Open Fractures

Cheryl Reese Lawing, MD, Feng-Chang Lin, PhD, and Laurence E. Dahners, MD
Investigation performed at the University of North Carolina at Chapel Hill, Chapel Hill, North Carolina

TABLE III Infection Rates			
	No Infection	Deep Infection	Deep and Superficial Infection
Control group (n = 183)	80.3% (147 fractures)	14.2% (26 fractures)	19.7% (36 fractures)
Intervention group (n = 168)	90.5% (152 fractures)	6.0% (10 fractures)	9.5% (16 fractures)
P value		0.011	0.010

Recommendations

• Grade 1

- 3 Days of Ancef
- PCN if farm



• Grade 2 and 3A

- 3 Days of ancef
- Add 24^h load of AG if late, contaminated, or tissue in poor condition
- Add PCN if farm

Debridement

Timing

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**

Debridement

Timing

Adequacy!

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Timing of Wound Closure in Open Fractures Based on Cultures Obtained After Debridement

By Christopher J. Lenarz, MD, J. Tracy Watson, MD, Berton R. Moed, MD, Heidi Israel, PhD, RN, J. Daniel Mullen, MSPH, BA, BS, and James B. MacDonald, BS

ED View



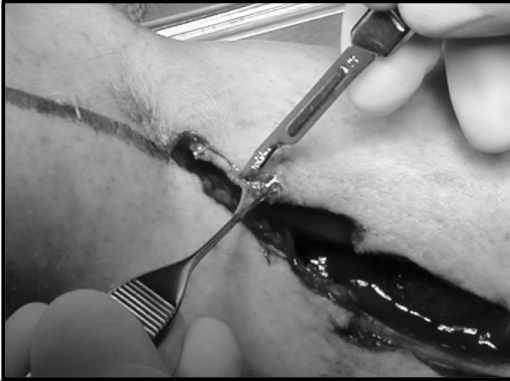
Closeup



Extensions



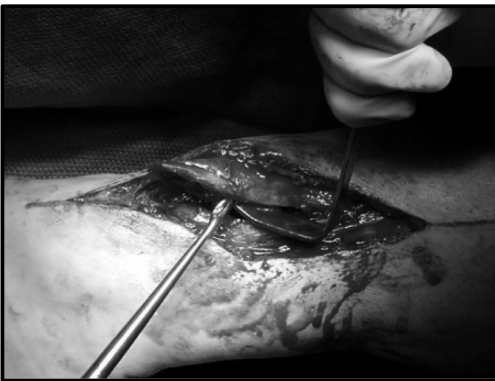
Debride Skin Edges



Then Extend



Deliver Bone Edges



Debride



Irrigation



Irrigation

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

The FLOW Investigators*

Flow Study

- **2338 Open fractures**

- ◆ **Tibia, other LE, UE**

- **Deep infection**

- ◆ **Tibia > UE**

- ◆ **Other LE > UE**

- ◆ **Gustilo type**

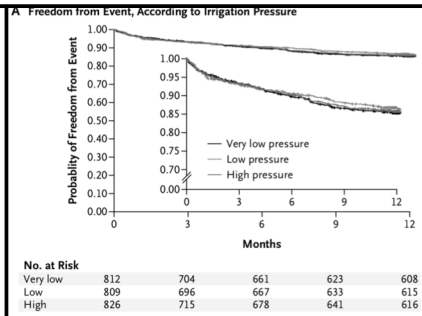
- ◆ **Delayed closure**

- ◆ **Need for flap**



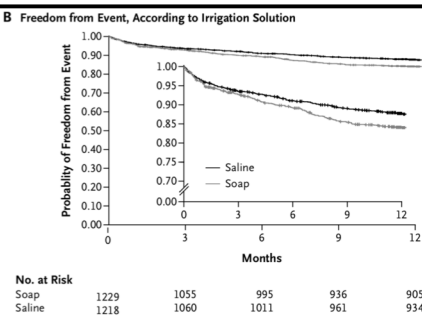
A Trial of Wound Irrigation in the Initial Management of Open Fracture Wounds

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

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Any Infection

Factor	Hazzard Ratio	P
Tibia vs UE	5.13	< 0.001
LE vs UE	3.63	
Severe contamination	2.12	0.004
Moderate contamination	1.08	
Need for flap	1.82	0.017
Low vs. high energy	0.61	0.02

Deep Infection

Factor	Hazzard Ratio	P
Tibia vs UE	2.72	< 0.001
LE vs UE	2.98	
Delayed closure	1.89	0.003
Type 3 Injury	1.57	0.016
Need for flap	2.05	0.017

Deep Infection

Factor	Hazzard Ratio	P
Tibia vs UE	2.72	< 0.001
LE vs UE	2.98	
Delayed closure	1.89	0.003
Type 3 Injury	1.57	0.016
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Contamination!

Single-stage orthoplastic reconstruction of Gustilo–Anderson Grade III open tibial fractures greatly reduces infection rates

J.A. Mathews*, J. Ward, T.W. Chapman, U.M. Khan, M.B. Kelly

Departments of Trauma & Orthopaedics/Plastic Surgery, North Bristol Trust, Bristol, UK

Table 2
Rates of deep infection in patients presenting with Gustilo–Anderson Grade III open tibial fractures divided by nature of operations.

Combined single-stage orthoplastic fixation and coverage	Deep infection		
	No (%)	Yes (%)	Total
No	17 (65.4%)	9 (34.6%)	26
Yes	46 (95.8%)	2 (4.2%)	48
Overall	63 (85.1%)	11 (14.9%)	74

p < 0.001 (Fisher's exact test)

Timing of Definitive Fixation with Respect to Flap Coverage in Open Tibia Fractures



Paul Tornetta III, Casey Kuripla, Justin Koh, Andrew Sems, Tayseer Shamaa, Hassan Mir, Benjamin Streufert, Clay Spittler, Heather Vallier, Debra Sorg, Brian Mullis, Brian McGowan, John Weinlein, Lisa Cannada, Jonathan Charlu, Jerald Westberg, Emily Wagstrom, Saam Morshed, Abigail Cortez, Peter Krause, Andrew Marcantonio, Gillian Soles, Jason

Implant to Flap Time

- Exposed implant
- Contamination
- Increase infection?



Purpose

- Evaluate
 - ◆ Time to coverage from injury
 - ◆ Time to coverage from fixation
- Open tibias requiring coverage

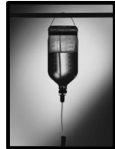
Methods

- Multicenter study
 - ◆ 14 Trauma centers
 - ◆ Retrospective



Infection

- **Clinical infection**
- **IV antibiotics > 1 week**
- **Debridement in OR**



Demographics

	Total	Infected	%
N	296	96	32.4
Male	227	77	33.9
Female	69	19	27.5
Age	40.34	39.88	
Smoker	143	46	32.2
Diabetic	15	5	33.3

Treatment

- **35 Definitive ex-fix**
- **81 Fixation on 1st I&D**
- **215 Delay in fixation**

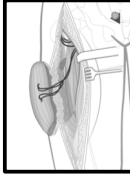


Soft Tissue Procedures

• 46% Rotational flap

• 38% Free muscle flap

• 16% Fasciocutaneous flap



Timing

Days to flap	Infected ?		P
	Yes (96)	No	
Debridement	12.7 ± 11.7	9.7 ± 7.3	0.007
Fixation	7.3 ± 9.2	4.9 ± 6.6	0.01

Infection: Univariate

	P value
Temporary internal fixation	0.6
Time 1 st debridement to flap	0.13
Time fixation to flap	0.004
Flap failure	<0.001

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Infection Multivariate		
	Coef	P value
Temp internal fixation	0.372	0.498
Time 1 st debride - flap	-0.002	0.918
Time fixation to flap	0.058	0.093
Flap failure	1.794	<0.001
Constant	-1.967	0

Infection Multivariate		
	Coef	P value
Temp internal fixation	0.372	0.498
Time 1 st debride - flap	-0.002	0.918
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Summary

- 296 patients
- High grade open tibias
 - 215 Delayed fixation
- Infection correlated with:
 - Time from fixation and flap
 - Flap failure



Example



Example



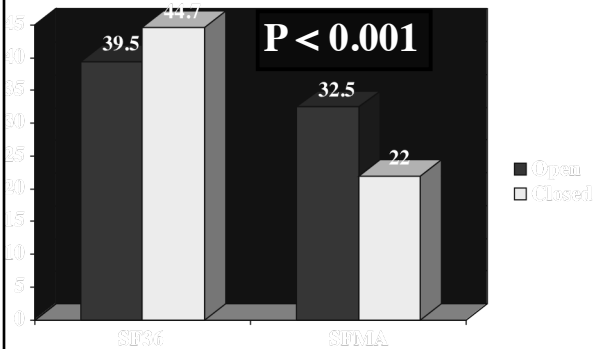
Functional Outcome?

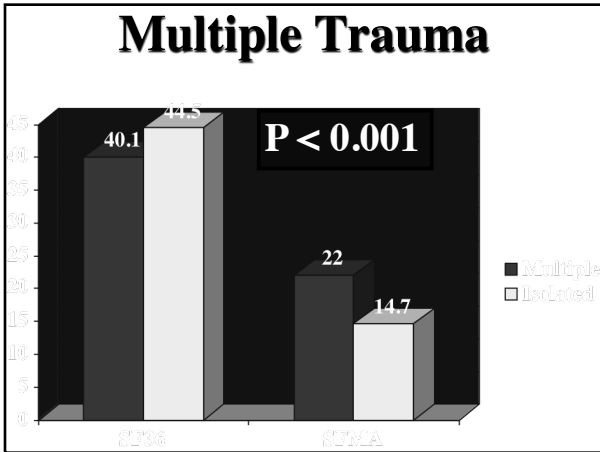
Functional, General, and Disability Outcomes after Tibial Nailing: A Randomized Trial

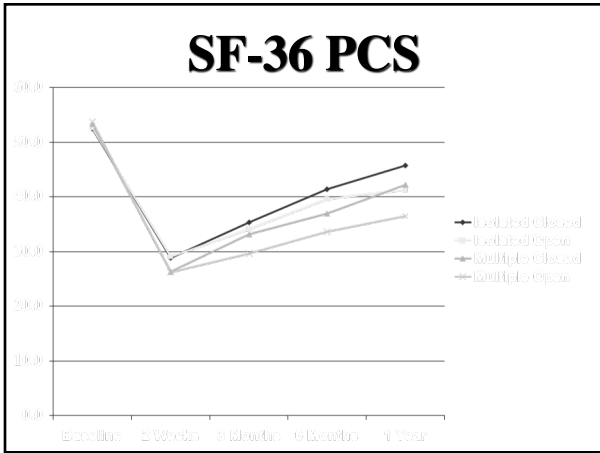
The Sprint Investigators

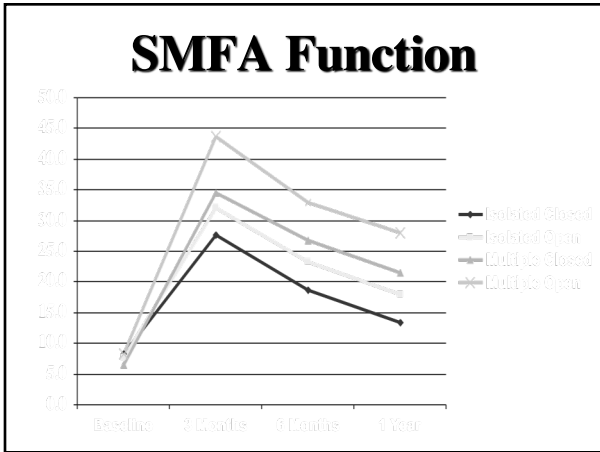


Open vs Closed









Activity Return

RETURN OF	All (661)	Open (205)	Closed (456)	Isolated (435)	Multitrauma (226)	Isolated Closed (307)
Exercise	56%	45%	61%	64%	40%	69%
Training	53%	43%	58%	60%	37%	65%
Sports	44%	33%	48%	50%	31%	54%
Employment	65%	50%	71%	73%	48%	79%

Summary

- Time to antibiotics
- Debridement
 - Adequacy
- Irrigation
 - Saline
- Timing of definitive fixation



Thank You



Boston Medical Center
