Minimizing Infection In EOS

2016 ICEOS
Utrecht, Netherlands

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HARVARD MEDICAL SCHOOL
TEACHING HOSPITAL

Disclosures

No relevant financial disclosures related to this talk

Disclosures in program book

Outline

What do we know?

- Infection rate
- Infection risk

Can we prevent?

Infection….Now What?

Outline

What do we know?

- Infection rate
- Infection risk

Can we prevent?

Infection….Now What?

Infections Are Expensive

SPINE Volume 34, Number 1, pp 60–64
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Failure of Attempted Implant Retention in Spinal Deformity Delayed Surgical Site Infections

Daniel Hedequist, MD, Anne Haugen, BS, Timothy Hresko, MD, and John Emans, MD

Mean hospital charges:

- $154,537 ($26,977-$961,722)

Indirect costs

Pay for performance

Bundled care

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Infection Rate is High

AIS:

-0.5-6.7%

Neuromuscular:

-4.3-14.3%

Myelodysplasia:

-6.1-30%

Repetitive procedures in patients with poor nutrition and medical comorbidities

What's the Evidence? Systematic Literature Review of Risk Factors and Preventive Strategies for Surgical Site Infection Following Pediatric Spine Surgery

Michael P. Glotzbecker, MD, Matthew D. Riedel, BA,† Michael G. Vitale, MD, MPH,† Hiroko Matsumoto, MA,† David P. Roye, MD,† Mark Erickson, MD,‡ John M. Flynn, MD,§ and Lisa Saiman, MD, MPH‖¶*

J Pediatr Orthop 2013;33:479–487

What is Infection Rate?

Rib Based Growing Construct (10-32%)

Emans, Spine 2005:
- 3/31 (10%)

Campbell, JBJS 2004:
- 3/27 (11%)

Smith, Spine Deformity 2011:
- 16/97 (16%)

Sankar, Spine 2010:
- 6/19 (32%)

Garg Spine 2014:
- **38/213 (18%)**

Growing Rods (7-40%)

Klemme, JPO 1997:
- 5/67 (7%)

Akbarnia, Spine 2005:
- 2/23 (9%)

Yang Spine 2011:
- 5/49 (10%)

Bess, JBJS 2010:
- 15/140 (14%)

McElroy, Spine 2011:
- 11/80 (14%)

Sankar , Spine 2010:
- 4/10 (40%)

Kabirian JBJS 2014
- **42/379 (11%)**

Infection Rate for GR

379 patients, 2344 procedures

42 patients w/ infection (11.1%)

- 10 (2.6%) by first lengthening
- 29 (7.7%) during lengthening
- 3 after final fusion

Deep Surgical Site Infection Following 2344 Growing-Rod Procedures for Early-Onset Scoliosis

Risk Factors and Clinical Consequences

Nima Kabirian, MD, Behrooz A. Akbarnia, MD, Jeff B. Pawelek, BS, Milad Alam, MD, Gregory M. Mundis Jr., MD, Ricardo Acacio, MD, George H. Thompson, MD, David S. Marks, FRCS, FRCS(Ortho), Adrian Gardner, MRCS, FRCS(Tr&Ortho), Paul D. Sponseller, MD, MBA, David L. Skaggs, MD, MMM, and the Growing Spine Study Group

J Bone Joint Surg Am. 2014;96:e128(1-8)

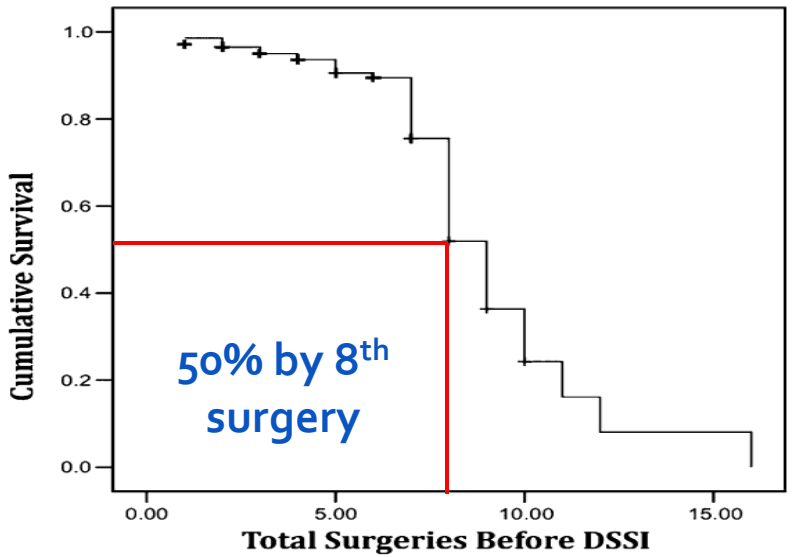

Fig. 1

Kaplan-Meier survival analysis of the cumulative survival of all patients, with deep surgical site infection (DSSI) as the end point.

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Infection Rate In Rib Based Growing Construct

Overall rate:

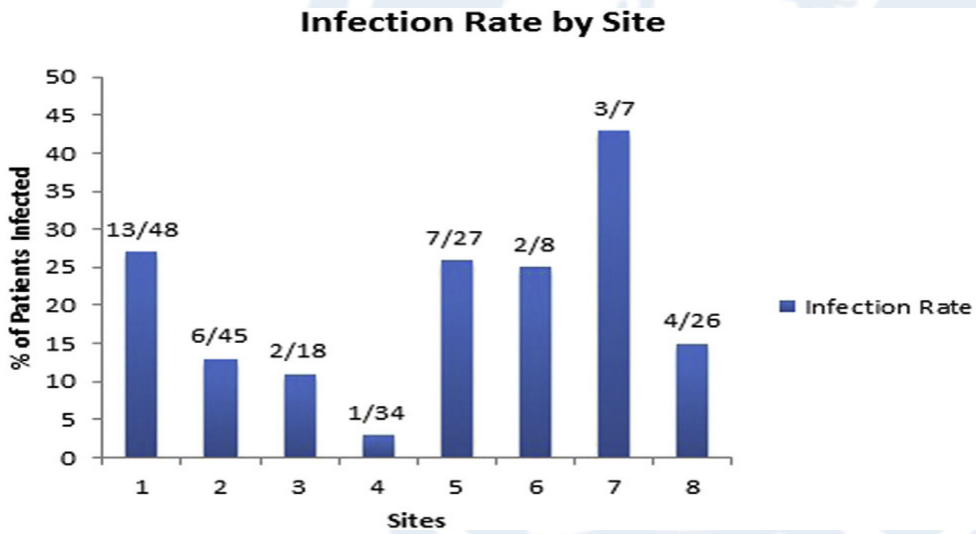
– 18% (38/213)

55 infection events
(1497 total procedures)

Spine Deformity
www.spine-deformity.org
Spine Deformity 4 (2016) 59–64

Variability of Surgical Site Infection With VEPTR at Eight Centers: A Retrospective Cohort Analysis

Sumeet Garg, MD[a,*], Micaela Cyr, BA[a], Tricia St. Hilaire, MPH[b], Tara Flynn, BA[b], Patrick Carry, BA[a], Michael Glotzbecker, MD[b,c], John T. Smith, MD[b,d], Jeffrey Sawyer, MD, FAAOS[b,e], Joshua Pahys, MD[b,f], Scott Luhmann, MD[b,g], John M. Flynn, MD[b,h], Ron El-Hawary, MD, MSc, FRCS(C)[b,i], Michael Vitale, MD, MPH[b,j]



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Staph Aureus…and Others

Kabirian et al, Smith et al, Garg et al:

-MSSA, MRSA, others

TABLE III Microorganisms Detected at the Initial Infection and Subsequent Recurrences

	Initial Infection	First Recurrence	Second Recurrence	Third Recurrence	Fourth Recurrence	Total No.	Total %
Single isolate							
Staphylococcus aureus	24	6	4			34	49
Methicillin-resistant *Staphylococcus aureus* (MRSA)	2	1				3	4
Staphylococcus epidermidis	2	2				4	6
Enterococcus faecalis	2	2				4	6
Escherichia coli	1		1			2	3
Pseudomonas aeruginosa	1					1	1
Group-A Streptococcus	1					1	1
Propionibacterium acnes	1					1	1
Mixed isolates							
Skin flora		1	1			2	3
Pseudomonas aeruginosa, Staphylococcus aureus	1	1				2	3
Enterococcus faecalis, Escherichia coli, and Streptococcus	1					1	1
Proteus mirabilis, Staphylococcus aureus	1					1	1
Escherichia coli, Staphylococcus aureus, Streptococcus	1					1	1
Acinetobacter baumannii, Staphylococcus aureus		1				1	1
Culture not specified	4	3	2	2	1	12	17
Total	42	17	8	2	1	70	100

Infecting Organism	N
MSSA	25
MRSA	9
Escherichia Coli	5
Enterococcus spp.	3
No Growth	3
Coag Neg Staph	2
Streptococcus spp.	2
Other	2
Bacillus spp.	1
Stenotrophomonas maltophilia	1
Staphylococcus Warneri	1
Klebsiella oxytoca	1
Candida Albicans	1
Staphylococcus epidermidis	1

TABLE 1. Organisms Identified and Associated With VEPTR Infection

Organism	
Staphylococcus aureus	15
Propionibacterum acnes	1
Gram + cocci	1
Pseudomonas	1
Staphylococcus epidermidus	1

Lots of Risk Factors

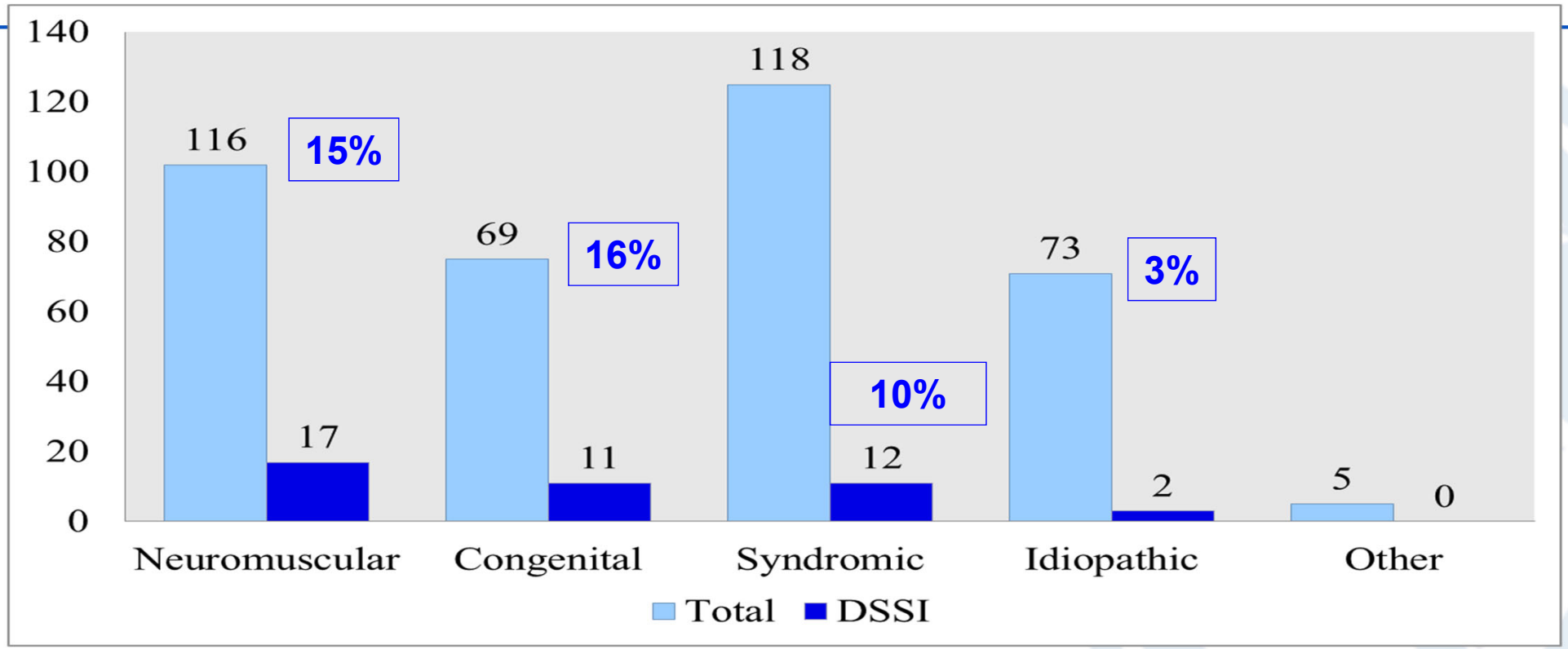
Patient Related

- Diagnosis, malnutrition, incontinence

Surgery Related

- Repetitive surgery, implant prominence, poor technique

Etiology Matters

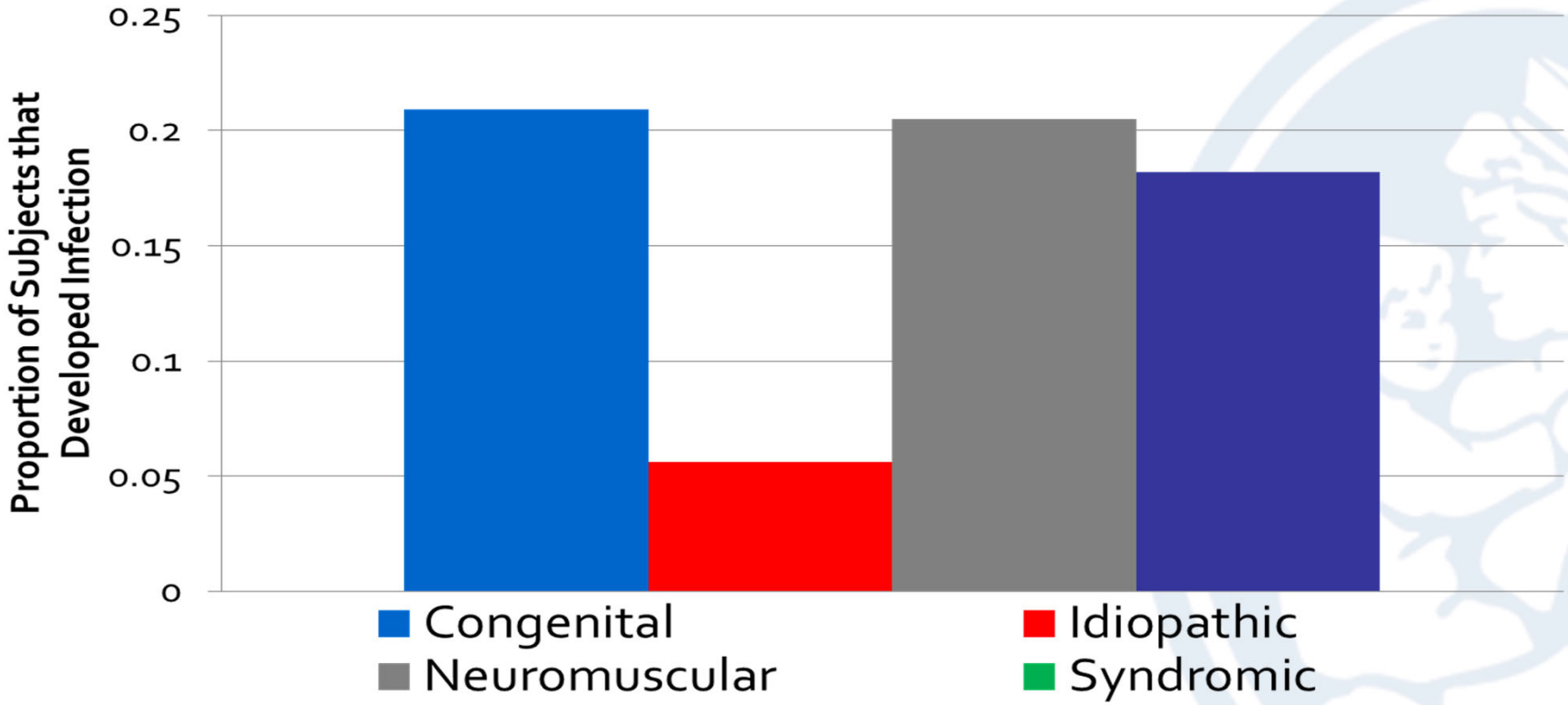


Deep Surgical Site Infection Following 2344 Growing-Rod Procedures for Early-Onset Scoliosis

Risk Factors and Clinical Consequences

Nima Kabirian, MD, Behrooz A. Akbarnia, MD, Jeff B. Pawelek, BS, Milad Alam, MD, Gregory M. Mundis Jr., MD, Ricardo Acacio, MD, George H. Thompson, MD, David S. Marks, FRCS, FRCS(Ortho), Adrian Gardner, MRCS, FRCS(Tr&Ortho), Paul D. Sponseller, MD, MBA, David L. Skaggs, MD, MMM, and the Growing Spine Study Group

Etiology-Rib Based Growing Construct



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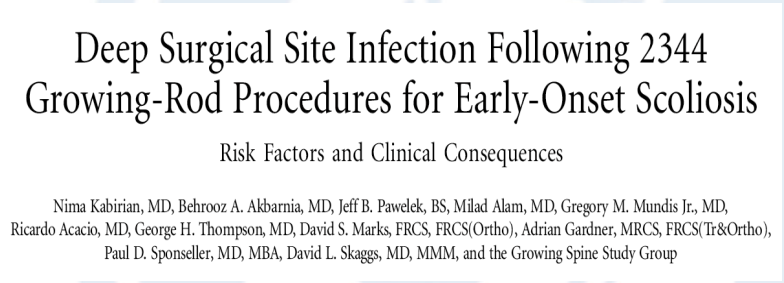
Garg et al

Risk Factors—Specific to EOS

Increased infection risk:

- Stainless steel (OR=5.7)
  - 30/221 (13.6%) vs 12/150 (8%)
- Non-ambulatory status (OR=2.9)
- Number of revisions (OR=3.3)



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Wound Complication Risk

Cahill et al, ICEOS 2016:

112 patients, 140 surgeries

22 complications

84% correctly predicted by model

Multivariable Analysis:

Age <4 (OR 4.9)

Male (OR 3.0)

Diapered, lower back incision (OR 2.9)

Bilateral procedure (OR 8.5)

Risk Severity Score ICEOS 2016

Development of a Risk Severity Score Predicting Surgical Site Infection in Early Onset Scoliosis

Hiroko Matsumoto MA; David Price Roye MD; Nicholas A Feinberg BA; John Taylor Smith MD; Amer Samdani MD; Michael P Glotzbecker MD; Jeffrey R Sawyer MD; David Lee Skaggs MD; Michael G Vitale; Growing Spine Study Group; Children's Spine Study Group
Columbia University Medical Center, New York

171 patients

22.8% infection

Risk:

-5.7→79.6%

Syndromic etiology (OR 5.3)
Pulmonary comorbidity (OR 2.2)
Cobb angle >90 (OR 1.7)
Non-ambulatory status (OR 2.7)
High BMI (95th percentile and above) (OR 1.1)
Pelvic instrumentation (OR 1.2)

Outline

What do we know?

- Infection rate
- Infection risk

Can we prevent?

Infection….Now What?

Can We Prevent?

Problem:

Data lacking….

Current Practice is Variable

J Child Orthop
DOI 10.1007/s11832-014-0584-1

ORIGINAL CLINICAL ARTICLE

Surgeon practices regarding infection prevention for growth friendly spinal procedures

Michael P. Glotzbecker · Sumeet Garg · Behrooz A. Akbarnia · Michael Vitale · Tricia St Hillaire · Ajeya Joshi

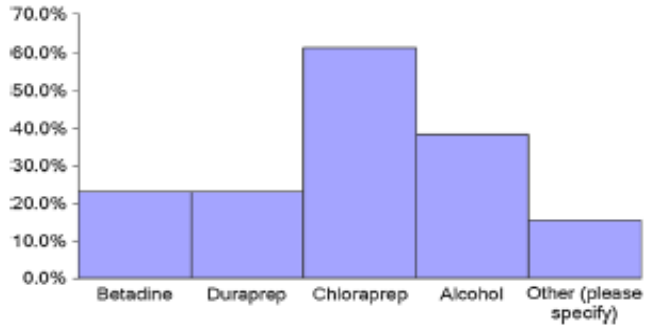

Fig. 1 Graphical depiction of variability in skin preparation prior to surgery amongst surgeons surveyed

Significant variability

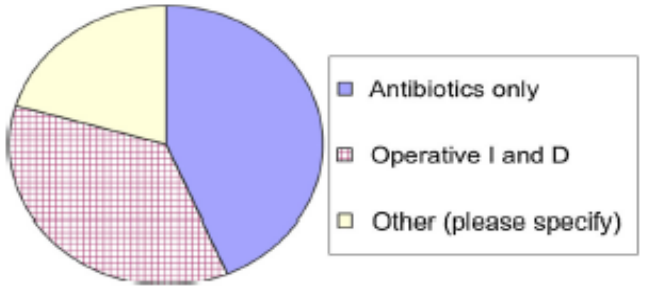

Fig. 2 Variable approach of surgeons toward a superficial infection

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Can We Use What We Know About Older Children?

What's the Evidence? Systematic Literature Review of Risk Factors and Preventive Strategies for Surgical Site Infection Following Pediatric Spine Surgery

Michael P. Glotzbecker, MD, Matthew D. Riedel, BA,† Michael G. Vitale, MD, MPH,† Hiroko Matsumoto, MA,† David P. Roye, MD,† Mark Erickson, MD,‡ John M. Flynn, MD,§ and Lisa Saiman, MD, MPH‖¶*

Building Consensus: Development of a Best Practice Guideline (BPG) for Surgical Site Infection (SSI) Prevention in High-risk Pediatric Spine Surgery

Michael G. Vitale, MD, MPH, Matthew D. Riedel, BA,* Michael P. Glotzbecker, MD,† Hiroko Matsumoto, MA,* David P. Roye, MD,* Behrooz A. Akbarnia, MD,‡*

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Best Practice Guidelines

Building Consensus: Development of a Best Practice Guideline (BPG) for Surgical Site Infection (SSI) Prevention in High-risk Pediatric Spine Surgery

Michael G. Vitale, MD, MPH, Matthew D. Riedel, BA,* Michael P. Glotzbecker, MD,† Hiroko Matsumoto, MA,* David P. Roye, MD,* Behrooz A. Akbarnia, MD,‡ Richard G.F. Anderson, MD, FACS, FAAP,§ Douglas L. Brockmeyer, MD,‖*

J Pediatr Orthop • Volume 33, Number 5, July/August 2013

TABLE 4. Final Best Practice Guidelines: Consensus Recommendations to Prevent Surgical Site Infections in High-risk Pediatric Spine Surgery

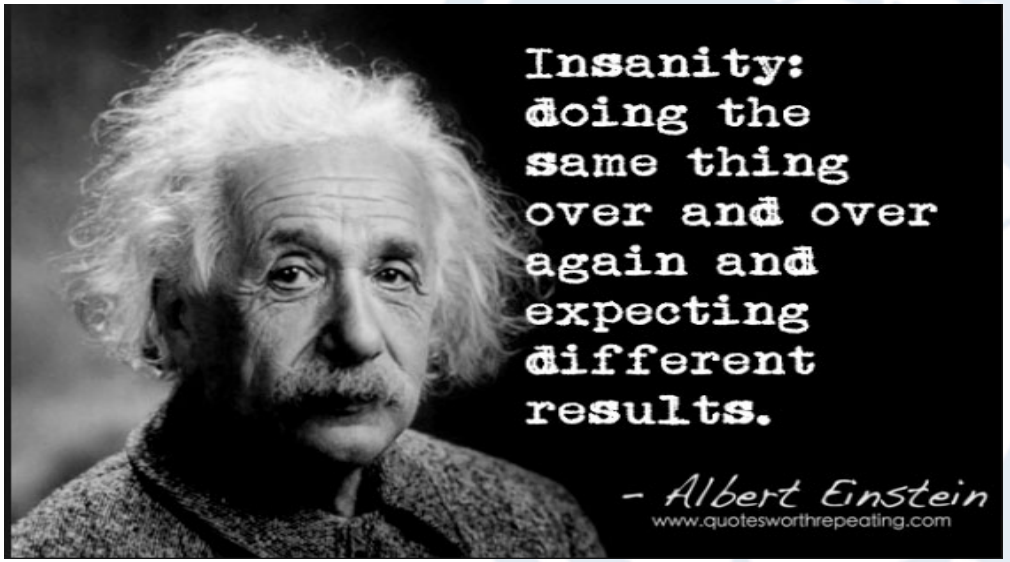
	Consensus (%)		
	Total	Strongly Agree	Agree
1. Patients should have a chlorhexidine skin wash at home the night before surgery.*	91	61	30
2. Patients should have preoperative urine cultures obtained and treated if positive.*	91	26	65
3. Patients should receive a preoperative Patient Education Sheet.*	91	48	43
4. Patients should have a preoperative nutritional assessment.*	96	57	39
5. If removing hair, clipping is preferred to shaving.†	100	61	39
6. Patients should receive perioperative intravenous cefazolin.*	91	65	26
7. Patients should receive perioperative intravenous prophylaxis for gram-negative bacilli.*	95	65	30
8. Adherence to perioperative antimicrobial regimens should be monitored (ie, agent, timing, dosing, redosing, cessation).*	96	61	35
9. Operating room access should be limited during scoliosis surgery whenever practical.*	96	61	35
10. Ultraviolet lights need not be used in the operating room.*	87	48	39
11. Patients should have intraoperative wound irrigation.*	100	83	17
12. Vancomycin powder should be used in the bone graft and/or the surgical site.†	91	48	43
13. Impervious dressings are preferred postoperatively.†	91	56	35
14. Postoperative dressing changes should be minimized before discharge to the extent possible.†	91	52	39

*These interventions reached consensus after the first round of voting.

Best Practice Guidelines

Strive to achieve best practices

Reduce variability



Risk Factors—Specific to EOS

Hartman et al, ICEOS 2016:

-Decreased implant uncovered time

-120→42 minutes

-Infection rate per procedure

-11.3%→3.2%

Reducing Risk with Intrawound Antibiotics

Free Paper #6: Vancomycin Powder Lowers Infection Rate in Growing Rod Surgery in Early Onset Scoliosis: A Preliminary Report

R. Justin Mistovich, Connie Poe-Kochert, Jochen Son-Hing, Christina Hardesty, George Thompson

LOTS IN ADULTS---LIMITED DATA FOR THIS POPULATION

J Neurosurg Spine 19:331–335, 2013
©AANS, 2013

Comparative effectiveness and cost-benefit analysis of local application of vancomycin powder in posterior spinal fusion for spine trauma

Presented at the 2013 Joint Spine Section Meeting

Clinical article

Saniya S. Godil, M.D.,[1,2] Scott L. Parker, M.D.,[1,2] Kevin R. O'Neill, M.D.,[3] Clinton J. Devin, M.D.,[2,3] and Matthew J. McGirt, M.D.[1,2]

Sweet, F., C. Silva, and M. Roh, *Intra-wound application of vancomycin for prophylaxis in instrumented thoracolumbar fusions.* Proceedings of the NASS 24th Annual Meeting, 2009.

O'Neill, K.R., et al., *Reduced surgical site infections in patients undergoing posterior spinal stabilization of traumatic injuries using vancomycin powder.* Spine J, 2011. **11**(7): p. 641-6.

Molinari, W.J., O. Khera, and R.W. Molinari, *Prophylactic Operative Site Powdered Vancomycin and Postoperative Deep Spinal Wound Infection: 1512 Consecutive Surgical Cases during a Six-Year Period [Abstract 37].* Presented at teh Scoliosis Research Society 46th Annual Meeting and Course, Louiville, Kentucky. September 14-17, 2011.

Rahman, R.K., et al., *Intrawound Vancomycin Lowers the Acute Deep Wound Infection Rate in Adult Spinal Deformity Patients.* Presented at teh Scoliosis Research Society 46th Annual Meeting and Course, Louiville, Kentucky. September 14-17, 2011.

Intrawound Vancomycin Powder Eradicates Surgical Wound Contamination

An in Vivo Rabbit Study

Lukas P. Zebala, MD, Tapanut Chuntarapas, MD, Michael P. Kelly, MD, Michael Talcott, DVM, Suellen Greco, DVM, and K. Daniel Riew, MD

Investigation performed at the Departments of Orthopaedic Surgery and Comparative Medicine, Washington University in St. Louis, St. Louis, Missouri

Spine
SURGERY
SPINE Volume 36, Number 24, pp 2084–2088
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Intrawound Application of Vancomycin for Prophylaxis in Instrumented Thoracolumbar Fusions

Efficacy, Drug Levels, and Patient Outcomes

Fred A. Sweet, MD, Michael Roh, MD, and Christopher Sliva, MD

Is Vanco Safe in Kids?

Adverse Reactions to Intra-Wound Vancomycin Powder in Early Onset Scoliosis:

A Multicenter Study of 1398 Children ≤12 Years Old

Flynn et al, (unpublished)

Adverse reactions:

-1/1398 (0.07%)

Spine
SURGERY

SPINE Volume 38, Number 19, pp 1703-1707

Adjunctive Vancomycin Powder in Pediatric Spine Surgery is Safe

Itai Gans, BS,*† John P. Dormans, MD,* David A. Spiegel, MD,* John M. Flynn, MD,*
Wudbhav N. Sankar, MD,* Robert M. Campbell, MD,* and Keith D. Baldwin, MD, MSPT, MPH*†

Does Vanco Work in Kids?

Mistovich et al, ICEOS 2016

- 14% per procedure vs 4.7%
- 66% RRR

Spine
SURGERY

SPINE Volume 38, Number 19, pp 1703-1707

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Itai Gans, BS,*† John P. Dormans, MD,* David A. Spiegel, MD,* John M. Flynn, MD,*
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Are we creating resistant organisms?

Take Care of the Soft Tissues

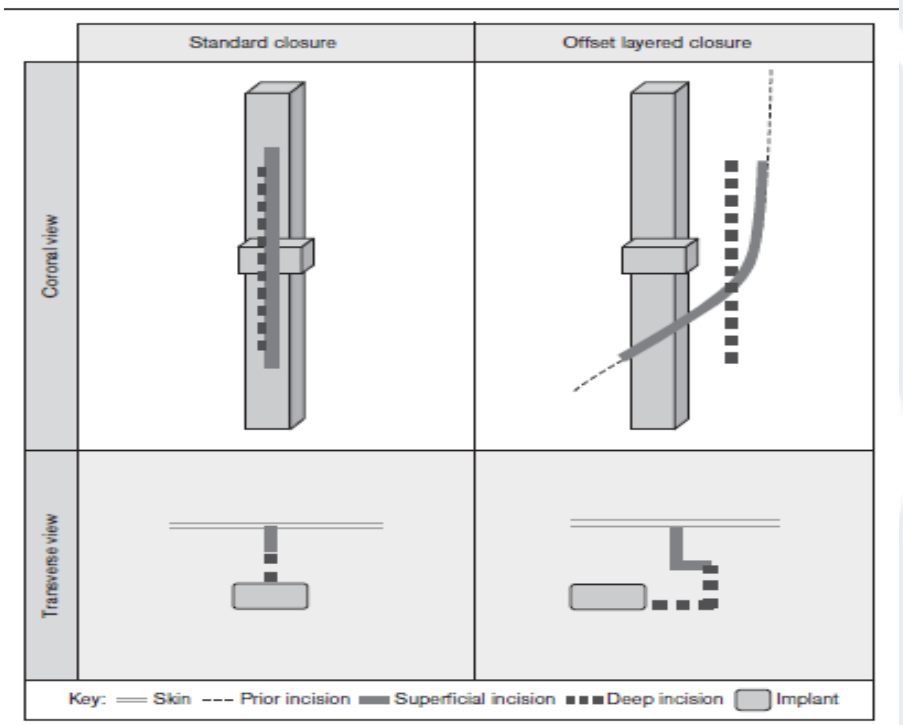
Offset layered closure reduces deep wound infection in early-onset scoliosis surgery

Alexandra M. Grzywna, Patricia E. Miller, Michael P. Glotzbecker and John B. Emans

Journal of Pediatric Orthopaedics B 2016, 25:361–368

Offset closure:

Infection rate <1% vs 3%



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Outline

What do we know?

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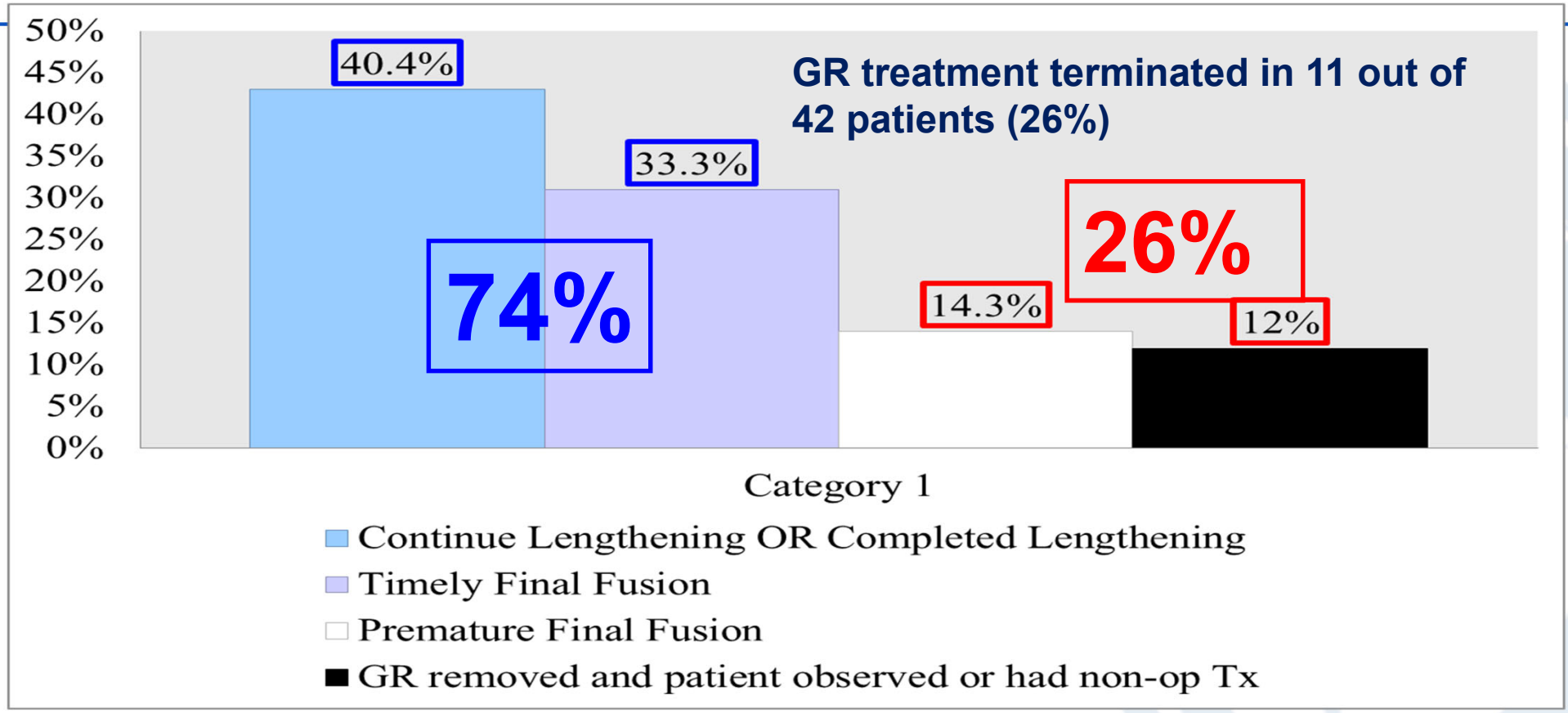
- Infection risk

Can we prevent?

Infection….Now What?

GR-Final Outcome at Final FU



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Rib Based Growing Construct

Spine
DEFORMITY
SPINE Volume 36, Number 25, pp 2176–2179
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Can Infection Associated With Rib Distraction Techniques Be Managed Without Implant Removal?

John T. Smith, MD, and Melissa S. Smith, CPNP

TABLE 2. Rate of Treatment Success With Debridement and Antibiotics

Resolution	
Initial treatment	13
Second treatment	3
Third treatment	2
Fourth treatment	1

97 patients, 678 procedures

- **19 infections, 16 patients**
- **IV abx 58 day, oral 34 days**
- **None required implant removal**

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What do we know?

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Can we prevent?

Infection….Now What?

Outline

What do we know?

- Infection rate
- Infection risk

-Common
-Expensive

Can we prevent? -Maybe

Infection….Now What? -Maintain implants?

Thank You

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