

SSI SUMMIT 4, ADVANCING SURGICAL CARE ACROSS THE OPERATIVE CONTINUUM

Options in Post-Operative Care

William J. Ennis DO,MBA,MMM

Catherine and Francis Burzik Professor of Surgery, Chief Section of Wound Healing and Tissue Repair

University of Illinois Hospital and Health Sciences System

DISCLOSURE

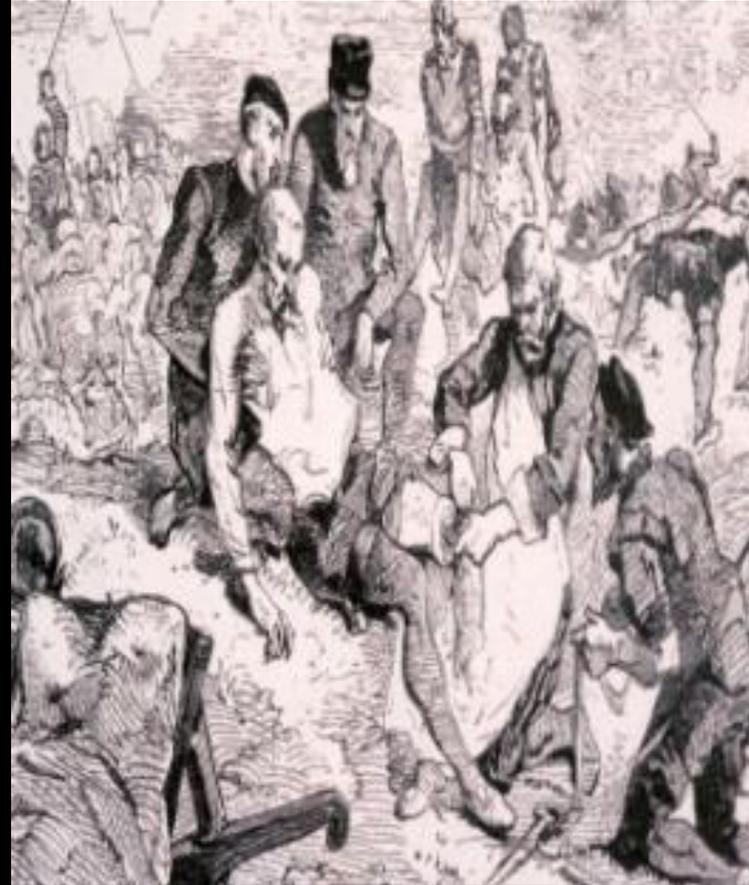
- Chief Science Officer Healogics
- NIH funding

OVERVIEW

- History
- SSI/Wound care
- UIC Department structure/ACWHTR
- Physiology
- Diagnosis/Surveillance
- Advanced technologies
 - Diagnostic
 - Therapeutic
- Prevention
- Rules, Benchmarks, Payment structure
- Summary and Q+A

HISTORY

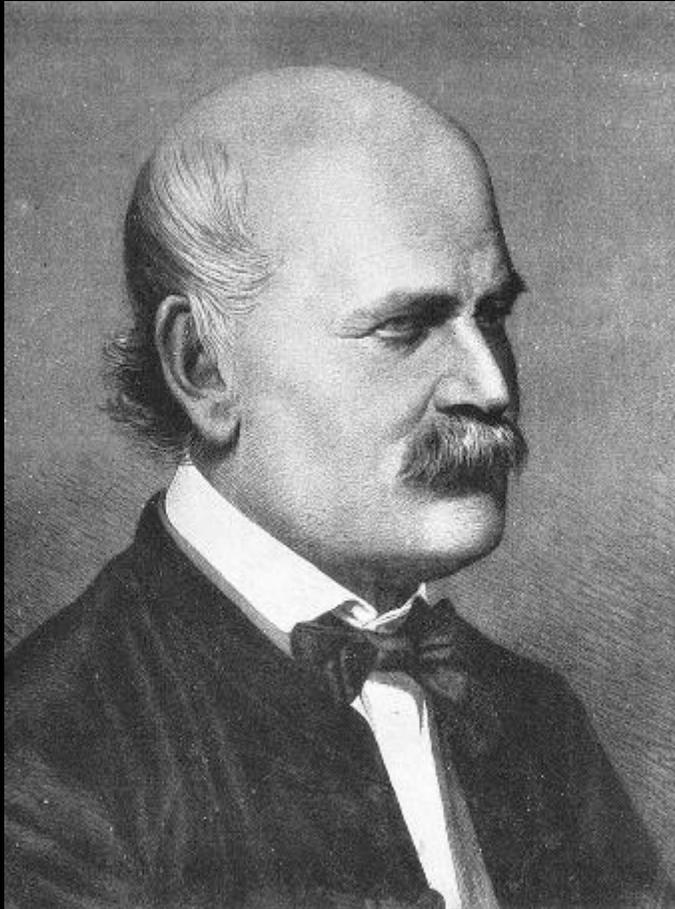
CHANGE IS DIFFICULT!



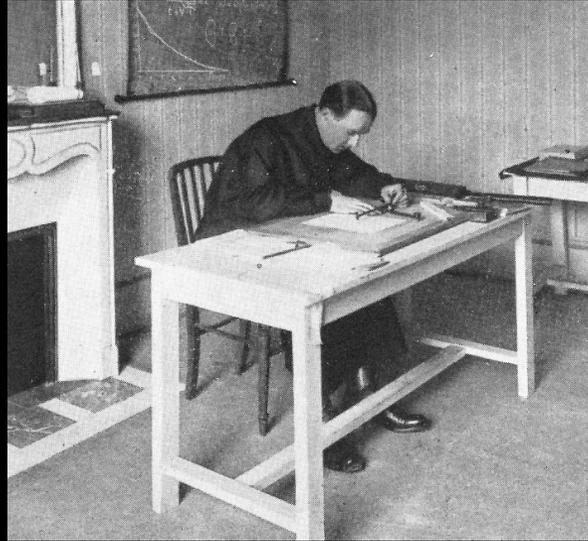
HISTORY



HISTORY



HISTORY



HEALING WOUNDED SOLDIERS TO ORDER

BY A REMARKABLE NEW SYSTEM OF IRRIGATING DEEP WOUNDS, DEvised AT THE FRONT
BY DR. ALEXIS CARREL, OF THE ROCKEFELLER INSTITUTE—AND THE WAY
THE SURGEONS CAN FORETELL TO THE DAY WHEN
A WOUNDED MAN WILL RECOVER

BY
LEWIS R. FREEMAN



HISTORY



Principles of Antibiotic Prophylaxis

Preop administration, serum levels adequate throughout procedure with a drug active against expected microorganisms

High Serum Levels

1. Preop timing
2. IV route
3. Highest dose of drug

During Procedure

1. Long half-life
2. Long procedure – redose
3. Large blood loss – redose

Duration

1. None after wound closed
2. 24 hours maximum

Mangram AJ et al. *Infect Control Hosp Epidemiol*. 1999;20:250-278.

INFECTIOUS DISEASE AND THE SURGICAL PATIENT

- Community acquired infections
- SSI
- Nosocomial

SSI AND WOUND CARE COMMONALITIES

- Absence of large volume of well designed RCT's to drive practice
- Wide practice variation
- Adequate risk based evaluations lacking
- Numerous treatment options
- Culture of dogmatic approaches
- Complex patients
- Increased surveillance leads to increased cost and reported frequency
- Are superficial SSI's really all the same, reported as such, are all wounds the same

SSI=CHRONIC WOUND

- Wound Healing Society Definition of a chronic wound
 - A wound that fails to heal within an anticipated time frame
- Although considered a surgical wound, after the occurrence, the SSI is essentially a chronic non healing wound and all the principles of modern moist wound care should and do apply

- 20 billion dollar industry
- 5-7 million patient in US
- Increasing age, diabetes, obesity, chronic conditions, surgical procedures
- Simultaneous health care reform, cost containment, pay for performance, increasing complexity of medical technology
- No formal medical education in wound care
- Conflicting certification process and confusion as to representative voice of the field

However, our current medical school curriculums address this epidemic by dedicating **only 9.2 hours** of training over **4 years**.

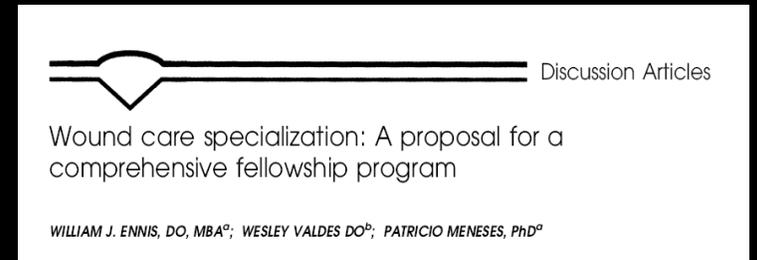
THIS CANNOT CONTINUE.

WOUND
REALITY

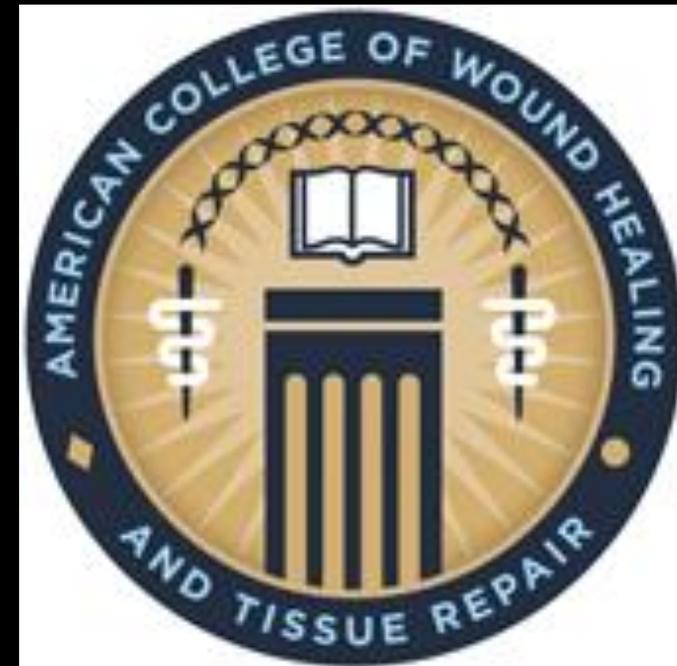
6.7 million people are suffering and adding **18.3 billion dollars** in cost to the health care system.

UIC SECTION OF WOUND HEALING AND TISSUE REPAIR

- *2004 first physician one year fellowship in wound healing, Advocate Christ hospital, Univ. of Illinois teaching facility
- *Physician hired into practice
- *December 2009, key opinion leaders met in St. Thomas and drafted initial conceptual model
- *Launch of SST meeting July 2008
- *University of Illinois Hospital and Health Sciences System creates Section of Wound Healing and Tissue Repair
- *First fellow accepted to University based program



(WOUND REP REG 2004;12:120-128)





UNIVERSITY OF ILLINOIS
Hospital & Health Sciences System
Changing medicine. For good.

Research Fellow in Minimally Invasive & Robotic Surgery
Galaxy Shah, MD
2008-2009

*Instructor in Advanced Surgical Laparoscopic and Basic
Open Techniques in Resident Training*
Francesco Bianco, MD
2008-2009

Presented by Pier C. Giulianotti, MD
*Distinguished Lloyd M. Nyhus Chair of Surgery
Professor & Chief, Division of General, Minimally Invasive
and Robotic Surgery*

Wound Healing and Tissue Repair Fellow
Malgorzata Anna Plummer, MD
August 1, 2008-July 31, 2009

Presented by Martin Borhani, MD
Chief, Division of Vascular Surgery

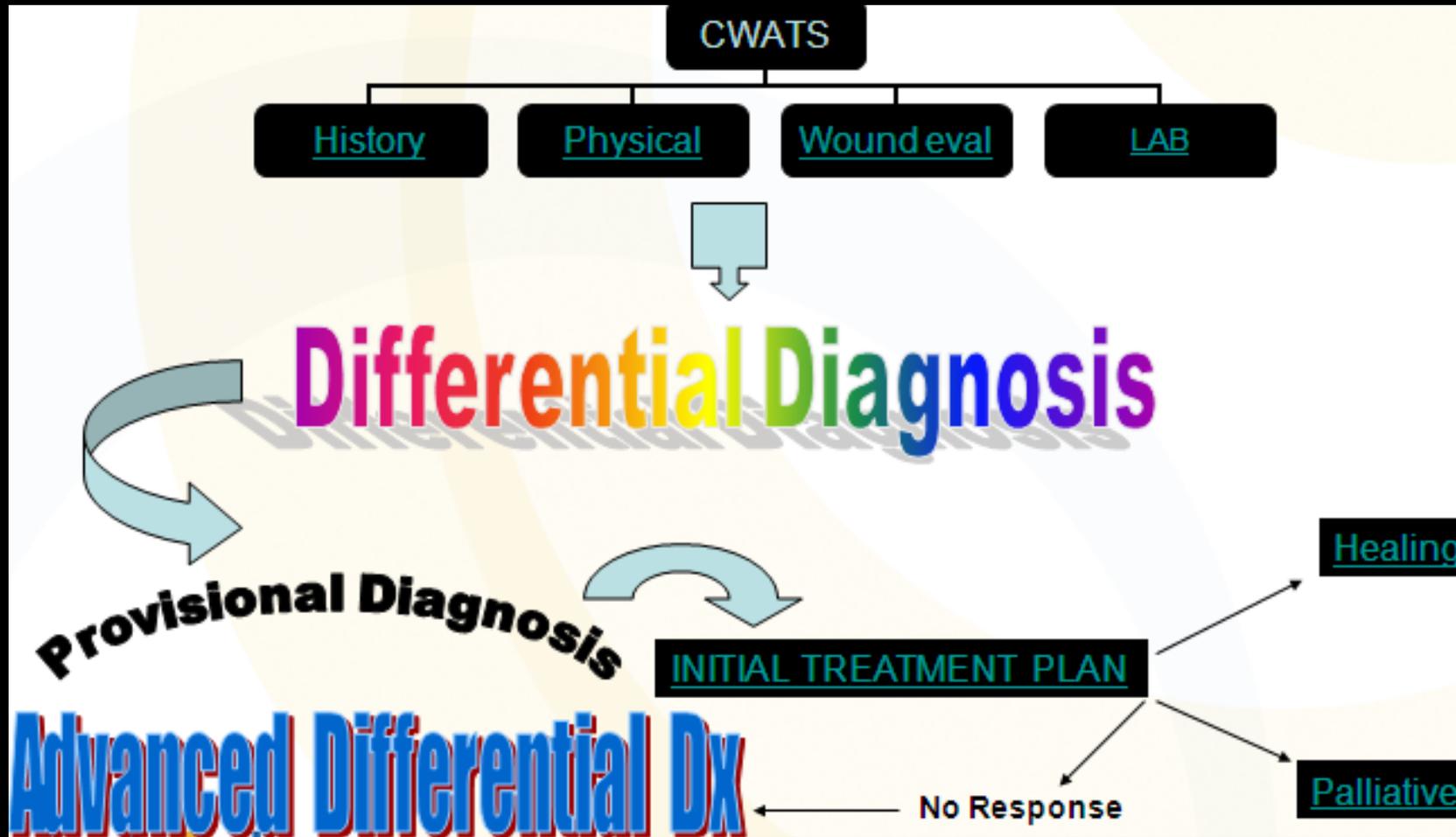
**UNIVERSITY OF ILLINOIS
AT CHICAGO**

**DEPARTMENT OF
SURGERY**

**2009 GRADUATION
CEREMONY**

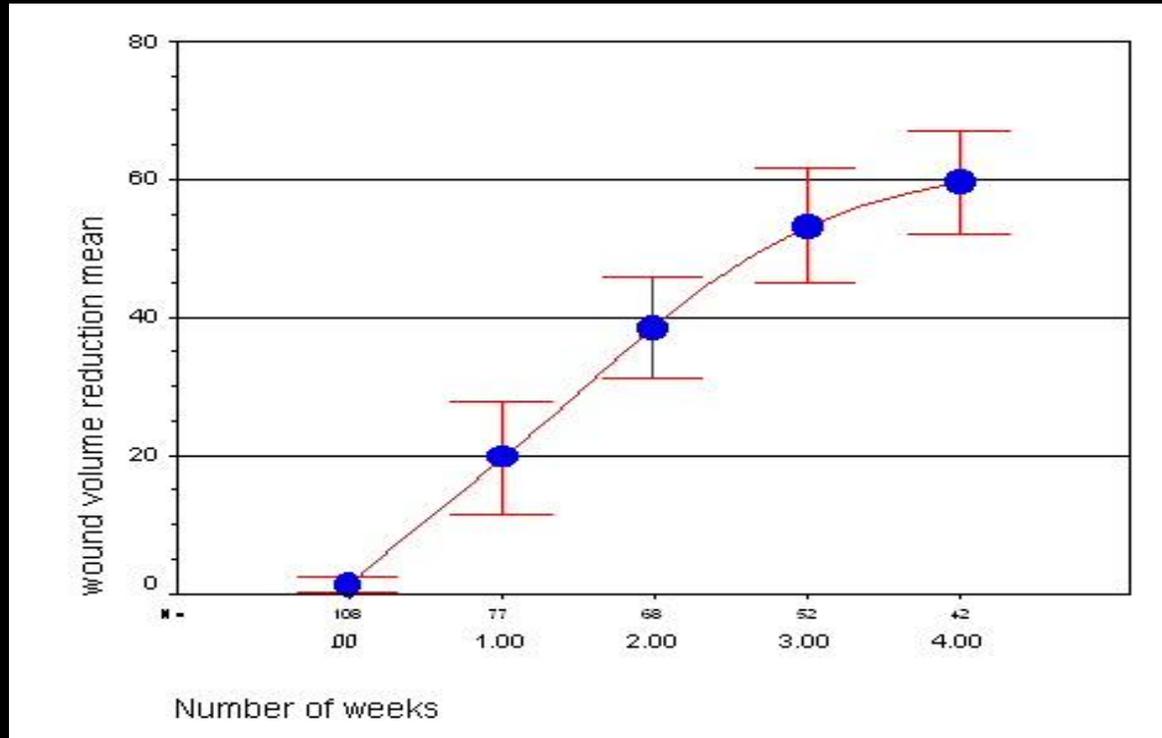
**JUNE 5TH, 2009
ART INSTITUTE OF CHICAGO**

PROTOCOL

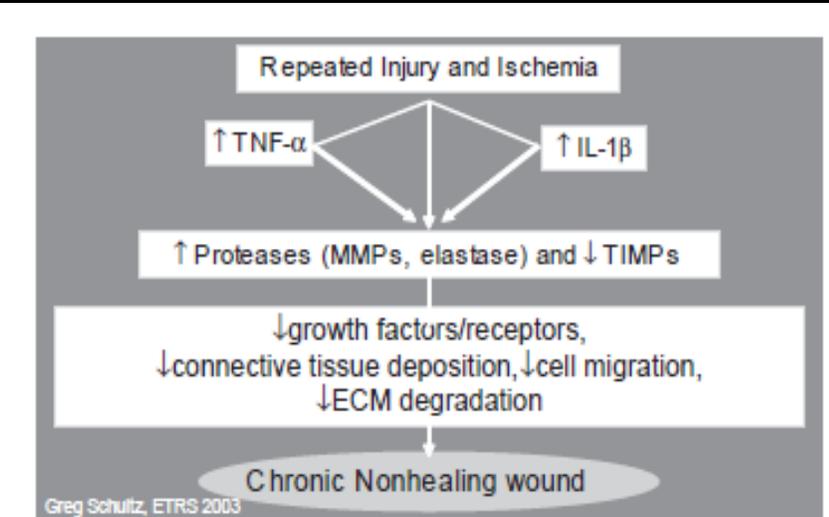
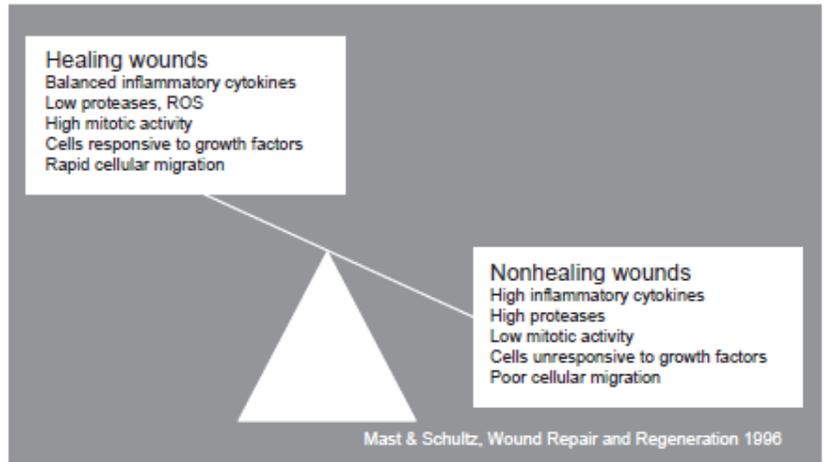


LCD MODEL
Tissue perfusion
Bioburden/Infection
Immune status/Nutrition
Pressure
Wound bed
Psychosocial/Functional

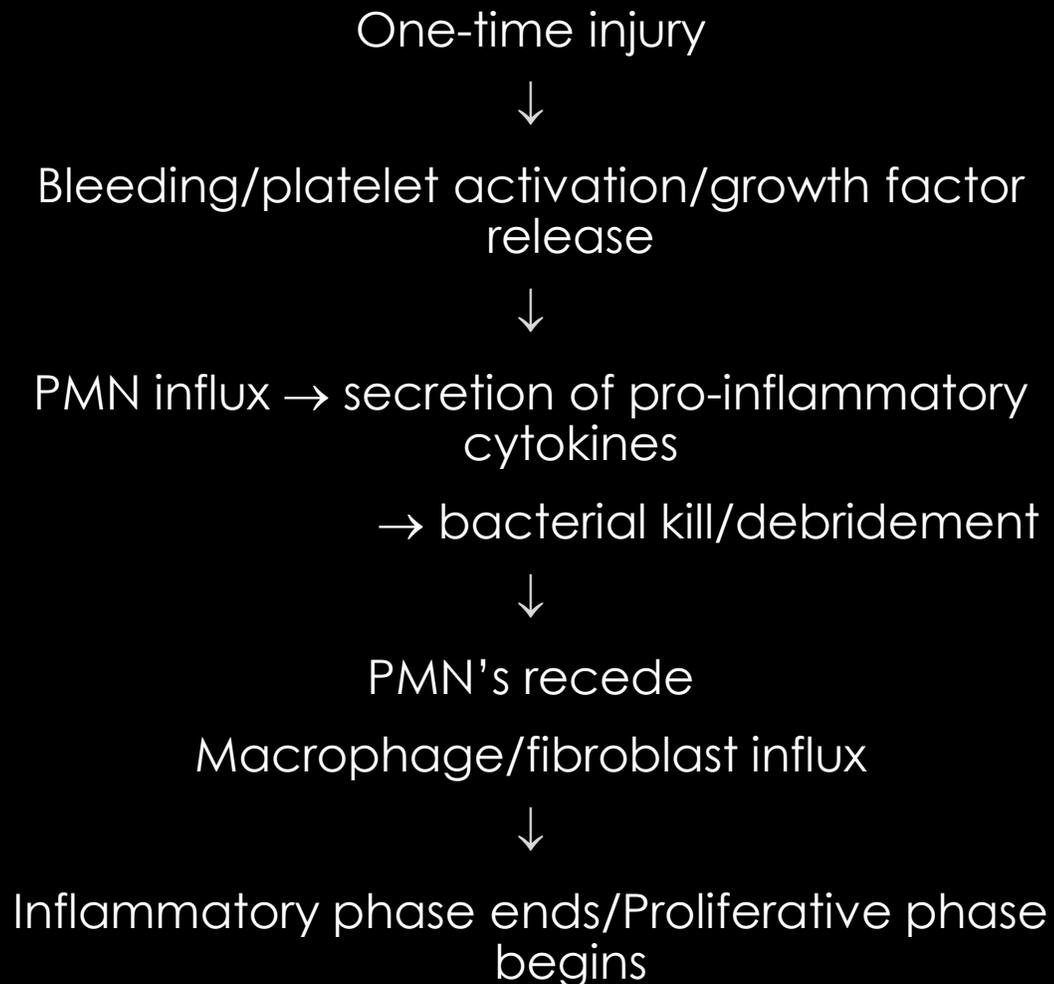
TRAJECTORY



Cellular and molecular imbalance between healing and nonhealing wounds



ACUTE WOUND



- Metabolically active cells
- Growth factors present
- Appropriate levels of pro-inflammatory cytokines (TNF α , IL-1, etc.)
- Balance between matrix metalloproteinases (MMP's) and tissue inhibitors of metalloproteinases (TIMP's)
- Healing occurs in predictable phases
- Excellent potential to heal despite dressing choice
- Complications are rare
- Good patient compliance

CHRONIC WOUND

- Repeated trauma
- Ischemia
- Bacterial contamination

Prolonged PMN influx and secretion of pro-inflammatory cytokines (TNF α , IL-1, etc.)



Increased MMP/decreased TIMP activity



Degradation of growth factors and target cell receptors

Degradation of extracellular matrix



Impaired healing

TREATMENT MATRIX?

Systemic Inflammation

| | | |
|-----------|---|--|
| High ↑ | Systemic therapy Standard wound care | Systemic therapy in combination with local therapy |
| | Normal Healing Process | Local wound bed treatments directed towards lowering inflammation |
| Low | → | |
| | Local Inflammation | |



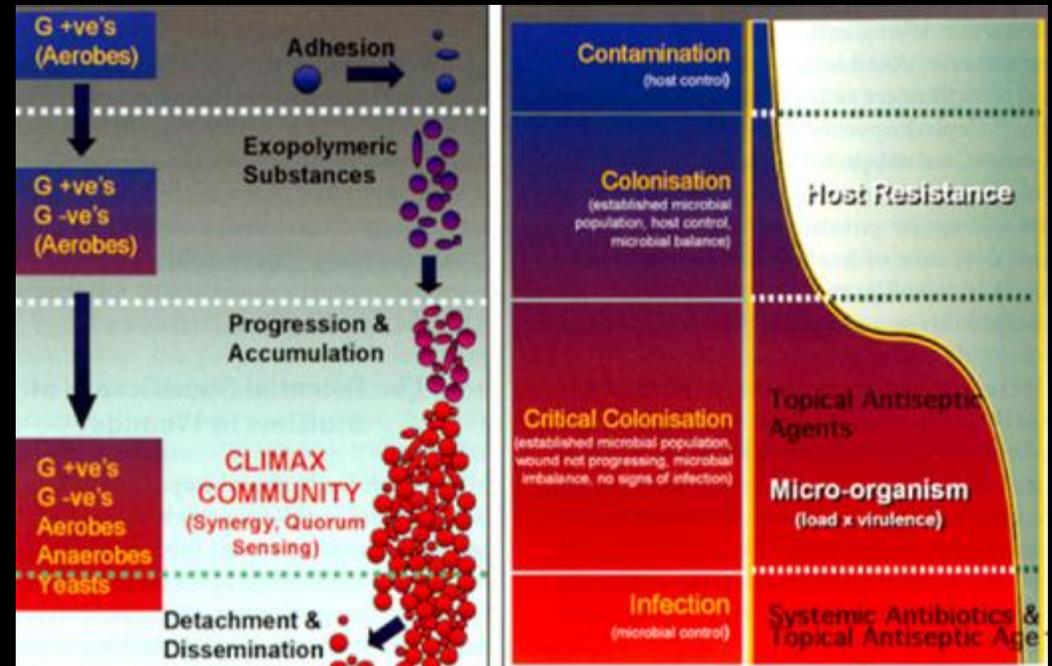
SSI EQUATION DONALD FRY MD



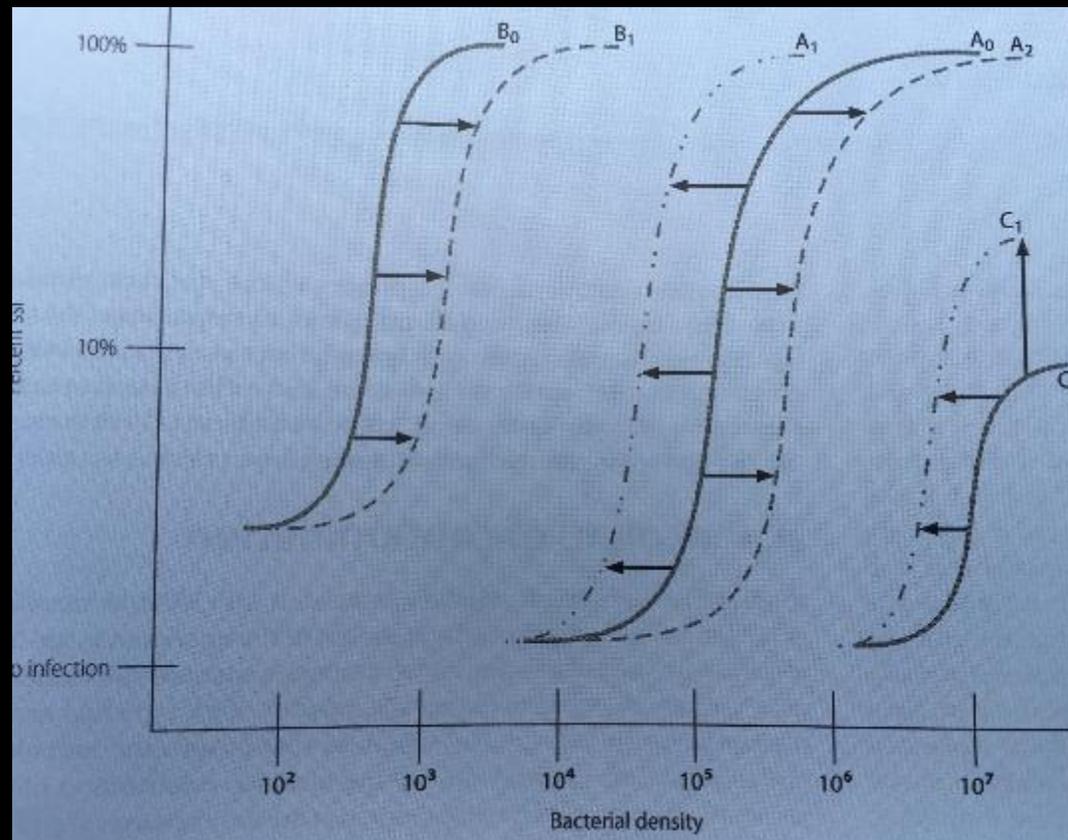
INNOCULUM

- SSI
 - Clean
 - Clean contaminated
 - Contaminated
 - Dirty

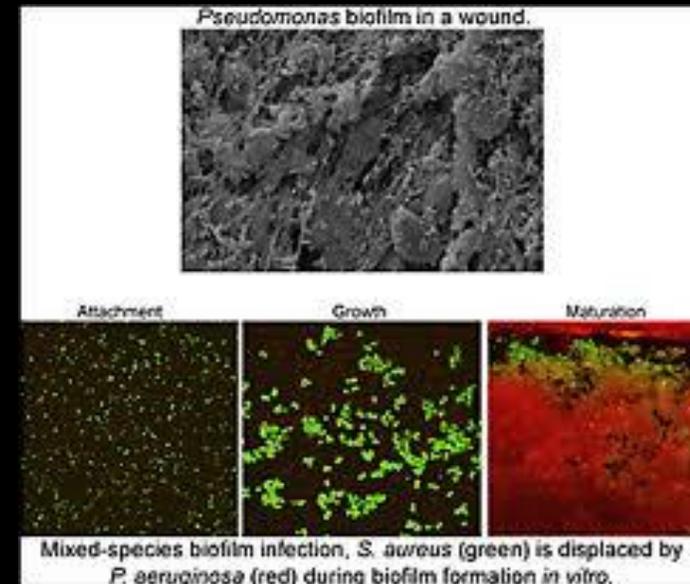
- Chronic wound



VIRULENCE

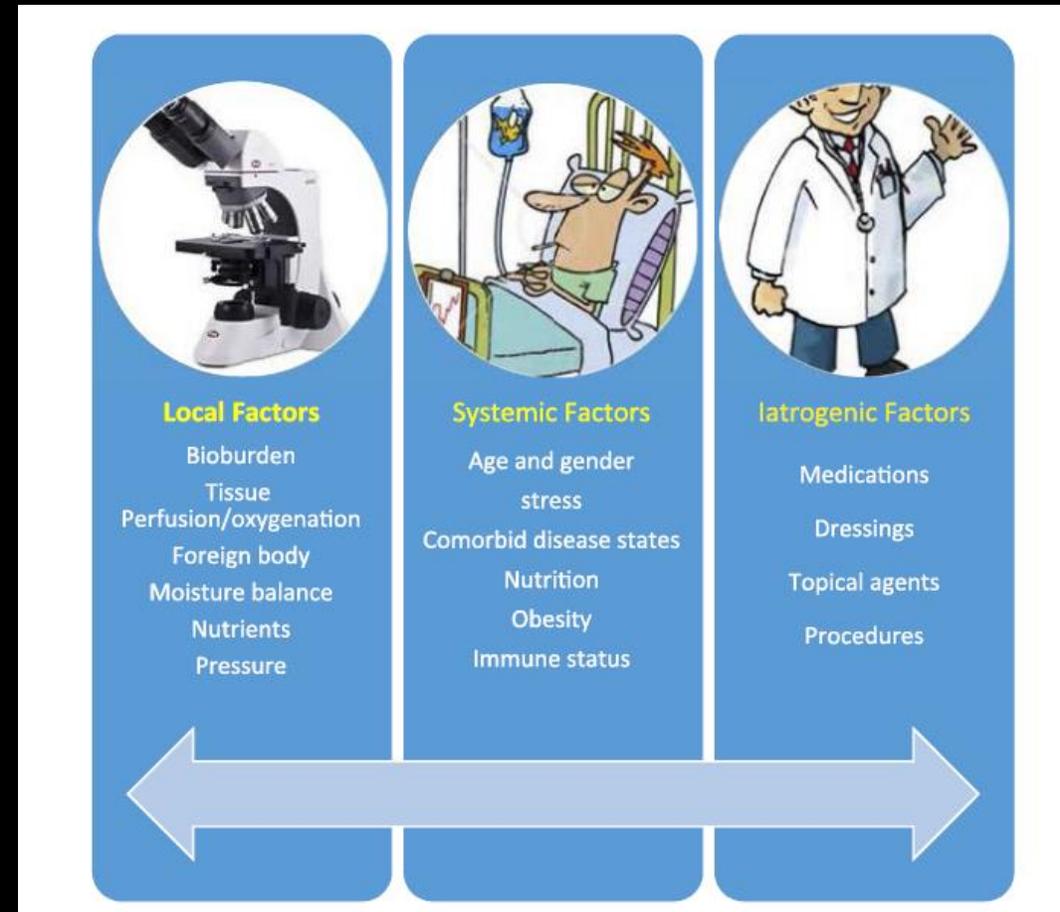


- Robson 10 to the 5th
- Robson 10 to the 6th
- Streptococcus
- Biofilm
- Adjuvant effects
 - Cautery
 - Hematoma
 - Seroma
 - Prosthetic
 - Suture



HOST

- Genetic variability
- Comorbid conditions
- Hypoxia
- Anemia
- Medications
- Albumen
- Inflammation



SURVEILLANCE AND CLASSIFICATION

- Superficial SSI
- Deep SSI
- Organ/Space SSI
- All categories have an option for the surgeon to make the diagnosis
- Prosthetic involved one year time frame
- Are all superficial SSI's the same
- SENIC
 - Abdominal operations
 - Operations > 2 hours
 - Surgical site: contaminated or dirty
 - More than 2 discharge diagnoses noted

NATIONAL HEALTHCARE SAFETY NETWORK

- ACS contaminated or dirty category
- ASA score of ≥ 3
- Surgery lasting $> 75\%$ in duration for type
- Surgical community looking for risk stratification to include patient risk and severity of SSI in one predictive model

ADVANCED TECHNOLOGIES

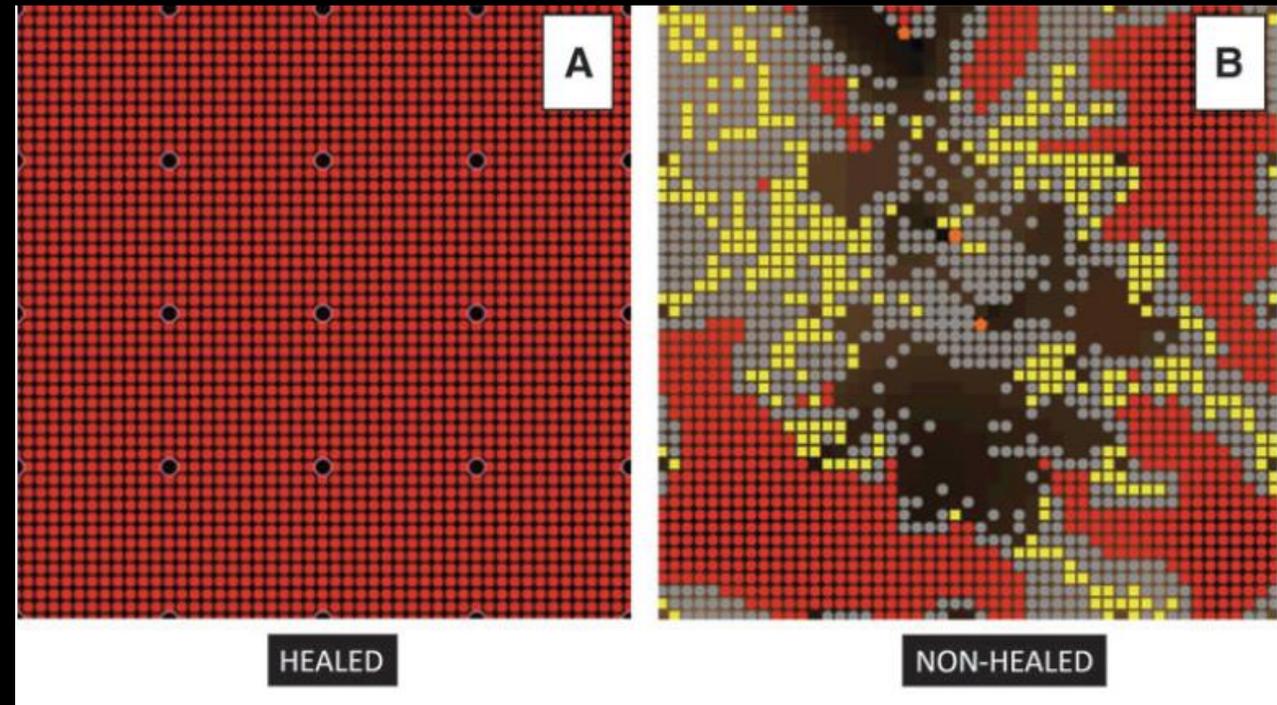
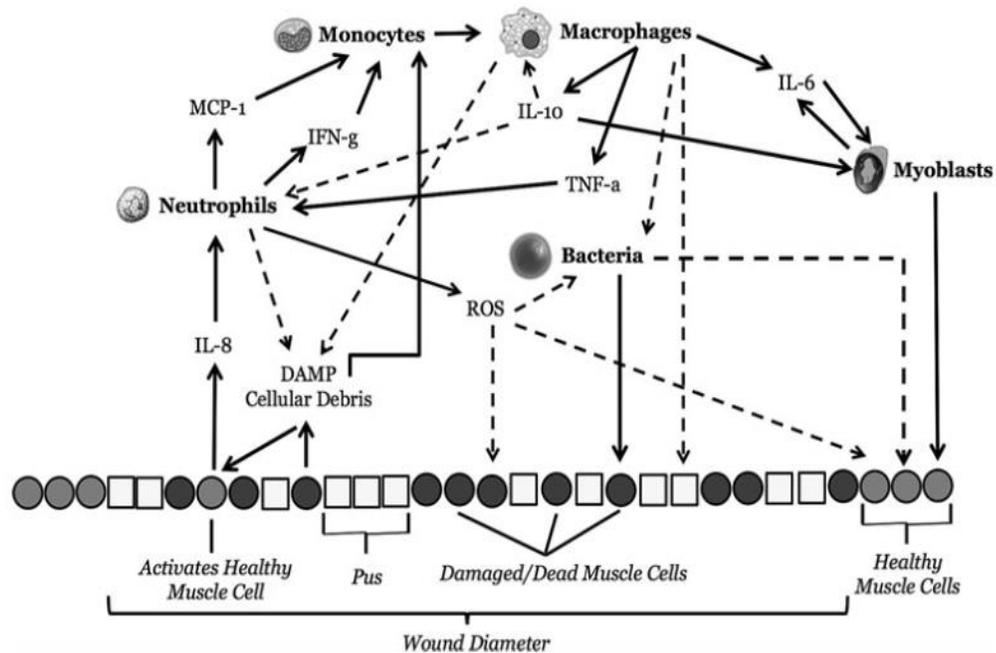
- Diagnostic and therapeutic
- Can we determine who will get an infection
- Can we direct costly therapy to those at the most risk
- Can we determine who will heal and who will not
- Can we follow our guidelines

Using an Agent-Based Model to Examine the Role of Dynamic Bacterial Virulence Potential in the Pathogenesis of Surgical Site Infection

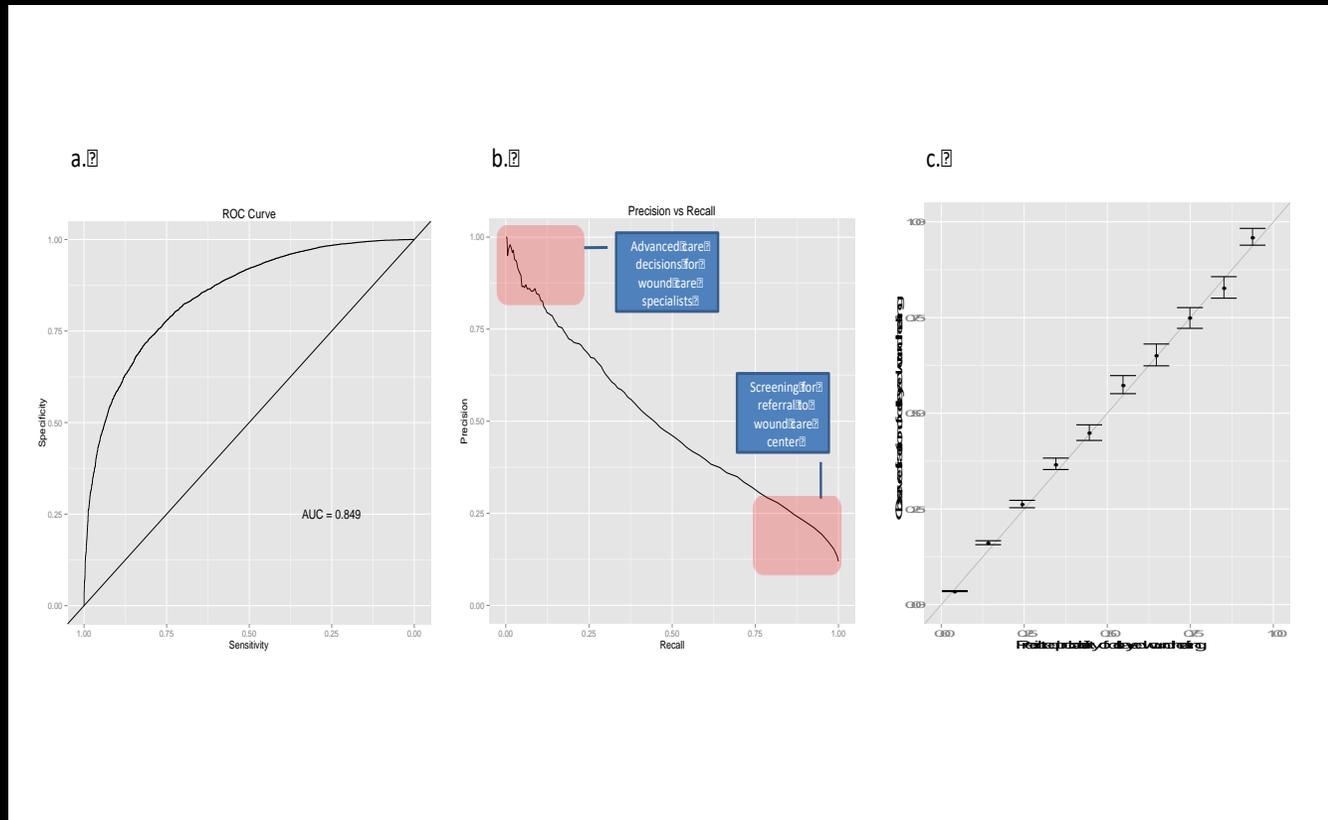
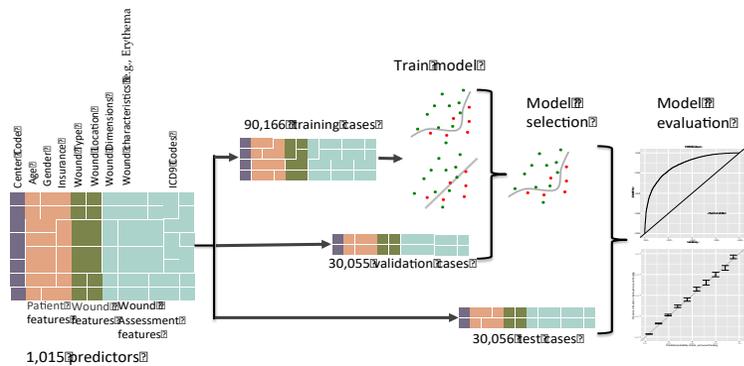
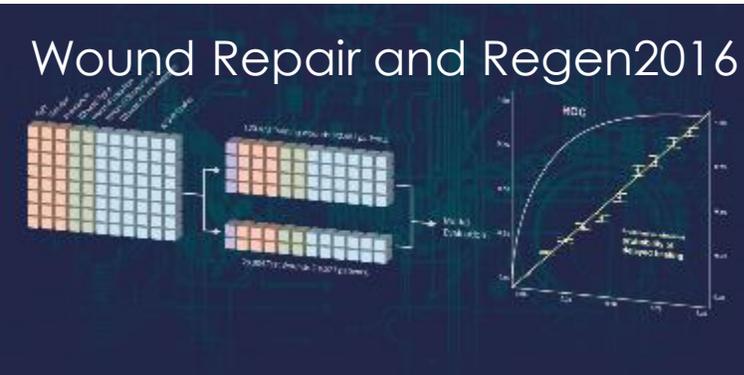
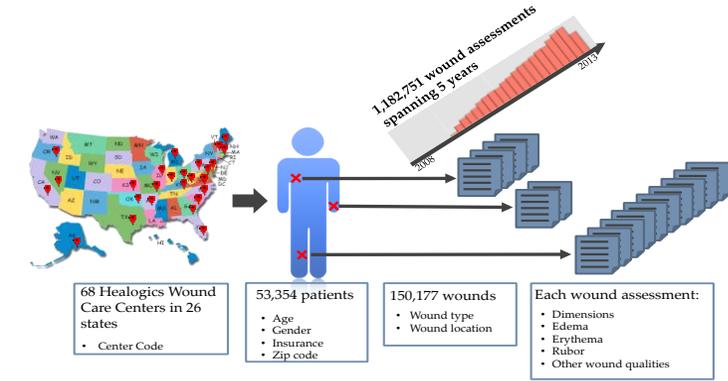
Vissagan Gopalakrishnan,¹ Moses Kim,² and Gary An^{2,*}

¹Department of Biology, Johns Hopkins University, Baltimore, Maryland.

²Department of Surgery, University of Chicago, Chicago, Illinois.



HEALOGICS/STANFORD DATA EFFORT



| | | | | | | | | | |
|---|------------------------|-----------|--------------------|---------------------|----------|--------------------|----------------------|-----------|--------------------|
| Study period: 1/1/2014-11/2015 | | | | | | | | | |
| Table #. Sample identification and healing- excludes no wound, consult, in treatment for one week or less, and missing data | | | | | | | | | |
| | 2014-2015 | | | 2006-2009 | | | 1995-1998 | | |
| | Wounds | Patients* | Wounds per Patient | Wounds | Patients | Wounds per Patient | Wounds | Patients* | Wounds per Patient |
| All wound records w/outcome | 907,389 | 412,687 | 2.20 (2.10) 1-25 | 2578 | 1111 | 2.32 | 659 | 500 | 1.32 |
| Exclude- No wound | 4,080 | 2,408 | | 63 | 34 | | 79 | 64 | |
| Total | 903,309 | 410,279 | 2.20 (2.09) 1-25 | 2515 | 1077 | 2.34 | 580 | 436 | 1.33 |
| Exclude- Consult only | 44,142 | 27,806 | | 652 | 268 | | 114 | 102 | |
| Total | 859,167 | 382,371 | 2.25 (2.14) 1-25 | 1863 | 809 | 2.30 | 466 | 334 | 1.40 |
| Exclude- seen once (days first to last <=7) | 191,876 | 87,325 | | 75 | 46 | | 35 | 24 | |
| Total | 667,291 | 295,046 | 2.26 (2.14) 1-25 | 1,788 | 763 | 2.34 | 431 | 310 | 1.39 |
| Exclude- missing wound measurement data | 24,042 | 10,327 | | 0 | 0 | | 0 | 0 | |
| Final Total | 643,249 | 284,719 | 2.24 (2.19) 1-25 | 1,788 | 763 | 2.34 | 431 | 310 | 1.39 |
| Percent of screened | 71.21 | 69.40 | | 69.40 | 68.70 | | 65.40 | 62.00 | |
| | 483,652 | | | 1,322 | | | 319 | | |
| Completely healed | 75.19 | | | 73.80 | | | 74 | | |
| | | 185,269 | | 471 | | | | 214 | |
| Patients with all wounds healed | | 65.07 | | 61.70 | | | | 69 | |
| *Patient admissions | Number of centers= 626 | | | Number of centers=1 | | | Number of centers= 1 | | |

ORIGINAL ARTICLE

Surgical site infection: poor compliance with guidelines and care bundles

David J Leaper¹, Judith Tanner², Martin Kiernan³, Ojan Assadian⁴ & Charles E Edmiston Jr⁵

¹ School of Applied Sciences, University of Huddersfield, Huddersfield, UK

² Clinical Nursing Research, DeMontfort University, Leicester, UK

³ Prevention and Control of Infection, Southport and Ormskirk Hospitals NHS Trust, Southport, UK

⁴ Department of Hospital Hygiene, Medical University of Vienna, Vienna, Austria

⁵ Department of Surgery, Medical College of Wisconsin, Milwaukee, WI USA

Key Messages

- surgical site infection rates do not seem to be falling
- national and international guidelines and care bundles exist which are based on level I evidence-based medicine
- compliance to care bundles has to be audited and acted on

THERAPEUTIC ADVANCES?

Pediatric Critical Care

©2016 American Association of Critical-Care Nurses
doi: <http://dx.doi.org/10.4037/ajcc2016843>



SILVER-IMPREGNATED DRESSINGS FOR STERNOTOMY INCISIONS TO PREVENT SURGICAL SITE INFECTIONS IN CHILDREN

By Sandra Staveski, RN, PhD, CPNP-AC, Claire Abrajano, RN, MS, WOCN, RNFA,

Conclusions The evidence did not support the superiority of silver-impregnated dressings for prevention of surgical site infections in children after cardiac surgery. Adherence to a bundle for prevention of surgical site infections may have decreased the incidence of such infections in the study population during the study period. (*American Journal of Critical Care*. 2016;25:402-408)

Incidence of wound complications in cesarean deliveries following closure with absorbable subcuticular staples versus conventional skin closure techniques



T.L. Schrufer-Poland et al. / *European Journal of Obstetrics & Gynecology and Reproductive Biology* 206 (2016) 53–56

Tabitha L. Schrufer-Poland^{a,1,*}, Maria P. Ruiz^{a,1}, Samuel Kassar^a, Christopher Tomassian^a, Stacey D. Algren^b, John D. Yeast^c

^aUniversity of Missouri Kansas City School of Medicine, Department of Obstetrics and Gynecology, Kansas City, MO, United States

^bUniversity of Missouri Kansas City School of Medicine, Department of Obstetrics and Gynecology, and Saint Luke's Hospital of Kansas City, Kansas City, MO, United States

^cUniversity of Missouri Kansas City School of Medicine, Department of Obstetrics and Gynecology, Division of Maternal and Fetal Medicine; Vice President of Medical Education and Research, Saint Luke's Hospital of Kansas City, Kansas City, MO, United States

comorbidities. The overall incidence of wound complications at our institution during this study was 5.7%. The incidence of complications among the suture and subcuticular staple closure was not significantly different (3.6% versus 0%, $p = 0.3$), however there were significantly less complications in the suture and subcuticular staple closure groups when compared to traditional staple closure (14.3%) ($p = 0.03$ and $p = 0.01$, respectively).

Conclusion: Herein, we report a decreased incidence of composite wound complications with subcuticular staple closure versus traditional staple closure in patients undergoing cesarean section. Absorbable subcuticular staple closure represents a convenient, safe and cost-effective closure technique.



ELSEVIER

Contents lists available at ScienceDirect

Materials Science and Engineering C

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



Efficacy of silver coated surgical sutures on bacterial contamination, cellular response and wound healing



Anna Lucia Gallo ^a, Federica Paladini ^{a,*}, Alessandro Romano ^b, Tiziano Verri ^c, Angelo Quattrini ^b, Alessandro Sannino ^a, Mauro Pollini ^a

^a Department of Engineering for Innovation, University of Salento, Via Monteroni, 73100 Lecce, Italy

^b Neuropathology Unit, Institute of Experimental Neurology and Division of Neuroscience, IRCCS San Raffaele Scientific Institute, via Olgettina 60, 20132 Milan, Italy

^c DLS.Te.B.A., University of Salento, Via per Monteroni, 73100 Lecce, Italy



ORIGINAL ARTICLE

Antimicrobial-coated sutures to decrease surgical site infections: a systematic review and meta-analysis

X. Wu¹ · N. Z. Kubilay² · J. Ren¹ · B. Allegranzi² · P. Bischoff³ · B. Zayed² · D. Pittet⁴ · J. Li¹

Antibiotic-loaded bone cement reduces risk of infections in primary total knee arthroplasty? A systematic review

A. Schiavone Panni¹ · K. Corona¹  · M. Giulianelli¹ · G. Mazzitelli¹ · C. Del Regno¹ · M. Vasso¹

Received: 14 June 2016 / Accepted: 23 August 2016

© European Society of Sports Traumatology, Knee Surgery, Arthroscopy (ESSKA) 2016

Conclusion

The findings of the present review did not reveal any statistically significant differences in terms of the rate of deep or superficial surgical site infections in patients

receiving ALBC versus PBC. Although ALBC is worldwide frequently used, the periprosthetic knee infections continue to verify. However, the rigorous use of perioperative prophylactic systemic antibiotics, efficient antiseptic procedures and improved surgical techniques remain the gold-standard in infection prevention in TKA surgery.



Contents lists available at ScienceDirect

American Journal of Infection Control

journal homepage: www.ajicjournal.org



Major Article

Endoscopic vein harvest in patients at high risk for leg wound complications: A cost–benefit analysis of an initial experience

Heyman Luckraz MD, FRCS ^{a,*}, Prabhjeet Kaur RGN ^a, Moninder Bhabra MD, FRCS ^b, Pankaj Kumar Mishra FRCS (CTh), MCh (CTh) ^a, Kumaresan Nagarajan MRCS ^a, Nelam Kumari RGN ^a, Kamran Saleem FCPS ^a, Alan M. Nevill PhD ^c

^a Cardiothoracic Surgery, Heart & Lung Centre, Wolverhampton, United Kingdom

^b Cardiothoracic Surgery, QE Hospital Birmingham, Birmingham, United Kingdom

^c University of Wolverhampton, Faculty of Education, Health and Wellbeing, Wolverhampton, West Midlands, United Kingdom

Conclusions: In patients at high-risk of leg wound complications, EVH was associated with significant cost-savings and less leg wound complications.

Table 2
Peri- and postoperative data

| Data variable | Endoscopic vein harvest (n = 50) | Open vein harvest (n = 50) | P value |
|------------------------------------|----------------------------------|----------------------------|---------|
| CPB time (min) | 111 ± 46 | 118 ± 49 | .3 |
| Postoperative ward stay (d) | 4 (1-9) | 5 (2-38) | .01 |
| Total wound clinic visits | 10 | 290 | <.01 |
| Total district nurse visit | 5 | 462 | <.01 |
| Total costs of wound treatment (£) | 2,758 | 78,036 | <.01 |

NOTE. Values are presented as mean ± standard deviation, median (range), or n. CPB, cardiopulmonary bypass.

Review Article

Innate
Immunity

Antimicrobial peptide elicitors: New hope for the post-antibiotic era

Ernesto Prado Montes de Oca^{1,2}

Innate Immunity
19(3) 227–241
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DOI: 10.1177/1753425912460708
ini.sagepub.com


ORIGINAL CONTRIBUTION

Effect of an Investigational Vaccine for Preventing *Staphylococcus aureus* Infections After Cardiothoracic Surgery

A Randomized Trial

Conclusions and Relevance Among patients undergoing cardiothoracic surgery with median sternotomy, the use of a vaccine against *S aureus* compared with placebo did not reduce the rate of serious postoperative *S aureus* infections and was associated with increased mortality among patients who developed *S aureus* infections. These findings do not support the use of the V710 vaccine for patients undergoing surgical interventions.

Trial Registration clinicaltrials.gov Identifier: NCT00518687

JAMA. 2013;309(13):1368-1378

www.jama.com

International Journal of Nanomedicine

Dovepress

open access to scientific and medical research

 Open Access Full Text Article

REVIEW

Reducing the risk of infection associated with vascular access devices through nanotechnology: a perspective

This article was published in the following Dove Press journal:
International Journal of Nanomedicine
20 November 2013
Number of times this article has been viewed

William J. Ennis, DO

REDUCING SURGICAL SITE INFECTION WITH NEGATIVE-PRESSURE WOUND THERAPY AFTER OPEN ABDOMINAL SURGERY: A PROSPECTIVE RANDOMIZED CONTROLLED STUDY

P.-Y. Li, D. Yang, D. Liu, S.-J. Sun, L.-Y. Zhang

State Key Laboratory of Trauma, Burns and Combined Injury, Trauma Center, Institute of Surgery Research, Daping Hospital, Third Military Medical University, Chongqing, China

Results: From May 2015 to December 2015, 71 patients were enrolled in this study, including 33 in the experimental group and 38 in the control group. There were 10 cases of incision complications, all superficial infections, with an incidence of 14.1%. The surgical site infection incidence was statistically different between the experimental and control groups (3.0% vs 23.7%, $p=0.031$). Multivariate logistic regression analysis showed that incision length ≥ 20 cm increased the surgical site infection incidence (odds ratio value of 15.576, $p=0.004$) and that the application of negative-pressure wound therapy reduced the surgical site infection incidence (odds ratio value of 0.073, $p=0.029$).

Conclusion: Negative-pressure wound therapy can reduce the incidence of surgical site infection in open abdominal surgery.

Negative-Pressure Wound Therapy with Instillation: International Consensus Guidelines

Paul J. Kim, D.P.M., M.S.
Christopher E. Attinger, M.D.
John S. Steinberg, D.P.M.
Karen K. Evans, M.D.
Burkhard Lehner, M.D.
Christian Willy, M.D., Ph.D.
Larry Lavery, D.P.M., M.P.H.
Tom Wolvos, M.D., M.S.
Dennis Orgill, M.D., Ph.D.
William Ennis, D.O., M.B.A.
John Lantis, M.D.
Allen Gabriel, M.D.
Gregory Schultz, Ph.D.

*Washington, D.C.; Heidelberg
and Berlin, Germany; Dallas, Texas;
Scottsdale, Ariz.; Boston, Mass.;
Chicago, Ill.; New York, N.Y.;
Vancouver, Wash.; Gainesville, Fla.*

Background: Negative-pressure wound therapy with instillation is increasingly utilized as an adjunct therapy for a wide variety of wounds. Despite its growing popularity, there is a paucity of evidence and lack of guidance to provide effective use of this therapy.

Methods: A panel of experts was convened to provide guidance regarding the appropriate use of negative-pressure wound therapy with instillation. A face-to-face meeting was held where the available evidence was discussed and individual clinical experience with this therapy was shared. Follow-up communication among the panelists continued until consensus was achieved. The final consensus recommendations were derived through more than 80 percent agreement among the panelists.

Results: Nine consensus statements were generated that address the appropriate use of negative-pressure wound therapy with instillation. The question of clinical effectiveness of this therapy was not directly addressed by the consensus panel.

Conclusion: This document serves as preliminary guidelines until more robust evidence emerges that will support or modify these consensus recommendations. (*Plast. Reconstr. Surg.* 132: 1569, 2013.)

ORIGINAL PAPER

First experiences with negative pressure wound therapy and instillation in the treatment of infected orthopaedic implants: a clinical observational study

Burkhard Lehner · Wim Fleischmann · Rolf Becker · Gerrolt N. Jukema

Received: 19 January 2011 / Accepted: 27 April 2011

© Springer-Verlag: 2011

- Prospective, observational registry
 - N = 32 infected joint implants (22 acute, 10 chronic)
 - % of patients where joints retained
 - 86.6% acute, 80% chronic
 - Published literature retention rates
 - 65% acute, 30% chronic
- *off label use in the US



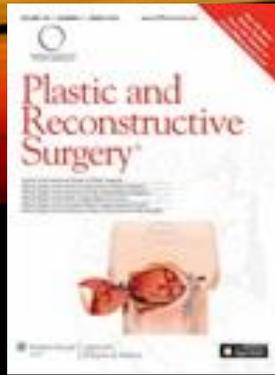
ORIGINAL ARTICLE

Negative pressure wound therapy with saline instillation: 131 patient case series

David Brinkert¹, Mazen Ali², Magali Naud³, Nicolas Maire¹, Chloé Trial⁴ & Luc Télet⁴

- **Prospective study: n = 131 patients treated with Veraflo Therapy**
 - **Wounds were either “infected or at risk for infection”**
- **Soak time 10 minutes, interval at least 4 hours**
- **Wounds included:**
 - **Open fracture**
 - **Infected Hematoma**
 - **Pressure Ulcers**
 - **Dehisced Surgical Incisions**
 - **DFUs**
 - **Necrotizing Fasciitis**
 - **35% of wounds were not responding to standard NPWT**
- **98% could be closed after debridement**

Brinkert D, Ali M, Naud M, Maire N, Trial C, Télet L. Negative pressure wound therapy with saline instillation: 131 patient case series. Int Wound J 2013; 10 (suppl. 1):56–60



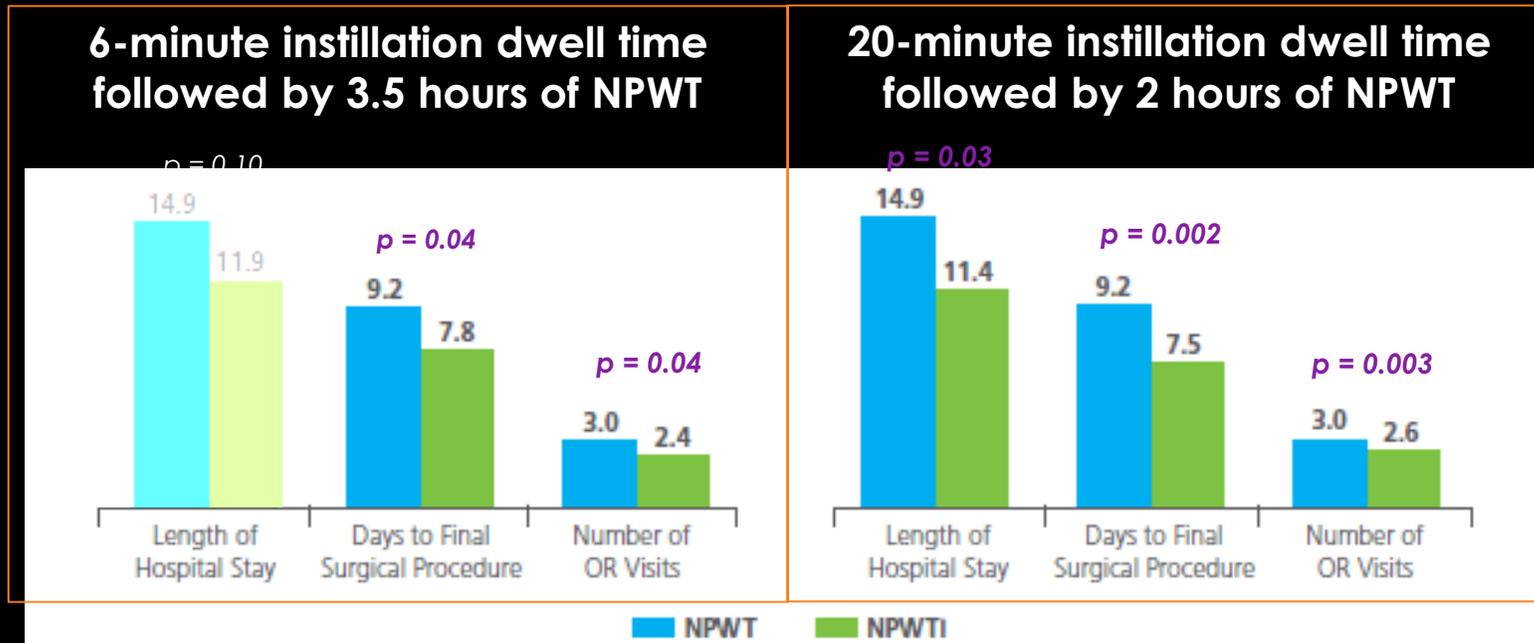
The Impact of Negative-Pressure Wound Therapy with Instillation Compared with Standard Negative-Pressure Wound Therapy: A Retrospective, Historical, Cohort, Controlled Study

- Retrospective chart review, n=142 wounds requiring admission and operative debridement
 - 6 min dwell time/3.5 hrs VAC: n=34
 - 20 min dwell time/2 hrs VAC: n=34
 - Standard VAC: n=74
- Solution used: Prontosan (Polyhexanide/Betain)
- Single Center, 4 surgeons (2 plastic and 2 podiatric)

Kim P, Attinger C, Steinberg J., et al. *Plastic and Reconstructive Surgery*. March 2014.

RESULTS

- The authors found a statistically significant difference in the following:
 - Number of OR Visits (*6-minute and 20-minute dwell*)
 - Length of Stay (*20-minute dwell*)
 - Time to Final Surgical Procedure (*6-minute and 20-minute min. dwell*)



OUTCOMES

| | NPWT (%) | NPWTi -d (6 min dwell) (%) | P - Value * | NPWTi -d (20 min dwell) (%) | P-Value† |
|---|------------|----------------------------------|-------------|--------------------------------------|----------|
| No. of OR visits | 3.0 | 2.4 | 0.04 | 2.6 | 0.003 |
| Length of stay | 14.9 | 11.9 | 0.10 | 11.4 | 0.03 |
| Time to final surgical procedure | 9.2 | 7.8 | 0.04 | 7.5 | 0.002 |
| Closed at d/c | 46 (62) | 32 (94) | 0.0004 | 27 (80) | 0.08 |
| Remained closed @ 1 month | 28 (61) | 24 (75) | 0.23 | 14 (52) | 0.47 |
| Culture improvement with Gram-negative | 17 (63) | 19 (90) | 0.0001 | 13 (65) | 0.77 |

More patients were closed prior to discharge and in fewer days compared to NPWT

PROTOCOL

- Evaluate patient, understand goals of wound care, maximize modifiable conditions
- Debride the wound, in OR if at all possible, remove all non viable tissue, prosthetic material if possible
- Local wound care includes
 - Moist dressings
 - Pt modalities, UVC light, electrical stimulation, ultrasound, npwt
- Social service involvement
- Sub acute wound unit when possible and indicated
- Follow up in multidisciplinary surgical clinic

WOUND HEALING III

Advanced Technologies to Improve Wound Healing: Electrical Stimulation, Vibration Therapy, and Ultrasound

William J. Ennis, DO, MBA, FACOS
Claudia Lee, MPT
Karen Gellada, MD
Thomas F. Corbiere, BS
Timothy J. Koh, PhD
Chicago, Ill.

Background: Cellular energy is required for the healing cascade to occur. A combination of cells, cytokines, chemokines, tissue perfusion, an extracellular matrix, and local forces are also required to allow for human tissue repair to proceed. Although there are many examples of treatment options, energy-based therapies are the least understood, appreciated, and employed by practicing wound care physicians. The recent growth of tissue engineering has encouraged researchers to employ both electrical stimulation and therapeutic ultrasound (US) to stimulate cells, induce migration, and modify tissue constructs.

AQ4

(Plast. Reconstr. Surg. | 138: 00, 2016.



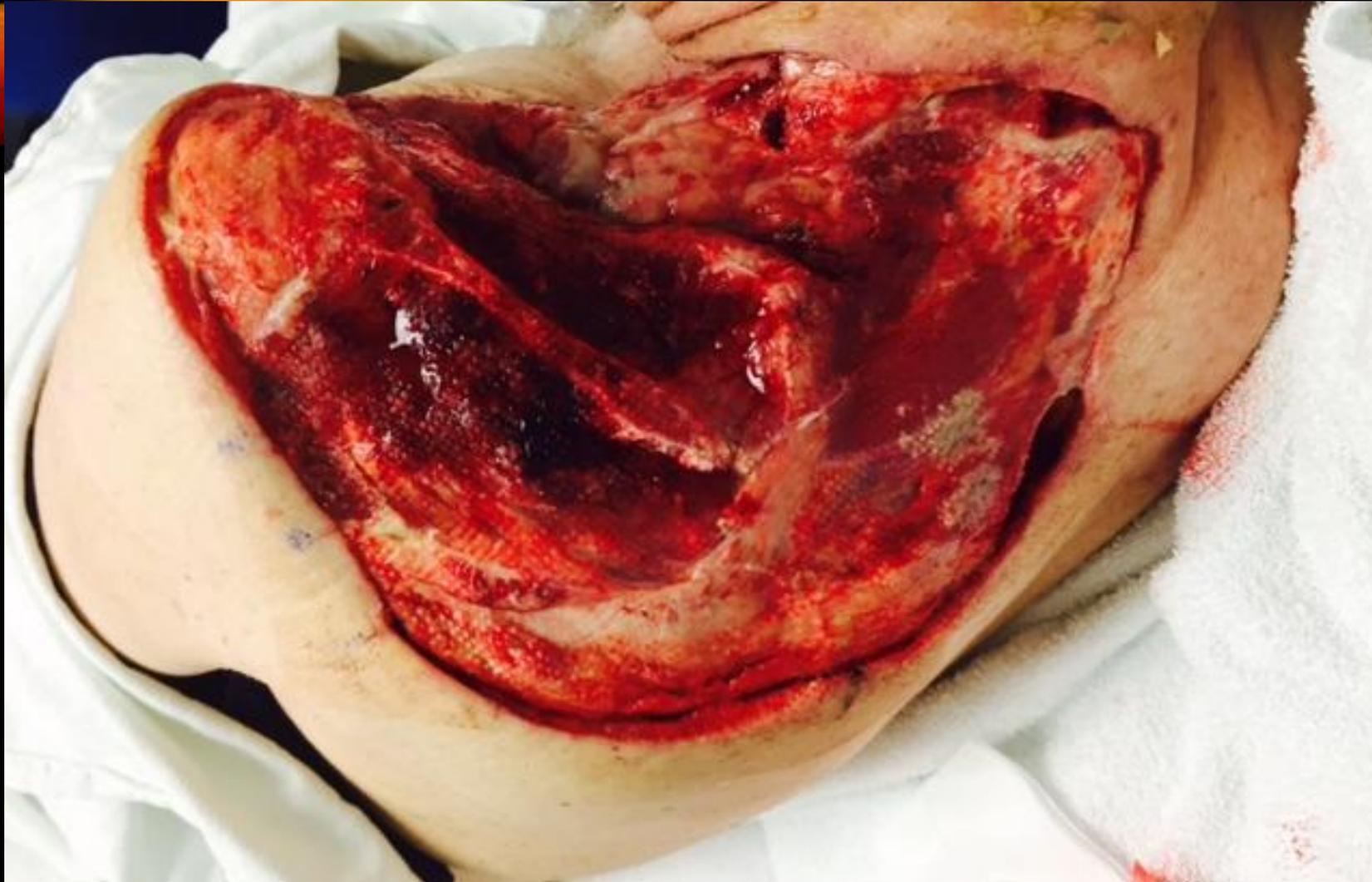
EVIDENCE

Table 1. Current Levels of Evidence for Ultrasound and Electrical Stimulation

| Reference | Wound Type | Ultrasound Wavelength Nonspecified | Kilohertz Ultrasound | Megahertz Ultrasound | Electrical Stimulation | Author Comments |
|-------------------------|---------------------|--|---|--|--|--|
| 129 | Pressure ulcer | NA | Strength of evidence = C Strength of negative recommendation = neutral | Strength of evidence = C Strength of recommendation = neutral | Strength of evidence = A Strength of recommendation = positive | There were no studies focused on pressure ulcers leading the reviewers unable to recommend |
| 130 | Pressure ulcer | Quality of evidence = low Treatment over comparator = no difference | NA | NA | Quality of evidence = moderate Treatment over comparator = improved | Only quoted articles accelerated healing but did not increase total healing rate |
| 5 | Pressure ulcer | Not studied | Not studied | Not studied | Level 1 evidence to support | Suggest using as an adjunct if conventional therapies fail |
| 131 | Diabetic foot ulcer | Not studied | Not studied | Not studied | Level 1 evidence to support | Different sources of electrical energy used, uncertain why ultrasound studies not included |
| 3 | Arterial ulcer | NA | Level 3 not enough studies | Level 3 recommendation | Not studied | |
| 4 | Venous leg ulcer | Consider after 4 weeks of conventional care Level 3 | NA | NA | Level 1 evidence to support | ES is effective in reducing the size of venous ulcers |
| Current authors opinion | Pressure ulcer | 2B | NA | NA | 1B | |
| Current authors opinion | Diabetic foot ulcer | NA | 1B | NA | 1B | |
| Current authors opinion | Arterial ulcer | NA | 2B | NA | 2B | |
| Current authors opinion | Venous ulcer | NA | 2B | 2C | 2B | |



INSTILLATION



ADMISSION DATE: April 22, 2015 72 yo s/p massive BCCA resection

*Initiated Veraflo therapy; Instillation of Saline, dwell time of 20 min & NPWT
125mmHg 2hours

* Current view: Posterior shoulder

Measurements: 26x27x1.2



Admission Date:
April 22, 2015

Side view of patient's LEFT
shoulder

Measurements: 26x27x1.2

April 24, 2015

Veraflo therapy: 20min dwell, 2hour Soak;
125mmHg
Application of Adaptic Touch over exposed
structure

Side view of left shoulder



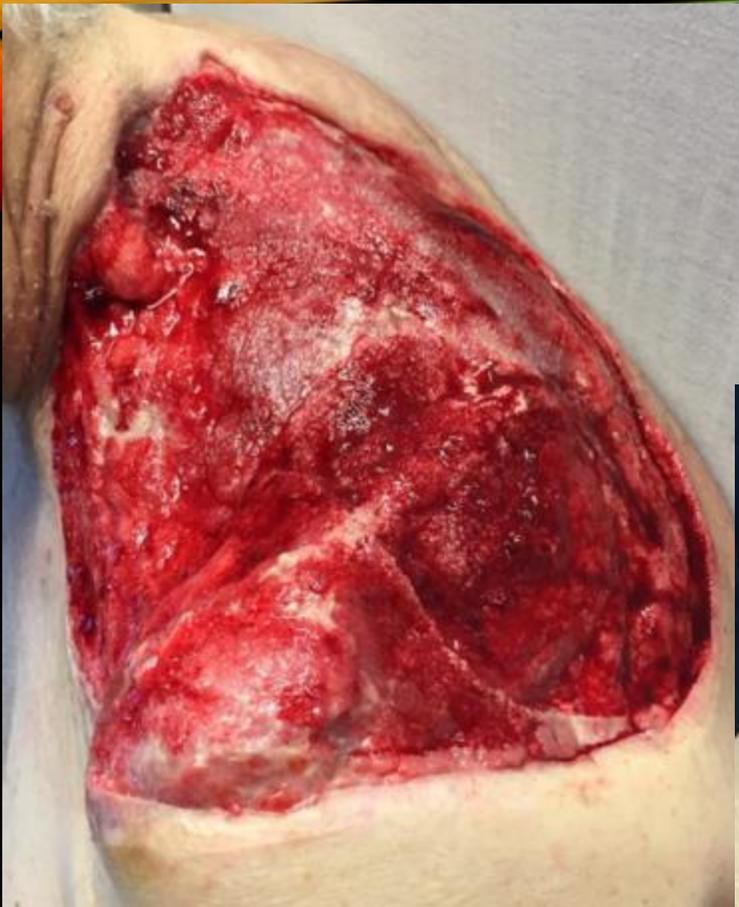
Back view of left shoulder



April 28, 2015

Veraflo therapy: 20min dwell, 2hour NPWT;
125mmHg

Application of Adaptic Touch over exposed structure



Side view of left shoulder

Measurements: 25x26x0.8



May 1, 2015 : Veraflo therapy cont'd



Back view of left shoulder

William J. Ennis, DO

May 1, 2015 cont'd



Front view of left shoulder

William J. Ennis, DO



Back view of left shoulder

Measurements: 25x25x0.5

May 4, 2015

Veraflo therapy 20 min dwell;
2hour Soak; 125 mmHg

Facility switched to Mepitel for
contact layer



MAY 6, 2015 : Veraflo Therapy discontinued & standard VAC therapy was applied

NOTE: Pressure set to 150 mmHG, Continuous & still applied Mepitel



MAY 6, 2015: Veraflo Therapy discontinued & standard VAC therapy was applied

NOTE: Pressure set to 150 mmHG, Continuous & still applied Mepitel



Side view

May 11, 2015

Patient discharged from LTAC;

Application of Promogran Prisma
until HHA could apply the ActiVAC



Rear view of left shoulder

Measurements: 22.5x24x0.2

Front view of shoulder



MAY 19, 2015

VAC therapy; Continuous at
150mmHg

Mepitel as contact layer

Measurements: 18.5x22x0.2



Back view of left shoulder

MAY 19, 2015

VAC therapy; Continuous at 150mmHg

Mepitel as contact layer



Side view of left shoulder

MAY 23, 2015



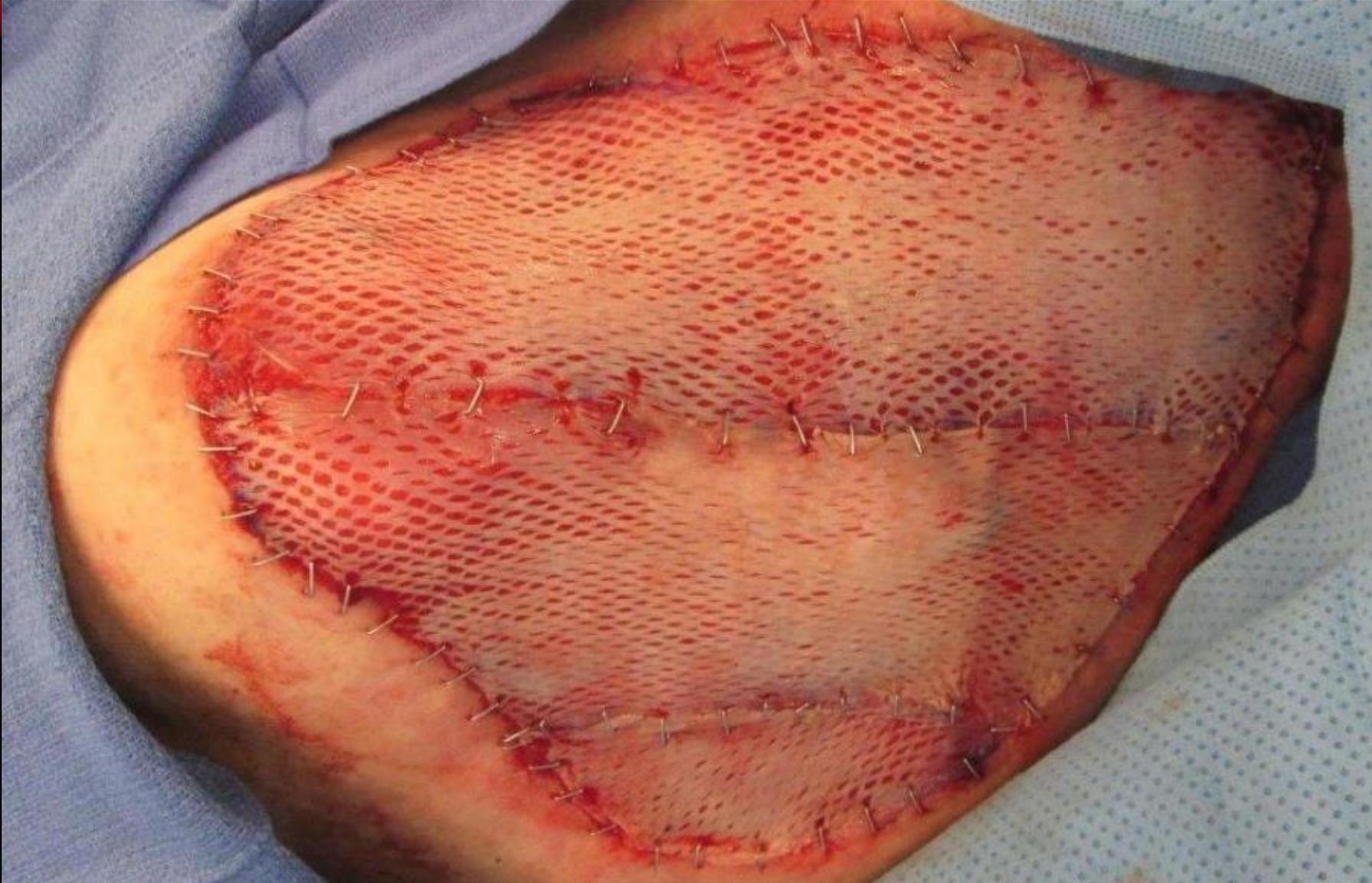
Side & Front views of left shoulder

MAY 25, 2015 : Back view of shoulder Measurement: 18.0 x 21.0 x 0.1



CASE MAY 26, 2016—STSG

NOTE: VAC therapy was utilized to bolster the graft; 125 mmHg, Continuous



June 2, 2015 : Side view of shoulder





June 4, 2015



William J. Ennis, DO



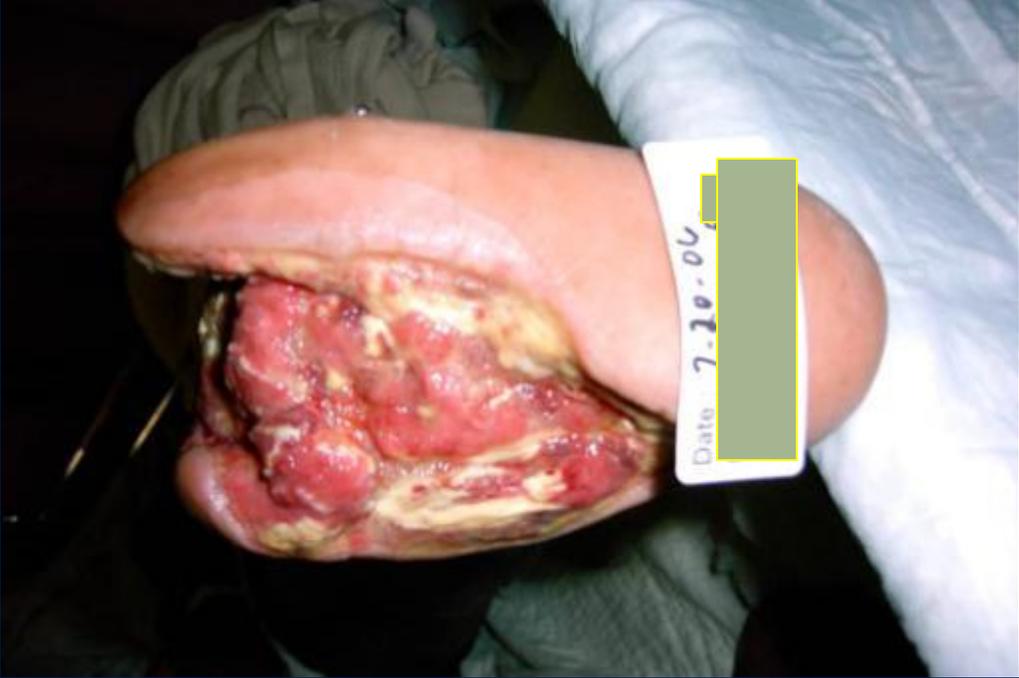
PAYMENT, REGULATIONS, VALUE BASED PURCHASING, AT RISK MODELS

PATIENT EDUCATION PROGRAM WITH
AMERICAN COLLEGE OF SURGEONS

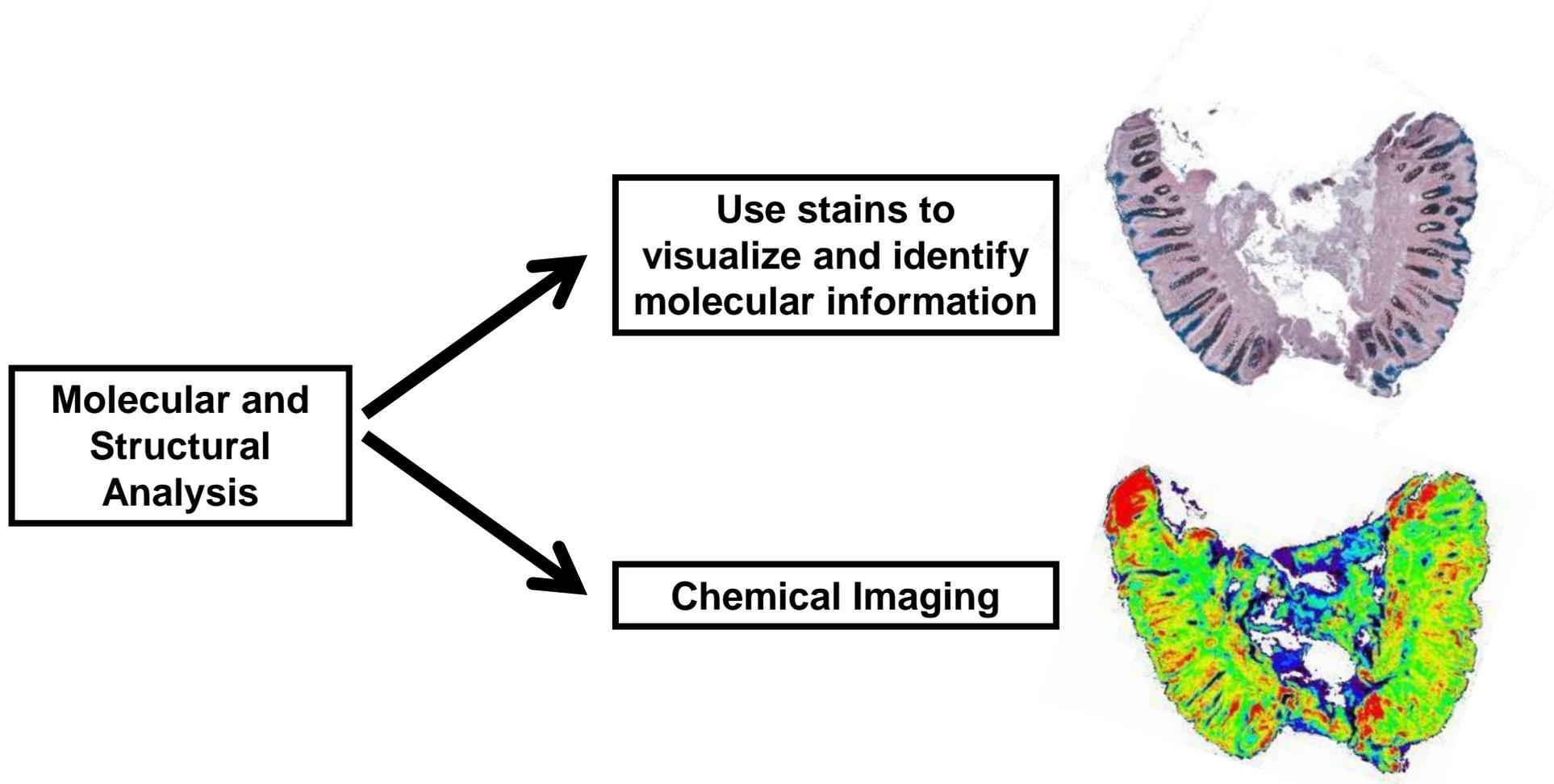




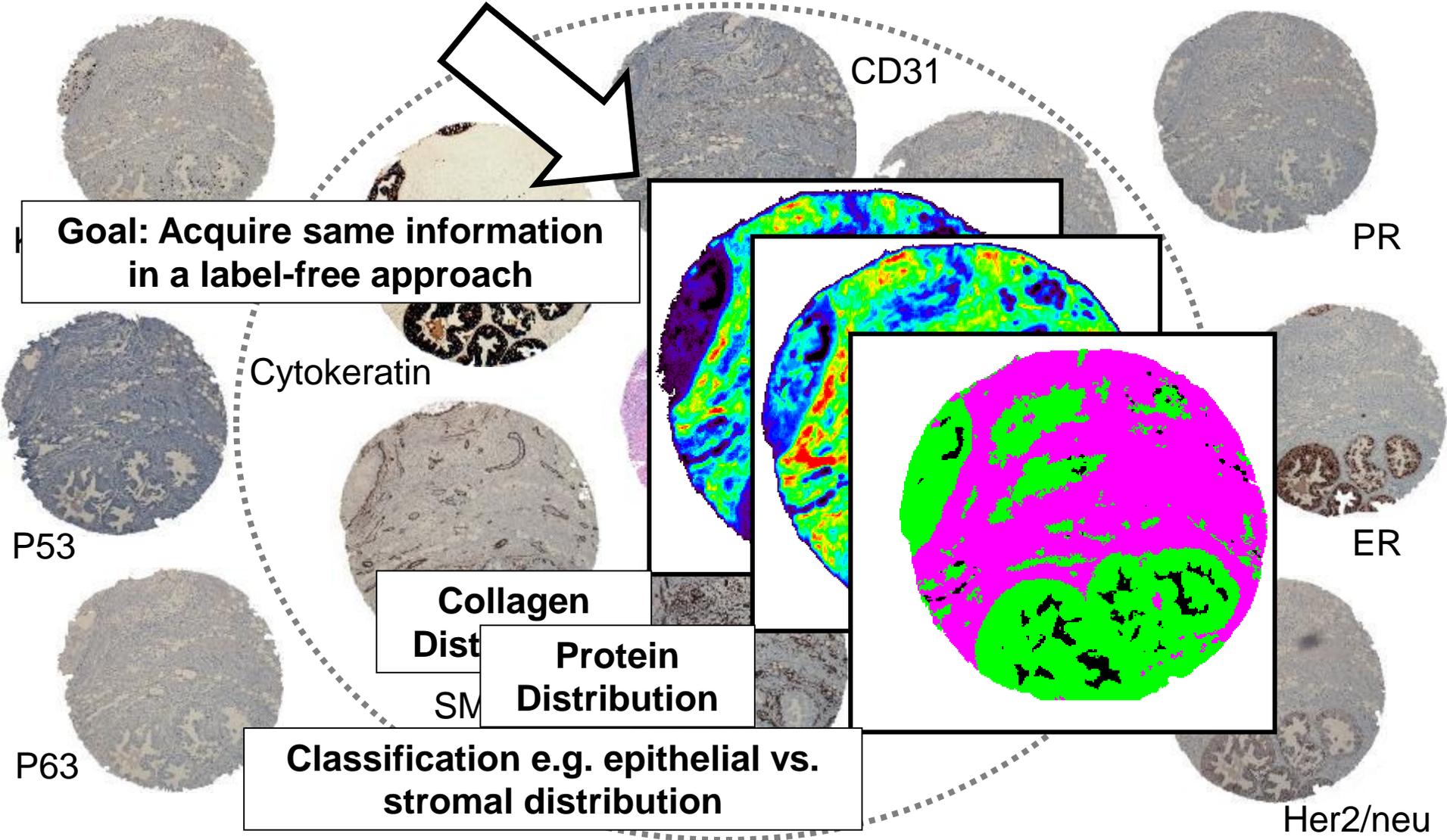
RESEARCH (IF TIME PERMITS)



Examining Chemical and Structural Information from Tissues



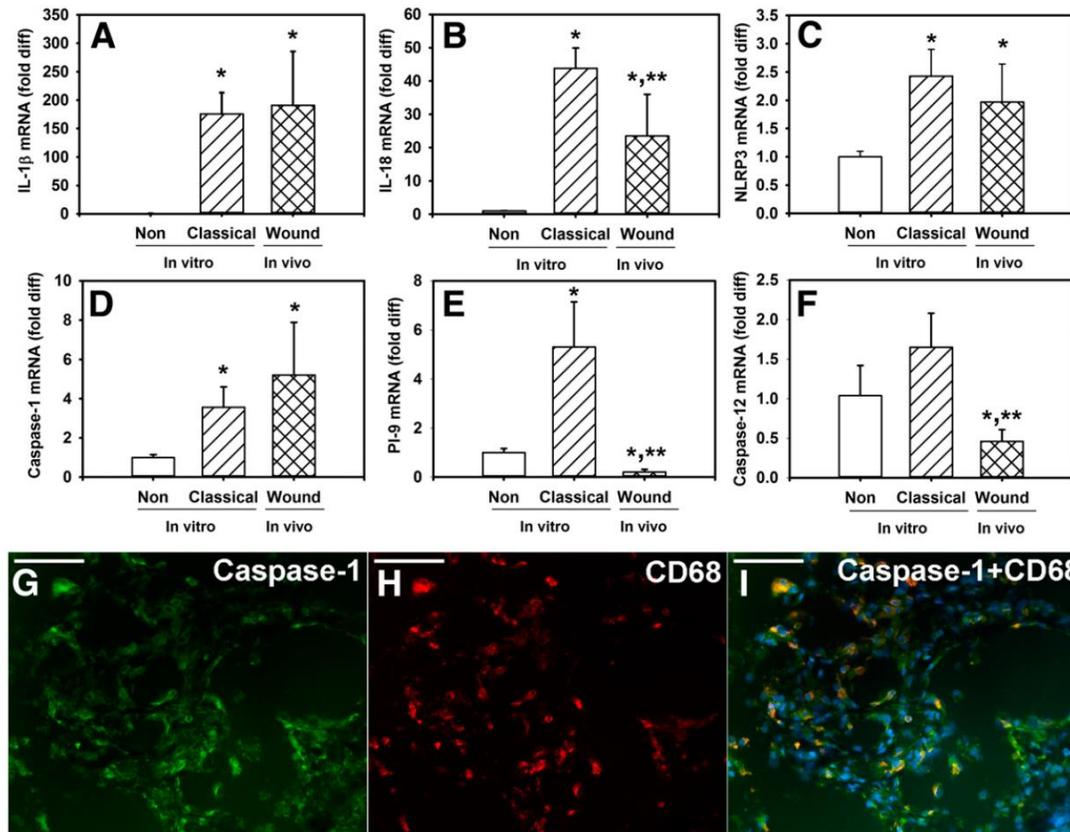
It is Critical to Segment Tissues into Key Cell Types/Components for Tissue Diagnosis



Sustained Inflammasome Activity in Macrophages Impairs Wound Healing in Type 2 Diabetic Humans and Mice

Diabetes Volume 63, March 2014

Rita E. Mirza,¹ Milie M. Fang,¹ Eileen M. Weinheimer-Haus,^{1,2} William J. Ennis,^{2,3} and Timothy J. Koh^{1,2}



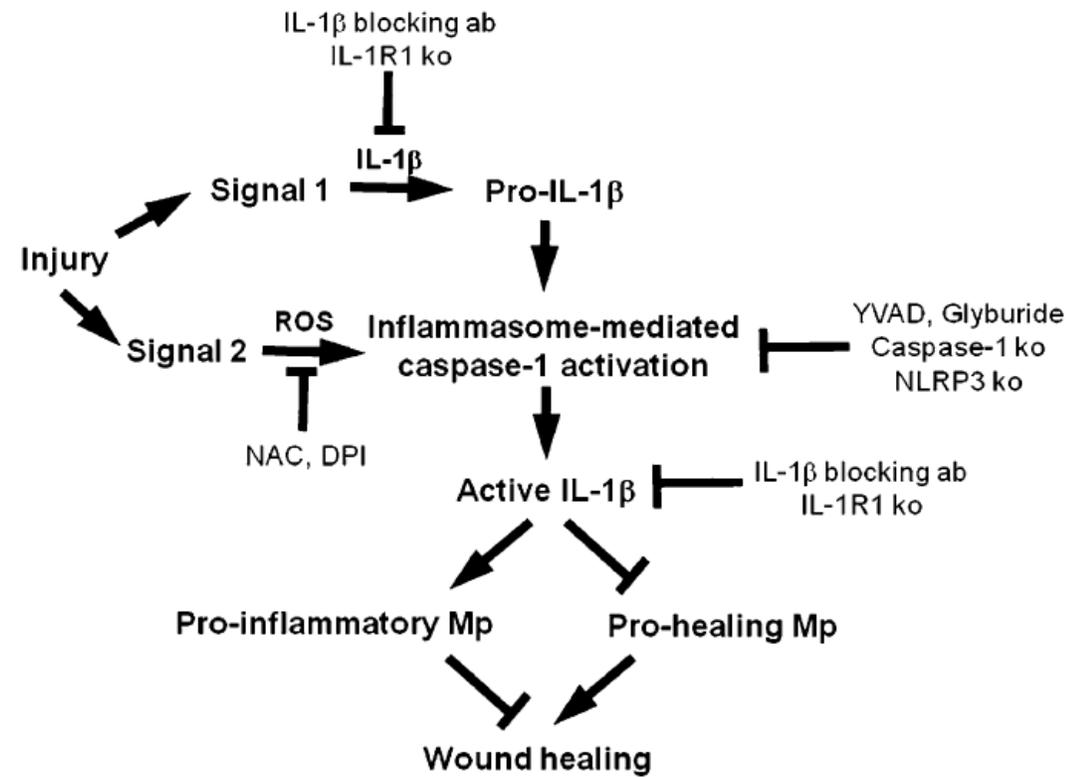
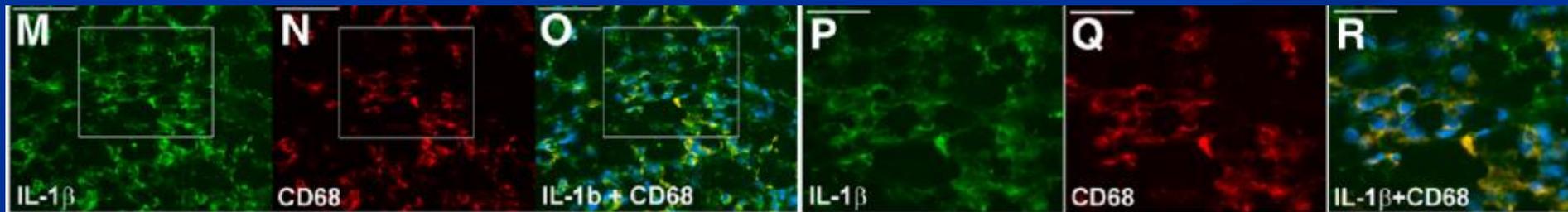
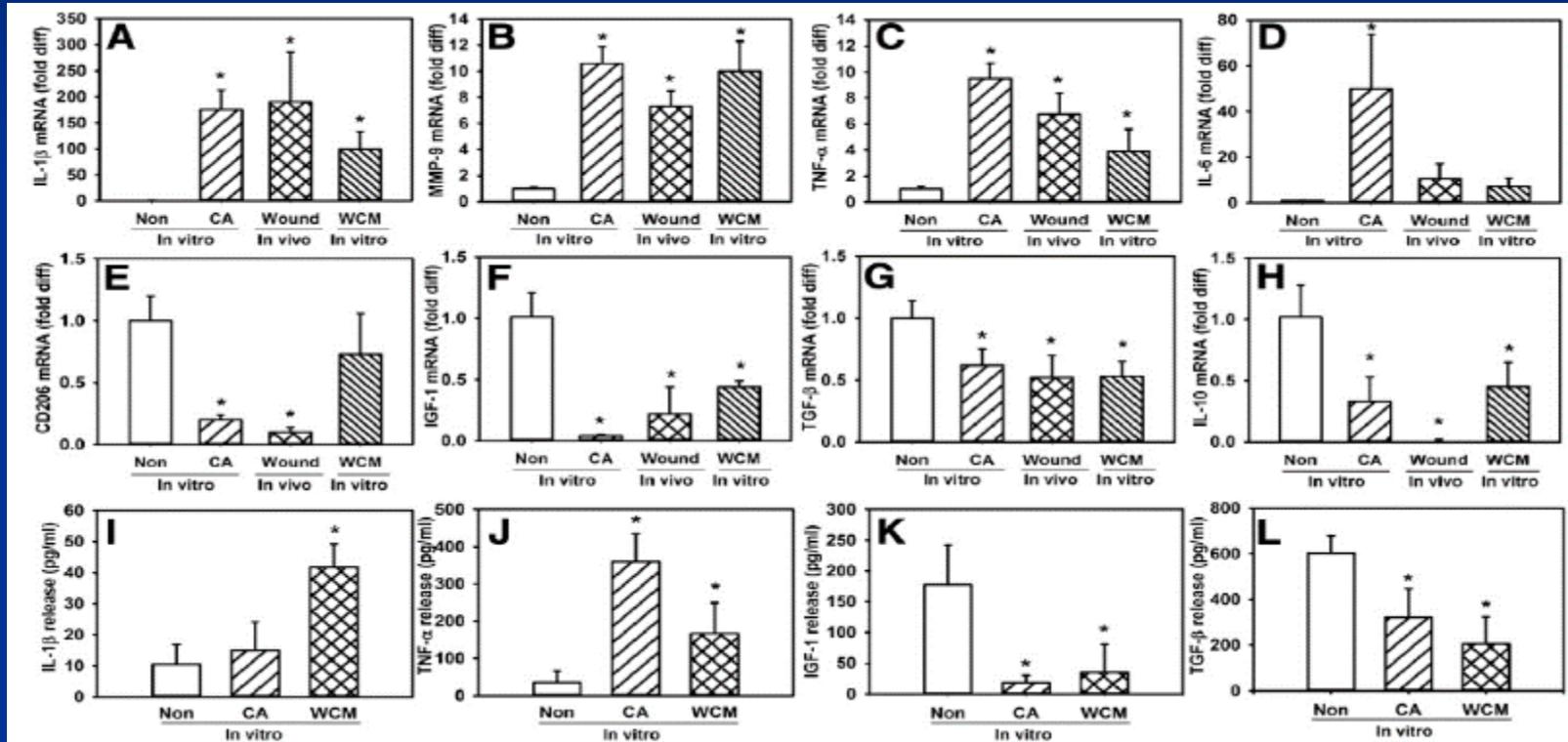


Figure 8—Model of the role of the inflammasome/IL-1 β pathway in impaired wound healing in type 2 diabetes. Our data indicate that IL-1 β can act as an upstream signal (signal 1) for sustaining inflammasome activity in chronic wound Mp and that ROS are involved in the second signal (signal 2) required for inflammasome activity. Since the inflammasome, in turn, activates IL-1 β , this cytokine appears to be part of a proinflammatory positive-feedback loop that promotes a bias toward a proinflammatory Mp phenotype and inhibits upregulation of the prohealing phenotype and healing in diabetic wounds. ab, antibody; ko, knockout.

Blocking Interleukin-1 β Induces a Healing-Associated Wound Macrophage Phenotype and Improves Healing in Type 2 Diabetes

Diabetes 62:2579–2587, 2013

Rita E. Mirza,¹ Milie M. Fang,¹ William J. Ennis,^{2,3} and Timothy J. Koh^{1,3}



NEUTRALIZING ANTIBODY IL-1B, IL knock out mice also used

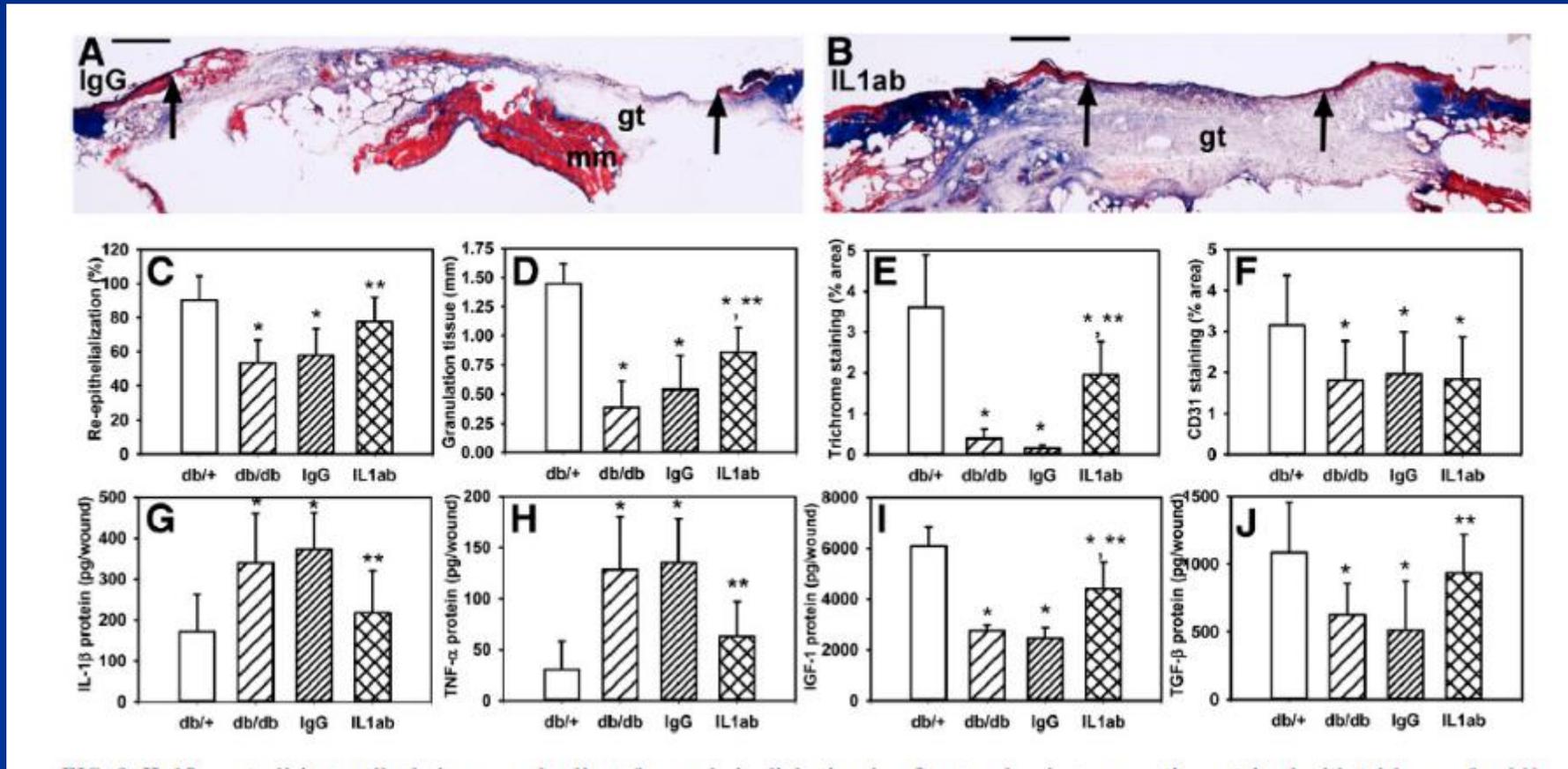


FIG. 6. IL-1 β neutralizing antibody improves healing of wounds in diabetic mice. Wound healing was quantitated by trichrome stain (A)

CRITICAL REVIEW

review article



U1 ▶ Stem Cells and Healing: Impact on Inflammation

1,2,4

U2 ▶ William J. Ennis,^{1,2,4} Audrey Sui,^{1,2} and Amelia Bartholomew³

U3 ▶ Departments of ¹Vascular Surgery, ²Wound Healing and Tissue Repair, and ³Surgery, University of Illinois Hospital and Health Sciences System, Chicago, Illinois

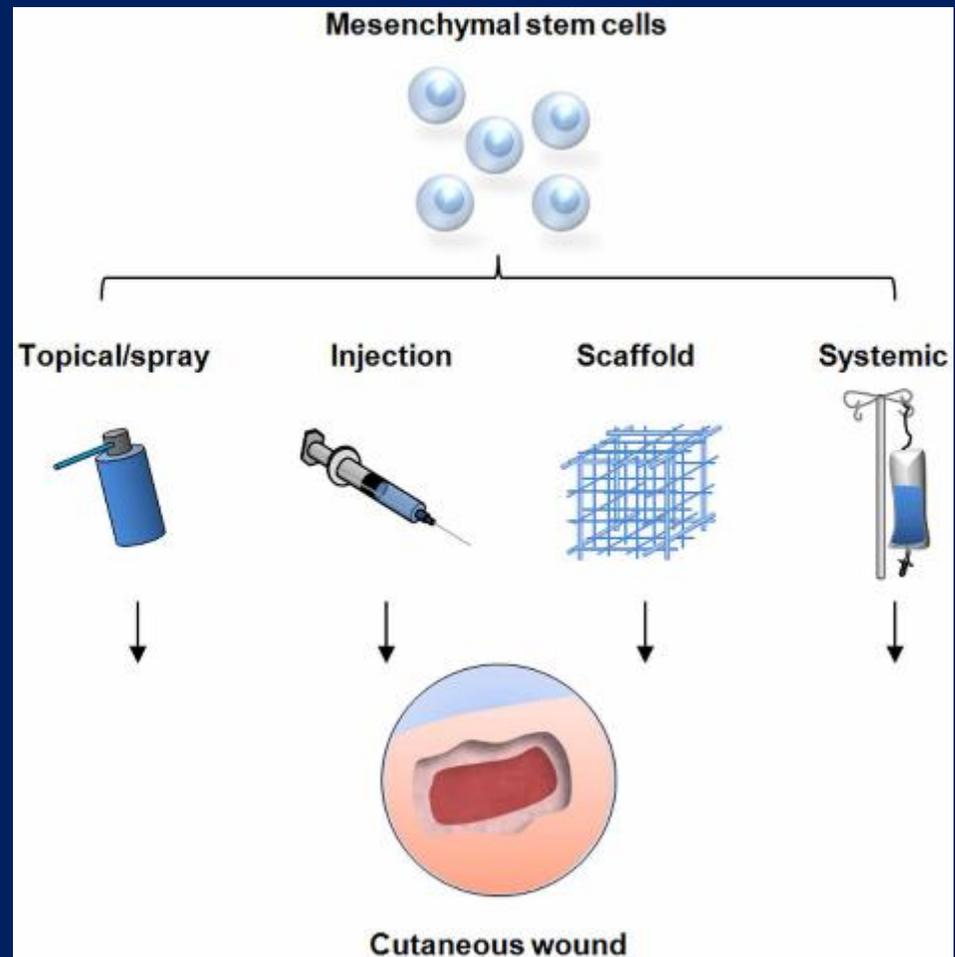
Significance: The number of patients with nonhealing wounds has rapidly accelerated over the past 10 years in both the United States and worldwide. Some causative factors at the macro level include an aging population, epidemic numbers of obese and diabetic patients, and an increasing number of surgical procedures. At the micro level, chronic inflammation is a consistent finding.

Recent Advances: A number of treatment modalities are currently used to accelerate wound healing, including energy-based modalities, scaffoldings, the use of mechano-transduction, cytokines/growth factors, and cell-based therapies. The use of stem cell therapy has been hypothesized as a potentially useful adjunct for nonhealing wounds. Specifically, mesenchymal stem cells (MSCs)



William J. Ennis, DO, MBA

Submitted to *JWMS* July 2, 2013
Accepted for publication August 1, 2013



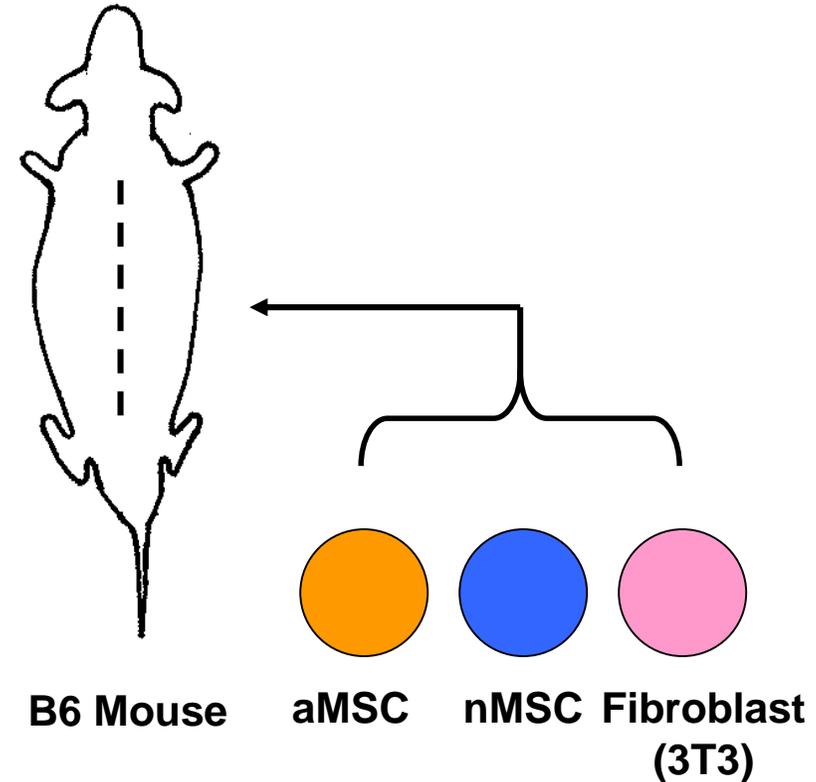
MSC Treatment and Tensile Strength

Hypothesis

Treatment with MSC may reprogram wound healing towards regeneration

Regeneration can be analyzed by tensile strength of the wound

Stronger wound may indicate tissue regeneration versus scar formation





Available online at www.sciencedirect.com

SciVerse ScienceDirect

journal homepage: www.JournalofSurgicalResearch.com



Association for Academic Surgery

Activated mesenchymal stem cells increase wound tensile strength in aged mouse model via macrophages

Simon Lee, MPH,^a Erzsebet Szilagyi, MD, PhD,^a Lin Chen, PhD,^b
Kavitha Premanand, MS,^a Luisa A. DiPietro, DDS, PhD,^b William Ennis, DO,^a and
Amelia M. Bartholomew, MD, MPH^{a,c,*}

^aDepartment of Surgery, University of Illinois, Chicago, Illinois

^bCollege of Dentistry, University of Illinois, Chicago, Illinois

^cCancer Center, University of Illinois, Chicago, Illinois

MSC and Tensile Strength

4 Treatment Groups

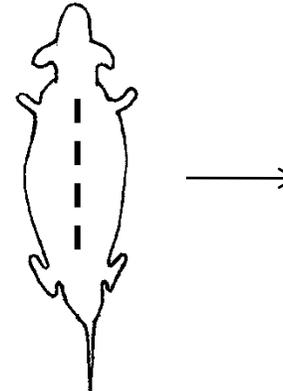
- Allogeneic aMSC (activated)
- Allogeneic nMSC(naïve)
- Fibroblast (3T3)
- Control (HBSS)

3 Cell Doses adjusted to standardized volume 200 microliters

- 50,000
- 250,000
- 500,000

Subcutaneous injection into a 3 cm incisional wound on the dorsum of B6 mice and surgically clipped.

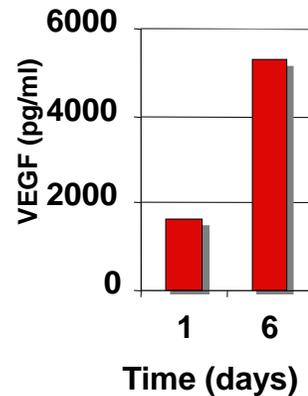
Day 7 - wounds excision and tensiometry



Mark -10 ESM300 Motorized Force and Torque Stand
© Mark-10 Corporation (Copiague, NY) 2010

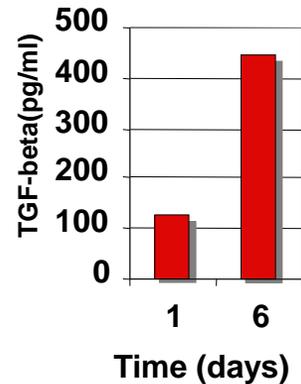
Activated MSC provide more powerful anti-inflammatory and pro-angiogenic properties

Activation Induced
Increase in
VEGF



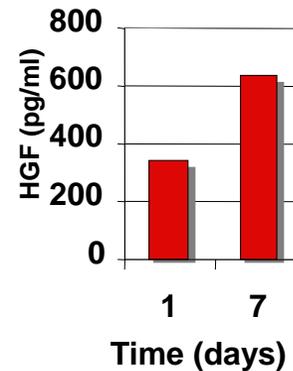
P = 0.001

Activation Induced
Increase in
TGF-beta

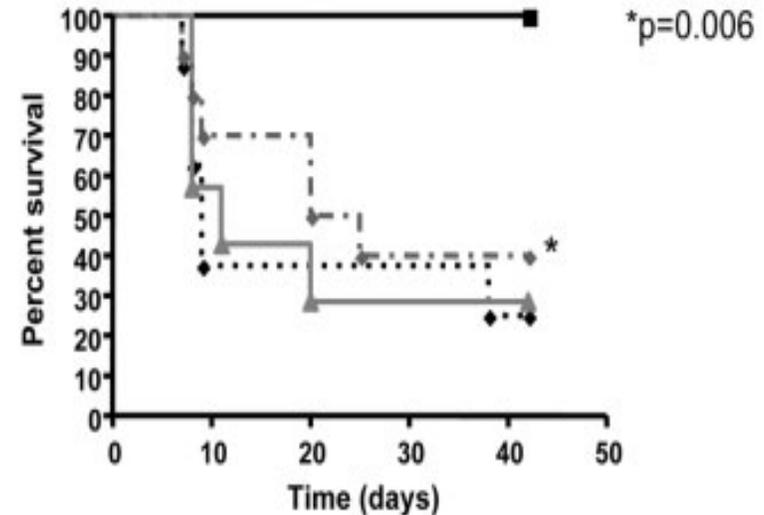


P = 0.001

Activation Induced
Increase in
HGF

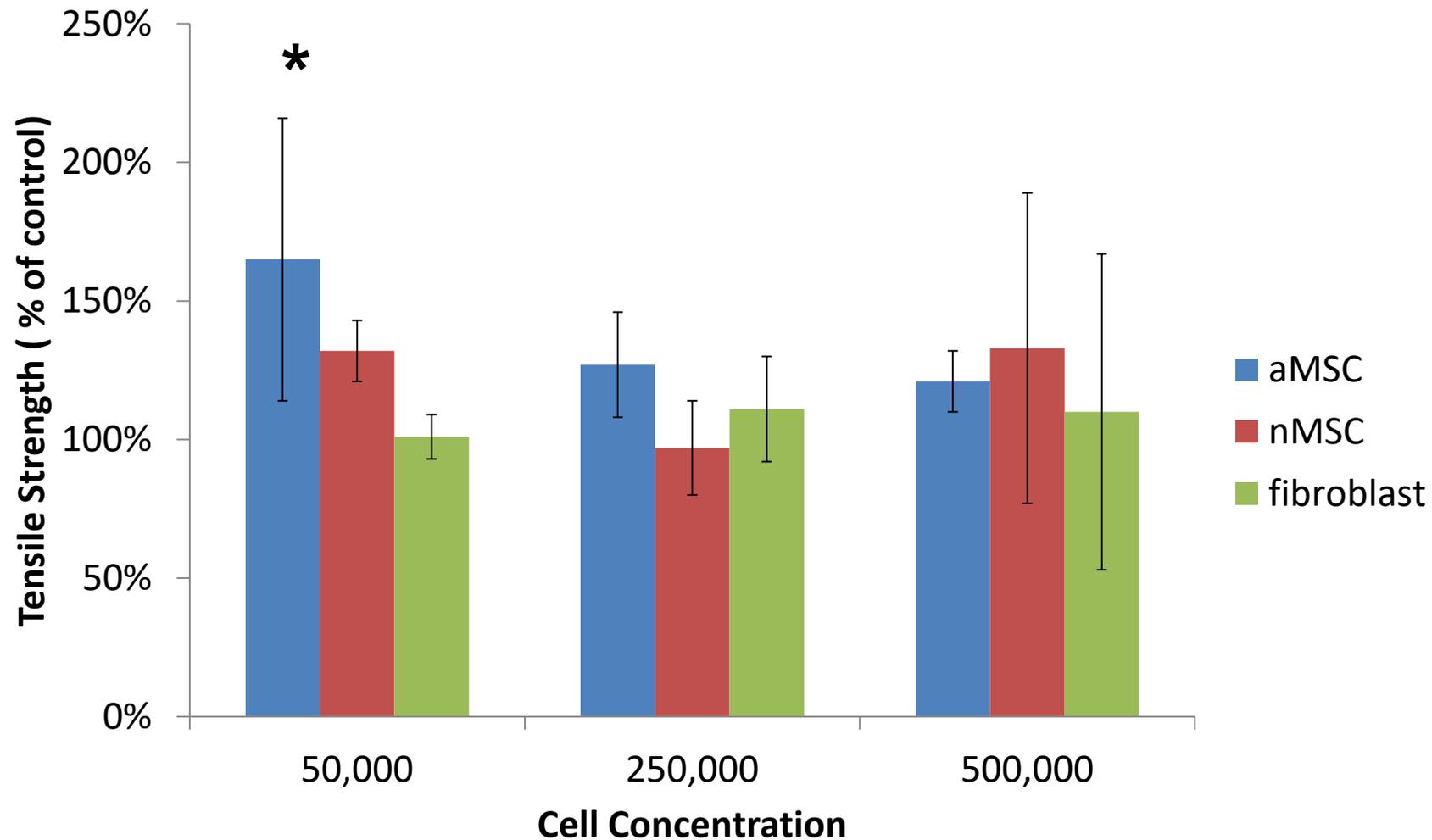


P = 0.002



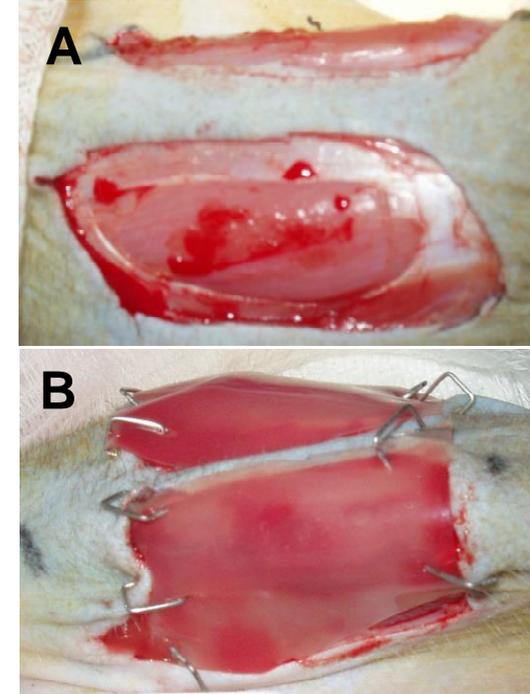
- Untreated (n=10)
- IFN-g Balb MSC Day 0, 5U (n=10)
- - - IFN-g Balb MSC Day 0, 50U (n=10)
- IFN-g Balb MSC Day 0, 500U (n=10)

Tensile Strength vs. Dose Response Following Treatment with aMSC, nMSC, fibroblast



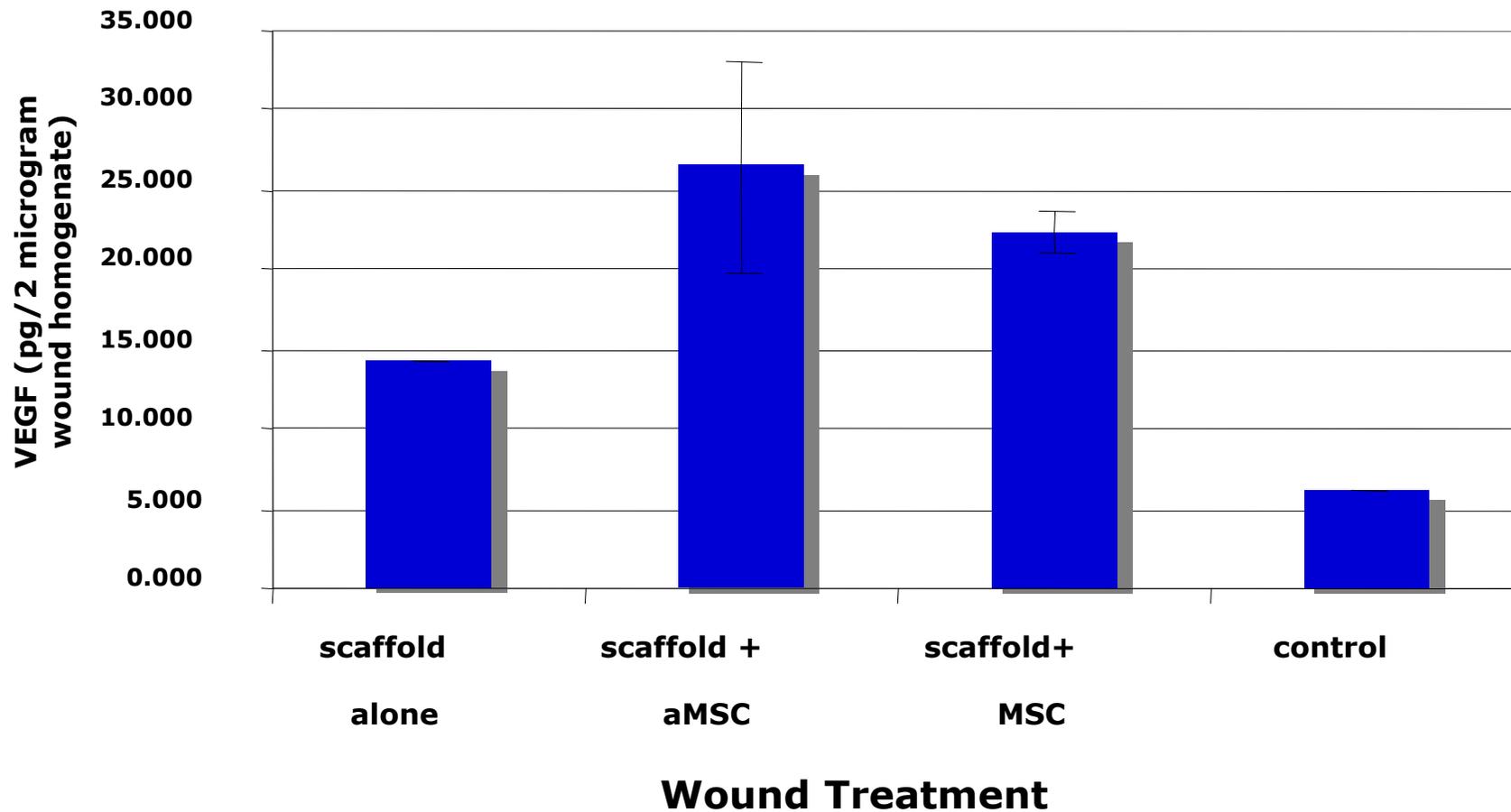
MSC Treatment and Blood Flow

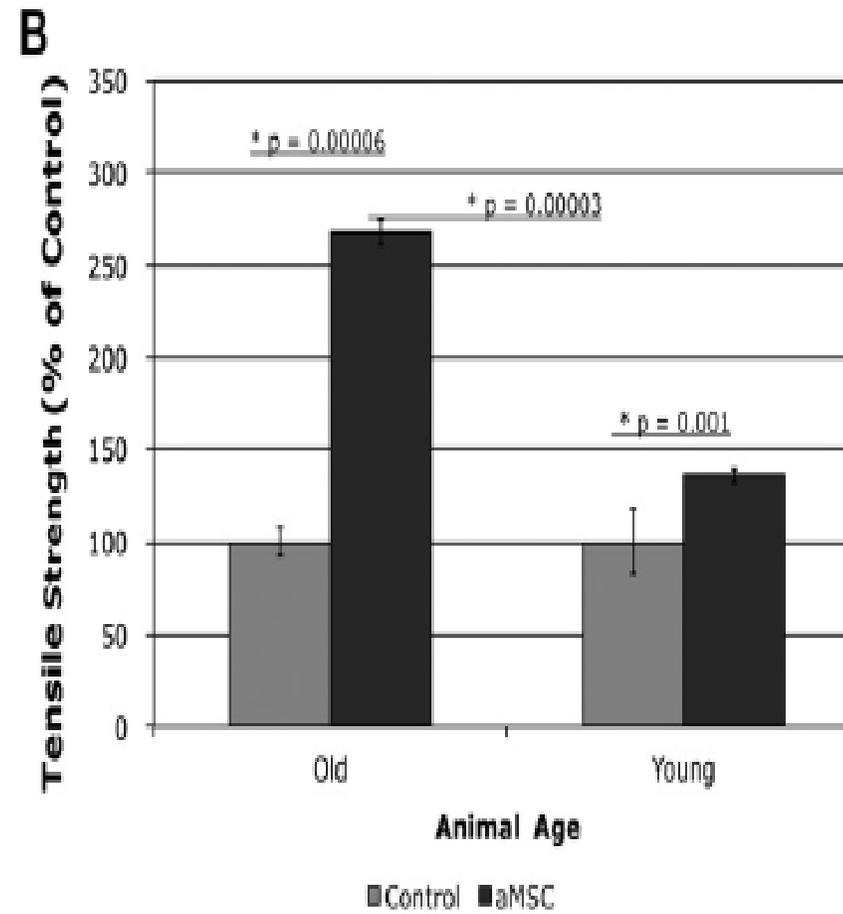
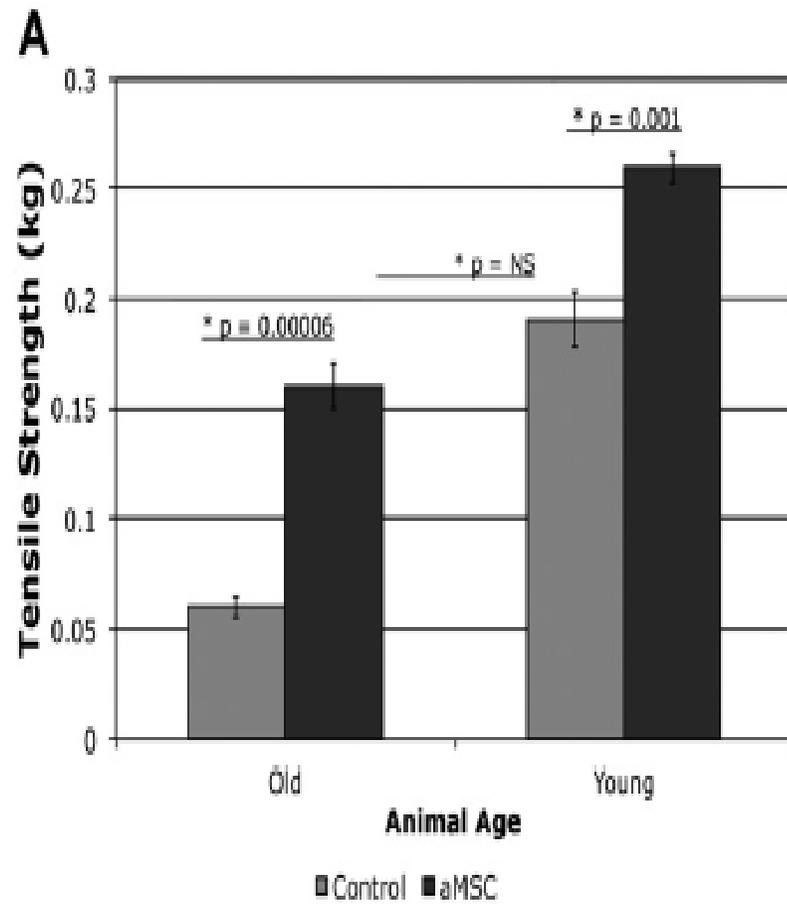
- Diabetic cynomolgus monkey model (n = 3)
- [Insert chart of different glucose readings to show hyperglycemia]
 - 4 (2 x 1 cm) wounds on lateral and medial side of the anterior femoral region
 1. Autologous aMSC with Integra
 2. Autologous nMSC with Integra
 3. Integra alone
 4. Saline soaked gauze
 - Blood flow measured hourly for first 6 hours with Laser Doppler



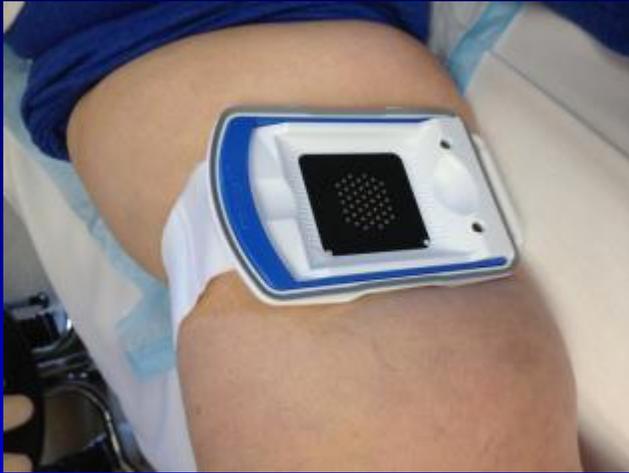
A = control excision wound
B = scaffold with MSC

Excised Nonhuman Primate Wound VEGF Content

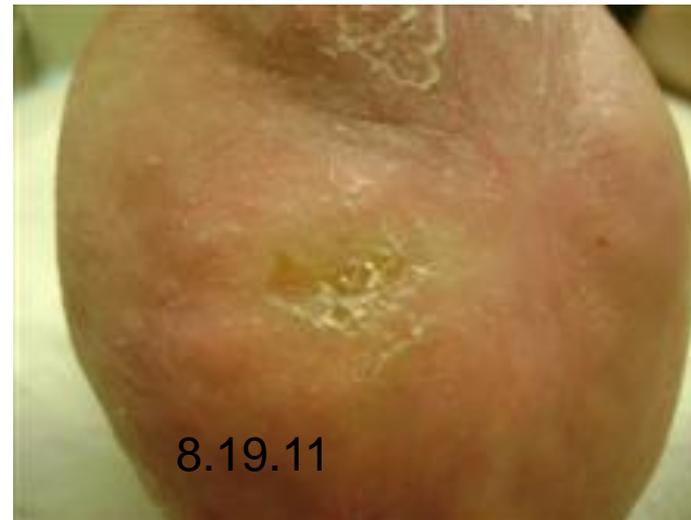




WR 3.15.13







Low-Intensity Vibration Improves Angiogenesis and Wound Healing in Diabetic Mice

Eileen M. Weinheimer-Haus^{1,2}, Stefan Judex⁴, William J. Ennis^{2,3}, Timothy J. Koh^{1,2*}

¹Department of Kinesiology and Nutrition, University of Illinois at Chicago, Chicago, Illinois, United States of America, ²Center for Tissue Repair and Regeneration, University of Illinois at Chicago, Chicago, Illinois, United States of America, ³Department of Surgery, University of Illinois at Chicago, Chicago, Illinois, United States of America, ⁴Department of Biomedical Engineering, Stony Brook University, Stony Brook, New York, United States of America

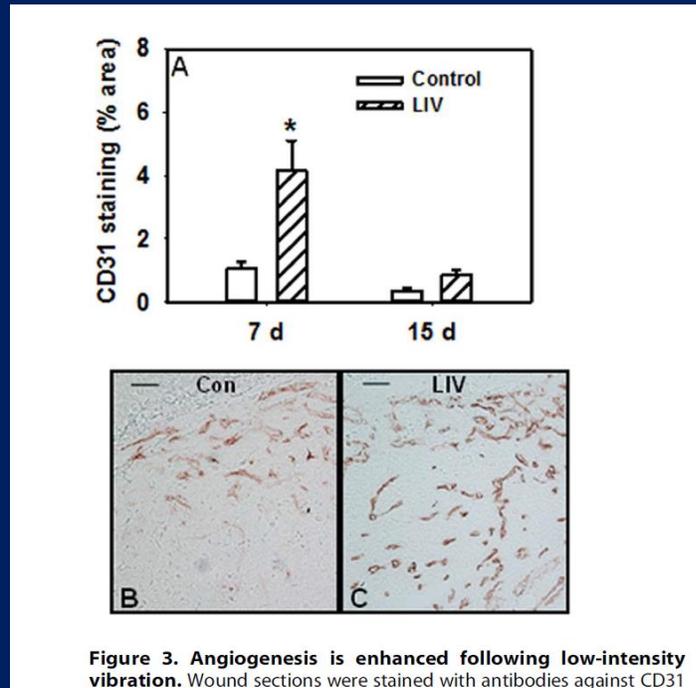
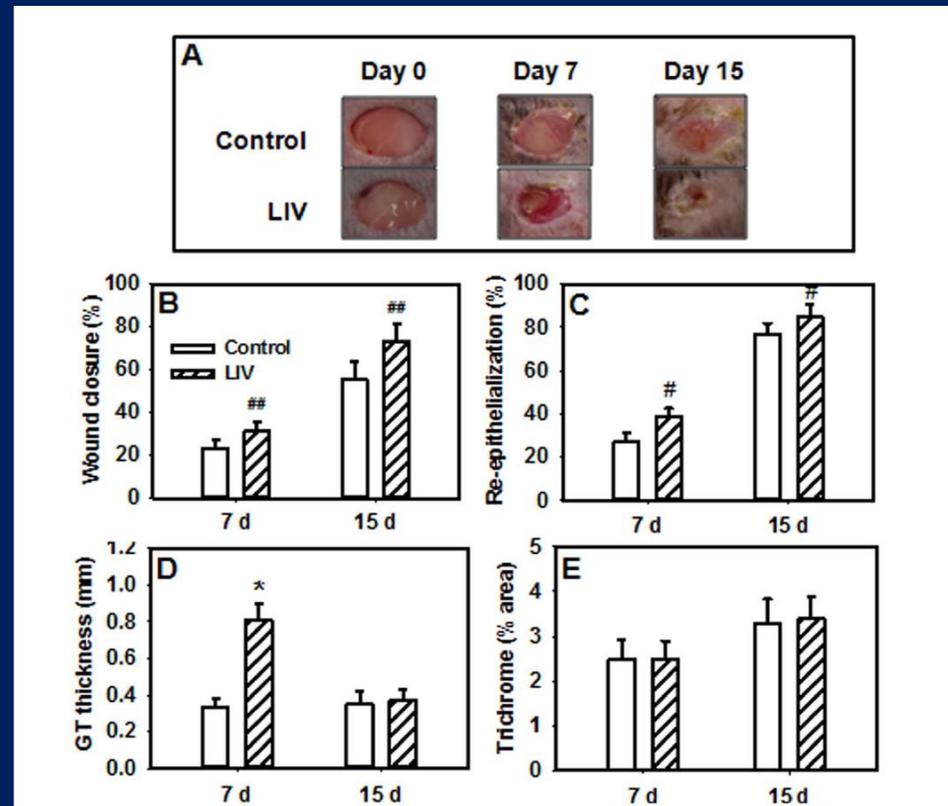


Figure 3. Angiogenesis is enhanced following low-intensity vibration. Wound sections were stained with antibodies against CD31



QUESTIONS/SUMMARY

