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

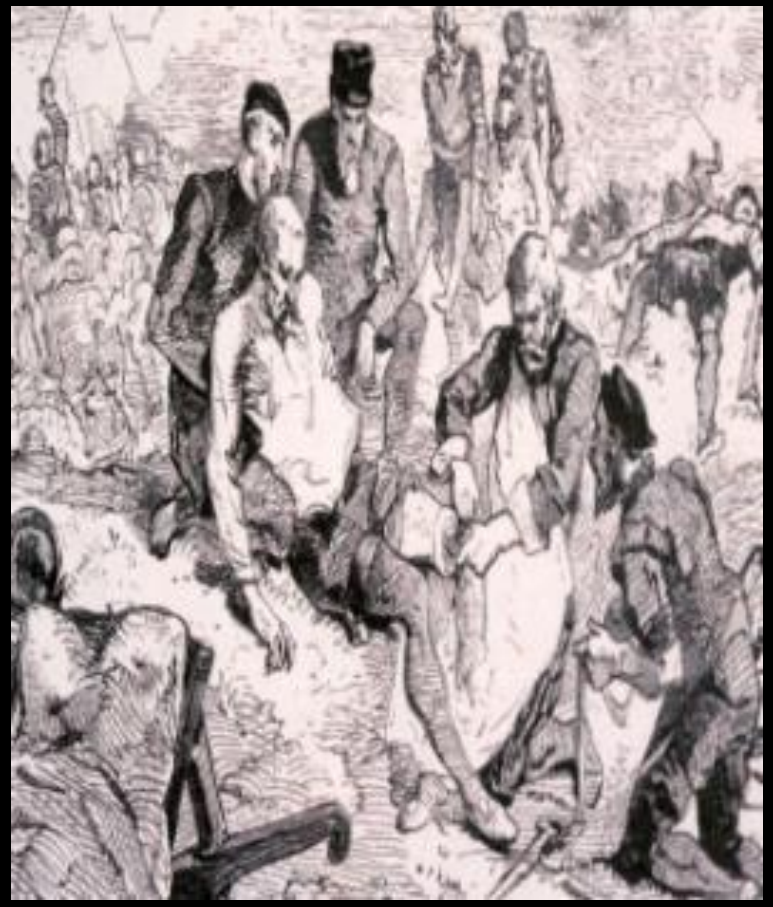
- Chief Science Officer Healogics
- NIH funding

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

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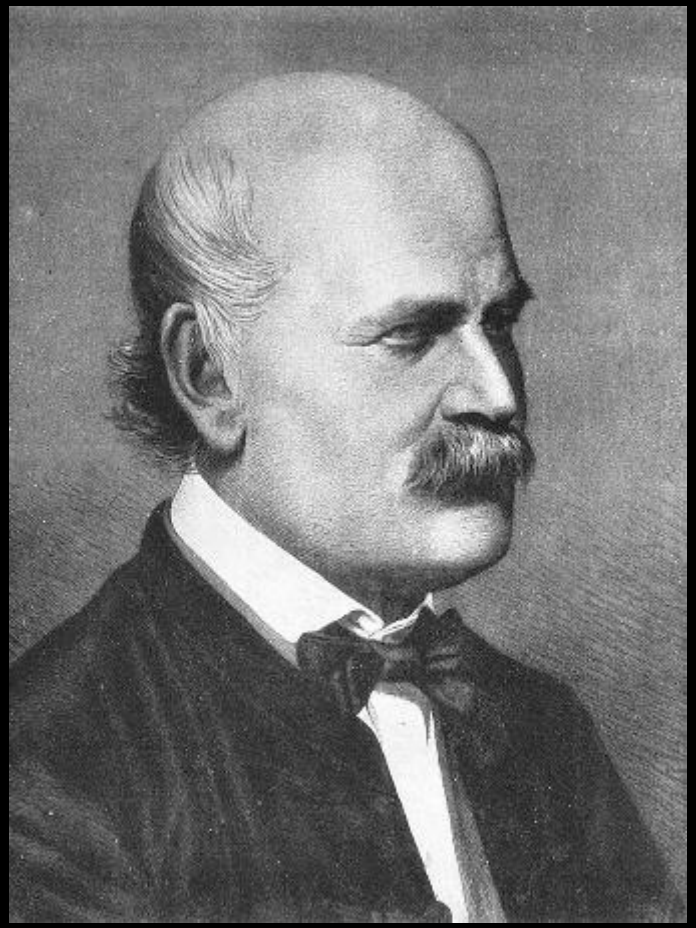
HISTORY



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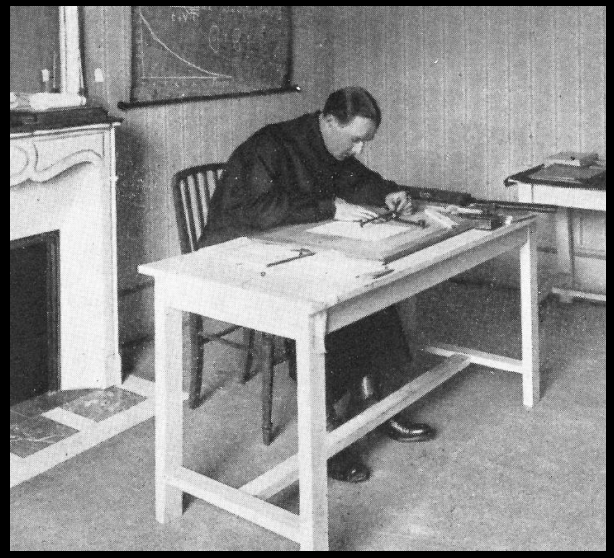
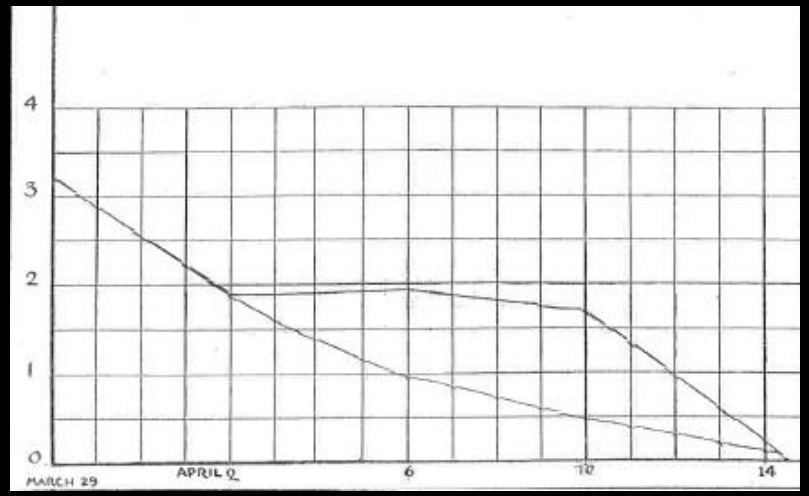
HISTORY





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

William J. Ennis, DO

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.

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INFECTIOUS DISEASE AND THE SURGICAL PATIENT

- Community acquired infections
- SSI
- Nosocomial

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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

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

THIS CANNOT CONTINUE.

- 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

WOUND REALITY

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

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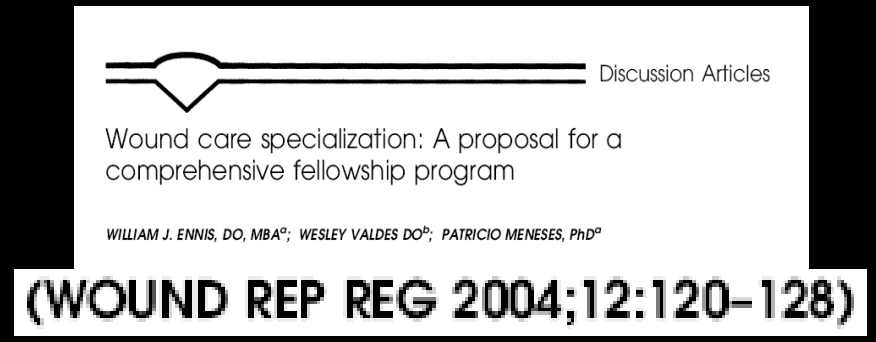
UIC SECTION OF WOUND HEALING AND TISSUE REPAIR

*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


Discussion Articles

Wound care specialization: A proposal for a comprehensive fellowship program

WILLIAM J. ENNIS, DO, MBA[a]; WESLEY VALDES DO[b]; PATRICIO MENESES, PhD[a]

(WOUND REP REG 2004;12:120–128)

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
Hospital & Health Sciences System
Changing medicine. For good.

UNIVERSITY OF ILLINOIS AT CHICAGO

DEPARTMENT OF SURGERY

2009 GRADUATION CEREMONY

JUNE 5TH, 2009
ART INSTITUTE OF CHICAGO

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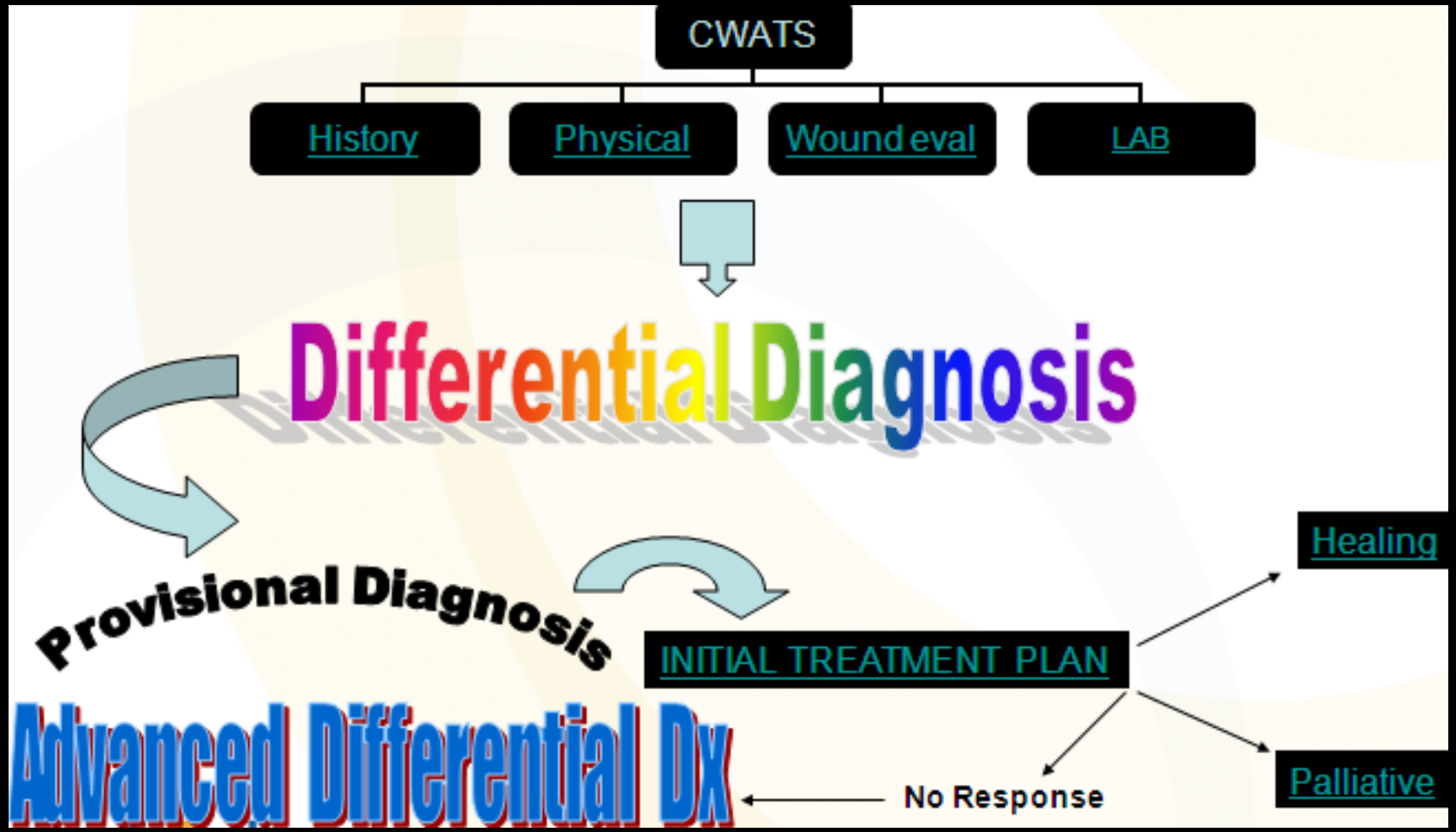
PROTOCOL



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

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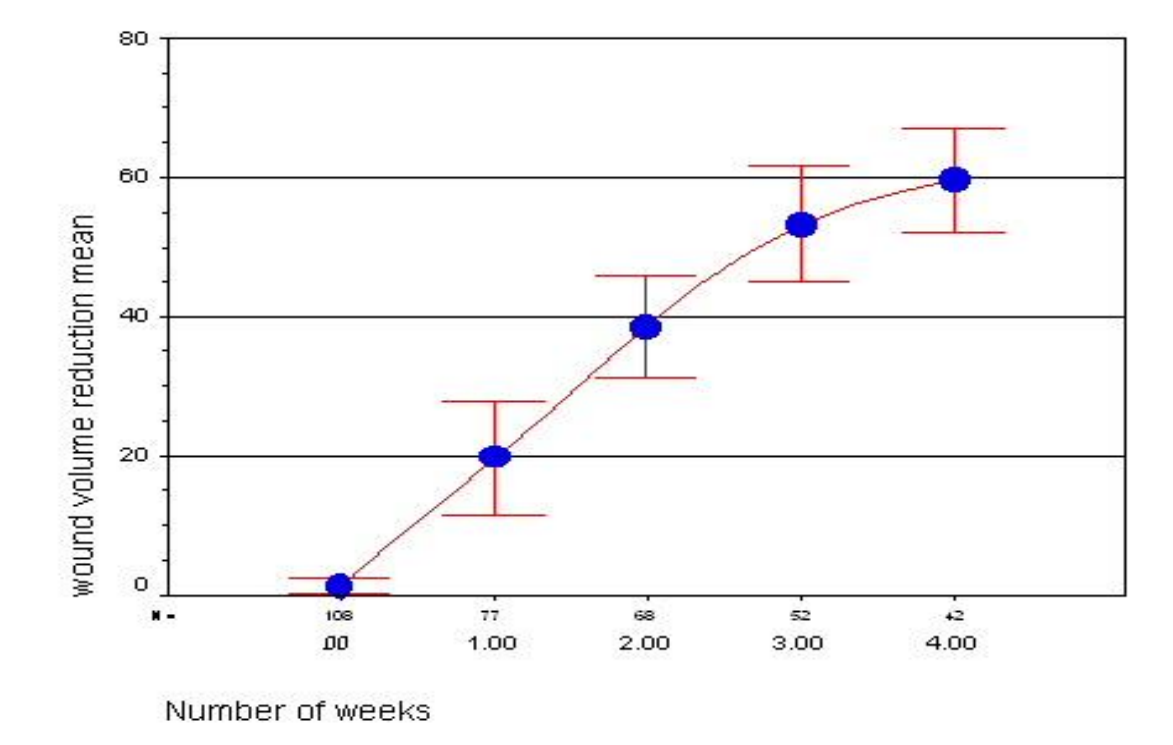
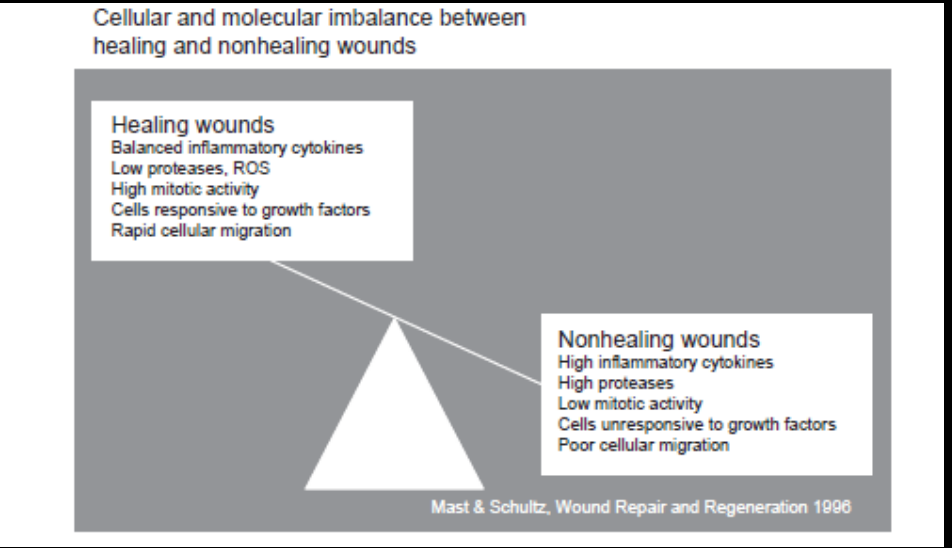
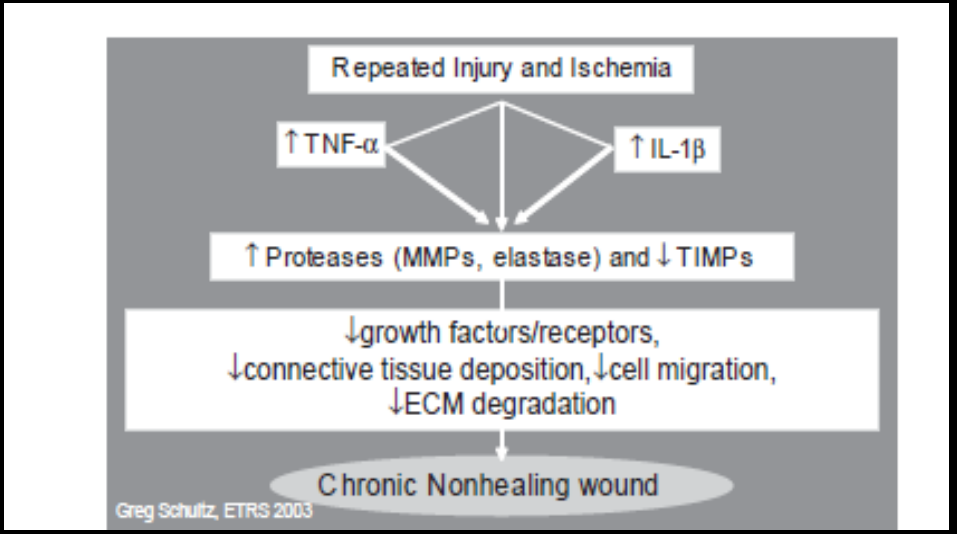
TRAJECTORY







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ACUTE WOUND

One-time injury

↓

Bleeding/platelet activation/growth factor release

↓

PMN influx → secretion of pro-inflammatory cytokines

→ bacterial kill/debridement

↓

PMN's recede

Macrophage/fibroblast influx

↓

Inflammatory phase ends/Proliferative phase begins

- Metabolically active cells
- Growth factors present
- Appropriate levels of pro-inflammatory cytokines (TNFα, 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 (TNFα, IL-1, etc.)

↓

Increased MMP/decreased TIMP activity

↓

Degradation of growth factors and target cell receptors

Degradation of extracellular matrix

↓

Impaired healing

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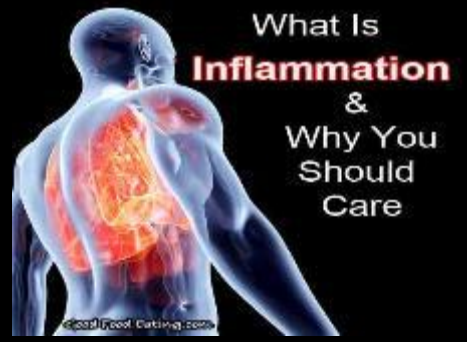
TREATMENT MATRIX?



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

High

Local Inflammation

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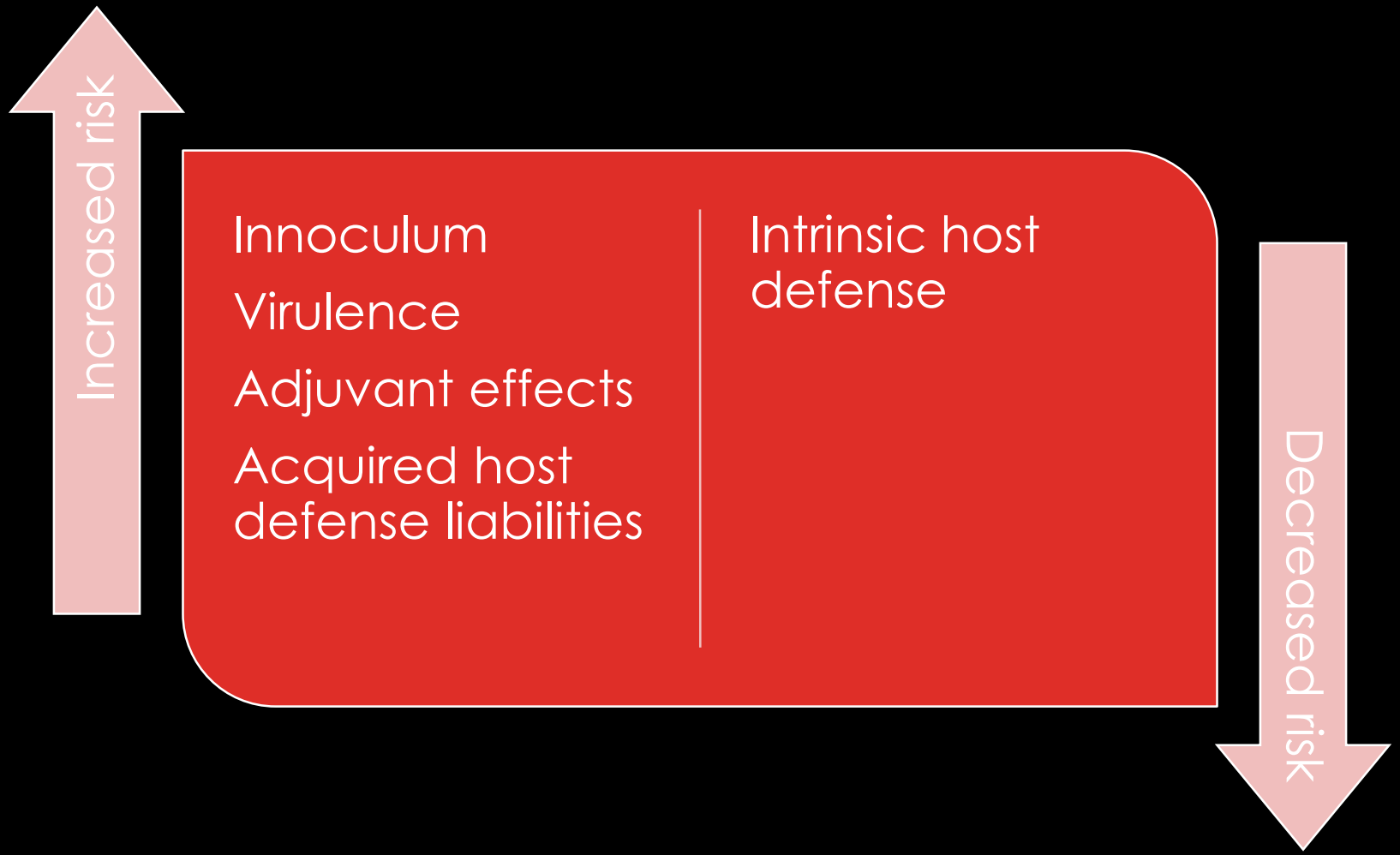
SSI EQUATION DONALD FRY MD



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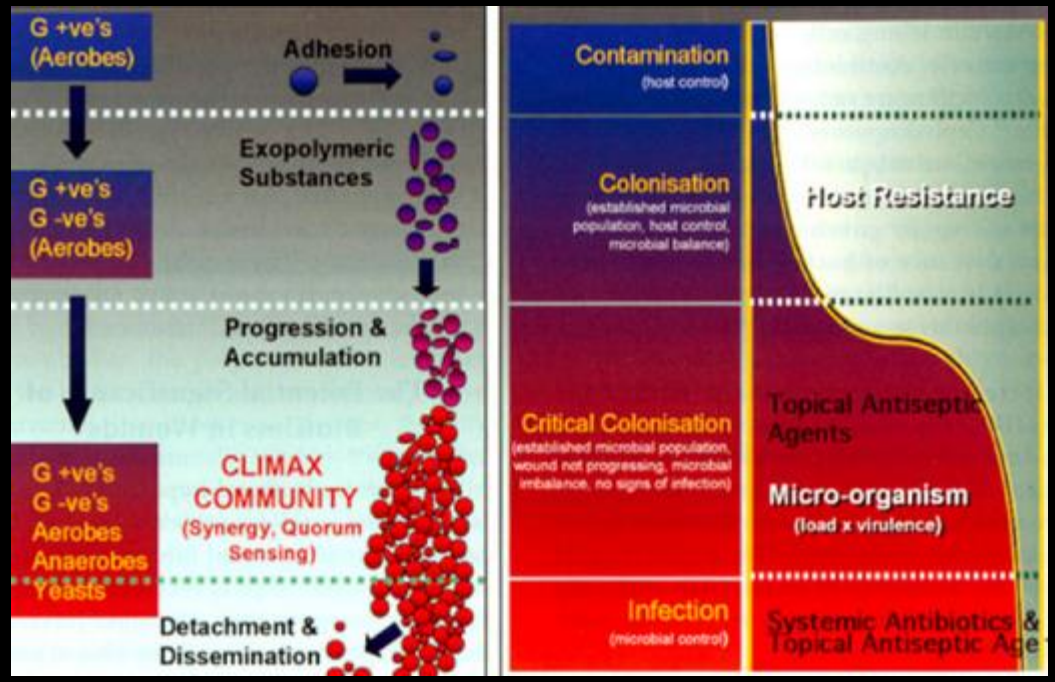
INNOCULUM

- SSI
  - Clean
  - Clean contaminated
  - Contaminated
  - Dirty

- Chronic wound



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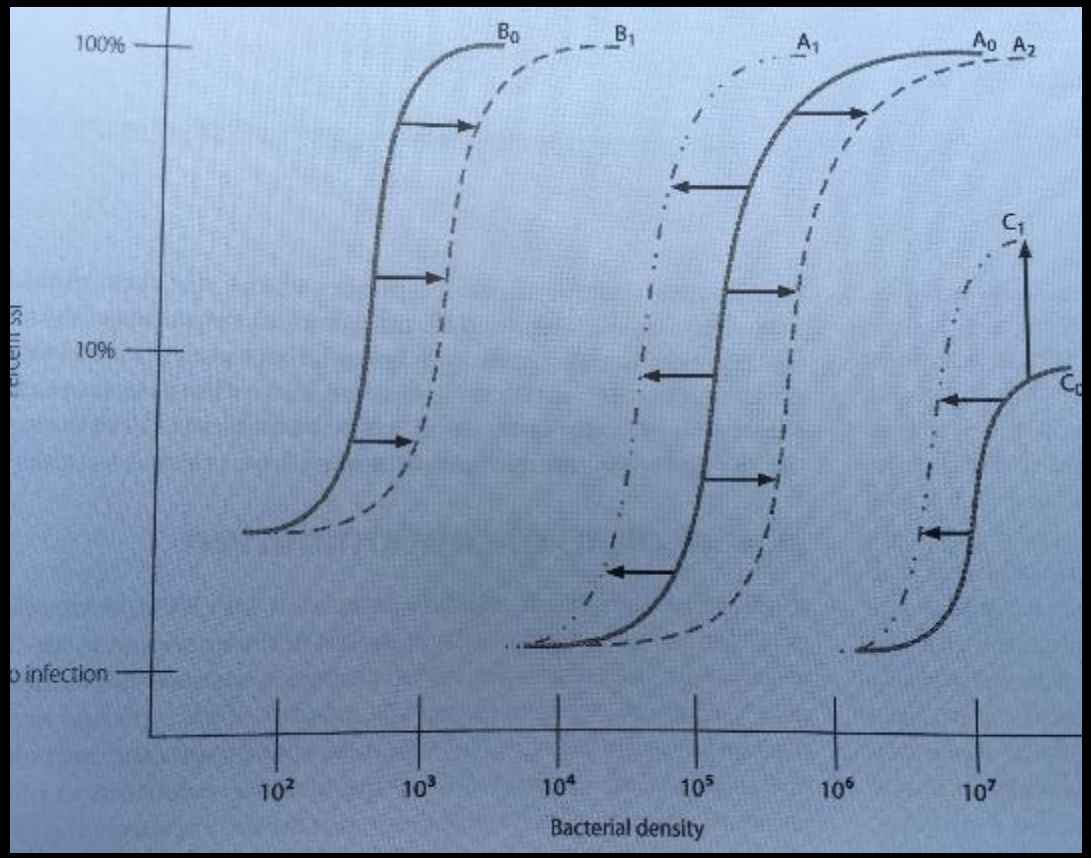
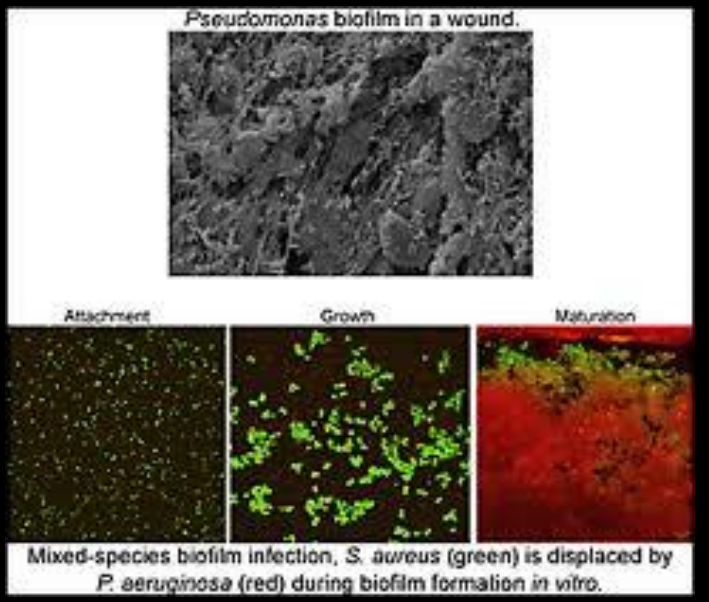
VIRULENCE

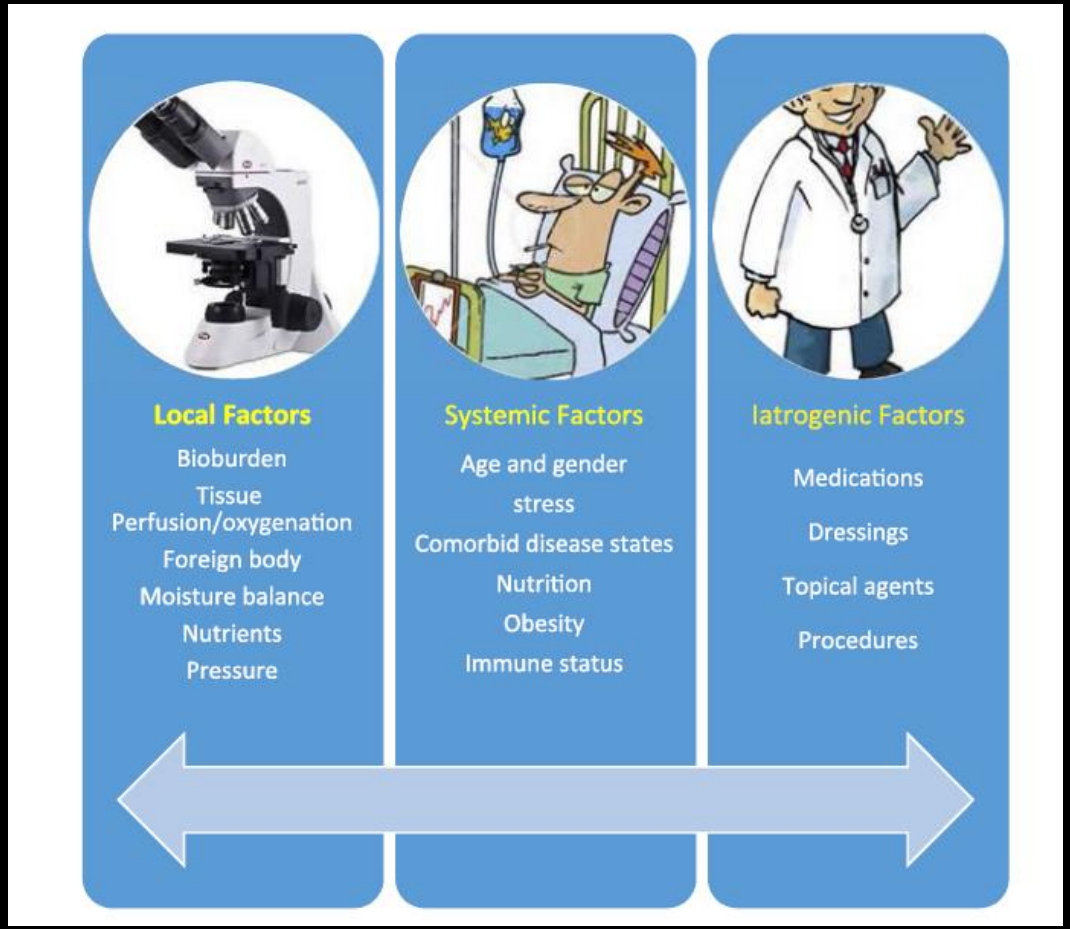


- Robson 10 to the 5th
- Robson 10 to the 6th
- Streptococcus
- Biofilm
- Adjuvant effects
  - Cautery
  - Hematoma
  - Seroma
  - Prosthetic
  - Suture



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

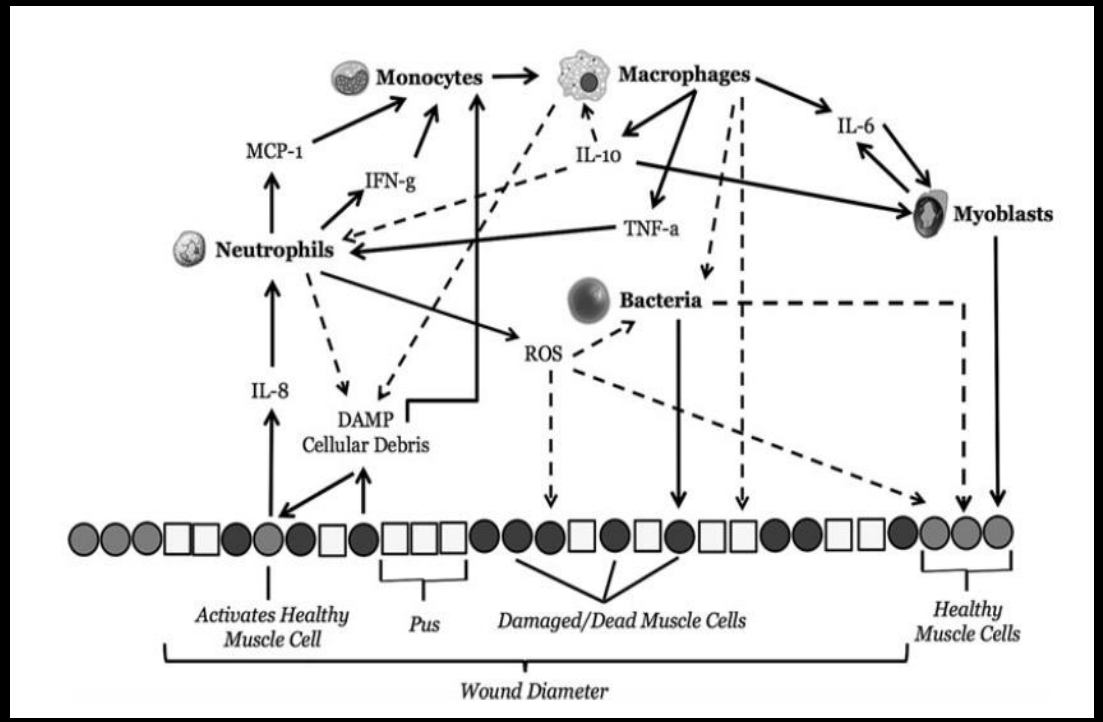
ADVANCED TECHNOLOGIES

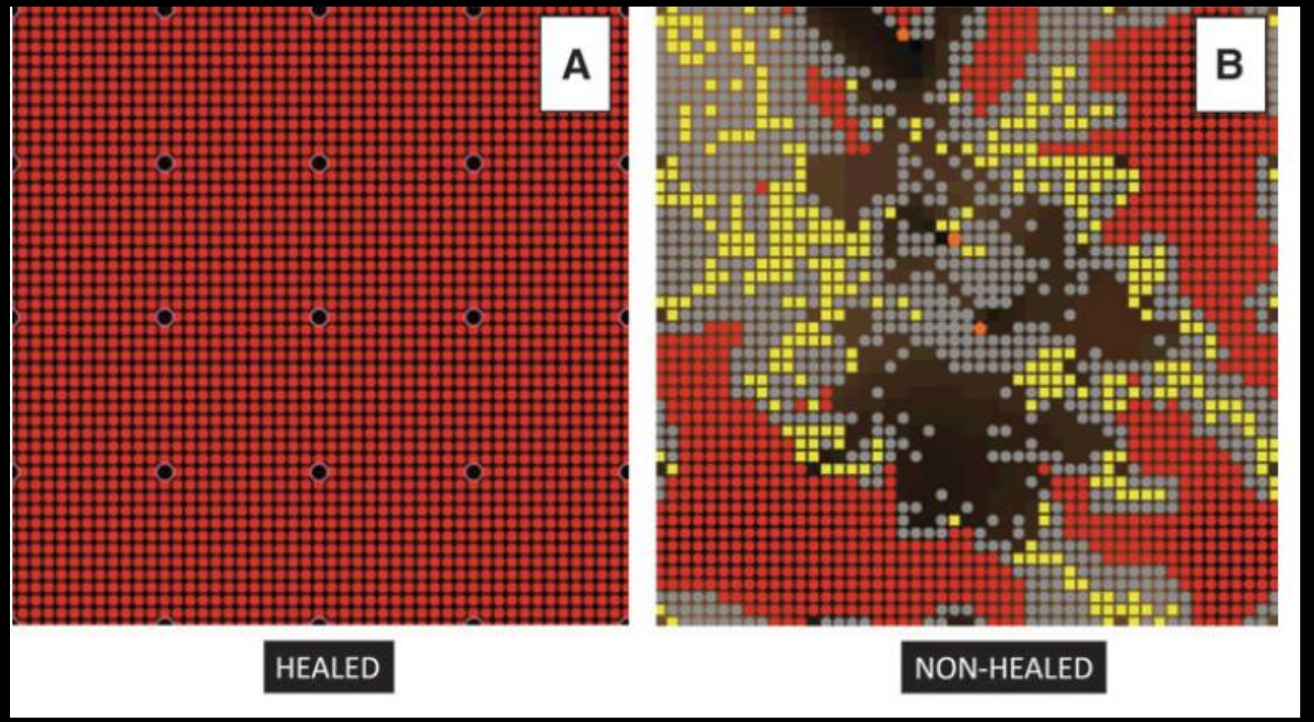
- Diagnostic and therapeutic
- Can we determine who will get an infection
- Can we direct costly therapy to those at the most risk
- Can we determine who will heal and who will not
- Can we follow our guidelines

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,*]

[1]Department of Biology, Johns Hopkins University, Baltimore, Maryland.
[2]Department of Surgery, University of Chicago, Chicago, Illinois.





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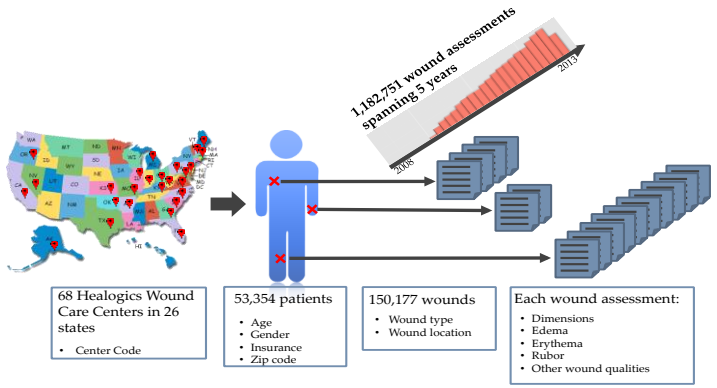
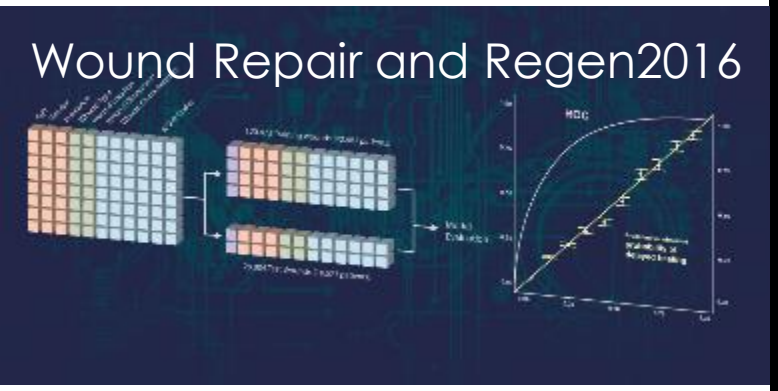
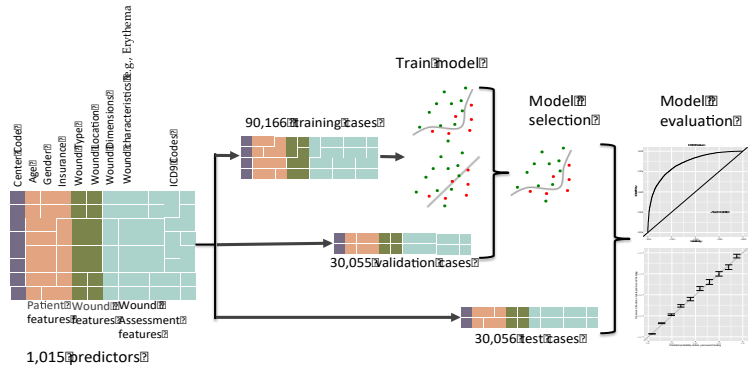
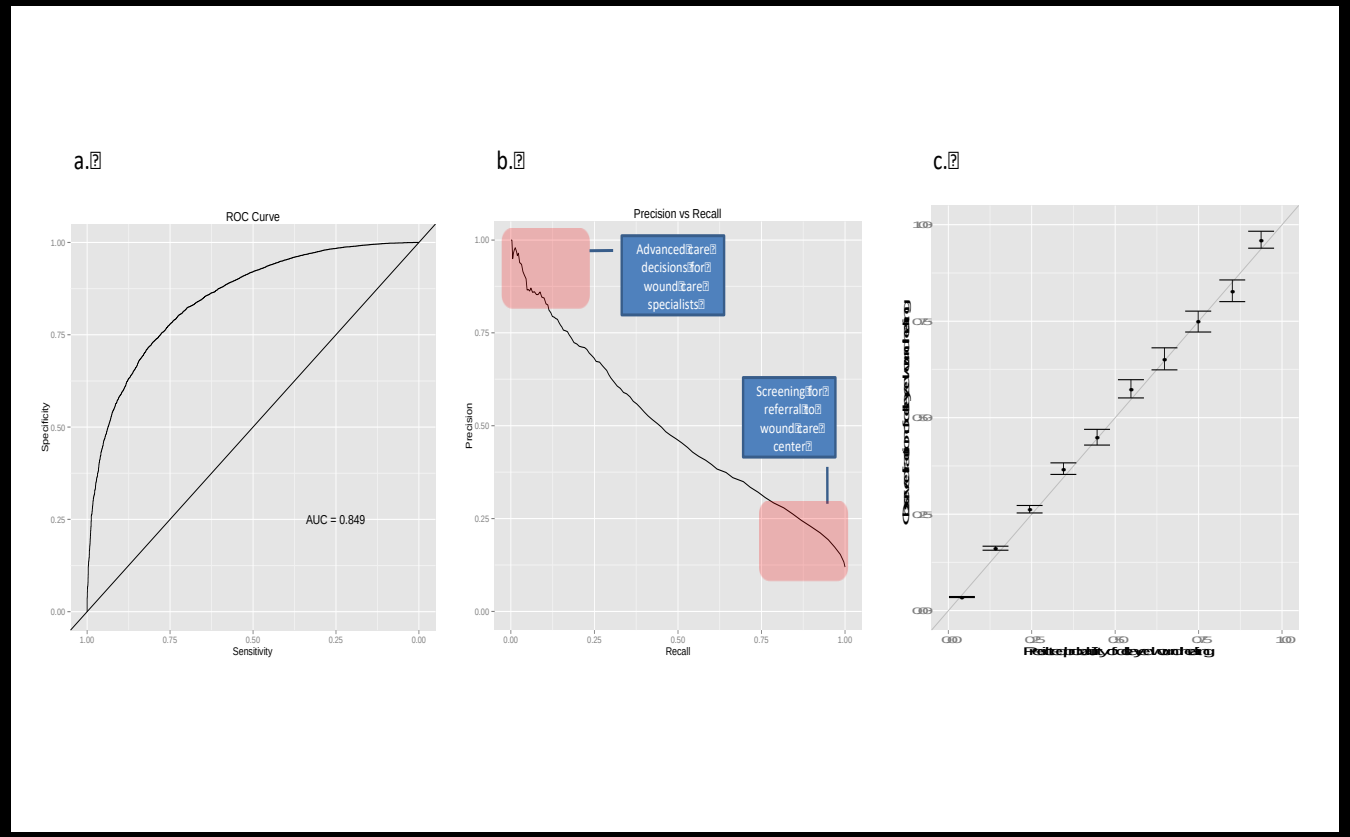
HEALOGICS/STANFORD DATA EFFORT









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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 Patien
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		

international wound journal

International Wound Journal ISSN 1742-4801

ORIGINAL ARTICLE

Surgical site infection: poor compliance with guidelines and care bundles

David J Leaper[1], Judith Tanner[2], Martin Kiernan[3], Ojan Assadian[4] & Charles E Edmiston Jr[5]

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

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THERAPEUTIC ADVANCES?

Pediatric Critical Care

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]

[a] University of Missouri Kansas City School of Medicine, Department of Obstetrics and Gynecology, Kansas City, MO, United States
[b] University 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
[c] University 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.

William J. Ennis, DO

Materials Science and Engineering C 69 (2016) 884–893

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] Di.S.Te.B.A., University of Salento, Via per Monteroni, 73100 Lecce, Italy

Eur J Clin Microbiol Infect Dis
DOI 10.1007/s10096-016-2765-y

ORIGINAL ARTICLE

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

X. Wu [1] · N. Z. Kubilay [2] · J. Ren [1] · B. Allegranzi [2] · P. Bischoff [3] · B. Zayed [2] · D. Pittet [4] · J. Li [1]

Received: 27 June 2016 / Accepted: 22 August 2016

William J. Ennis, DO

Knee Surg Sports Traumatol Arthrosc
DOI 10.1007/s00167-016-4301-0

KNEE

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

A. Schiavone Panni[1] · K. Corona[1] · M. Giulianelli[1] · G. Mazzitelli[1] · C. Del Regno[1] · M. Vasso[1]

Received: 14 June 2016 / Accepted: 23 August 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.

William J. Ennis, DO

American Journal of Infection Control ■■ (2016) ■■-■■

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.

William J. Ennis, DO

Innate Immunity

Review Article

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

Ernesto Prado Montes de Oca[1,2]

Innate Immunity
19(3) 227–241

DOI: 10.1177/1753425912460708
ini.sagepub.com
SAGE

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
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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

Original Article

SJS Scandinavian Journal of Surgery

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 $\geqslant 20$ 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.

William J. Ennis, DO

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.)

International Orthopaedics (SICOT)
DOI 10.1007/s00264-011-1274-y

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

- 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

international wound journal

International Wound Journal ISSN 1742-4801

ORIGINAL ARTICLE

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

David Brinkert [1], Mazen Ali[2], Magali Naud[3], Nicolas Maire[1], Chloé Trial[4] & Luc Téot[4]

- 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, Téot L. Negative pressure wound therapy with saline instillation: 131 patient case series. Int Wound J 2013; 10 (suppl. 1):56–60

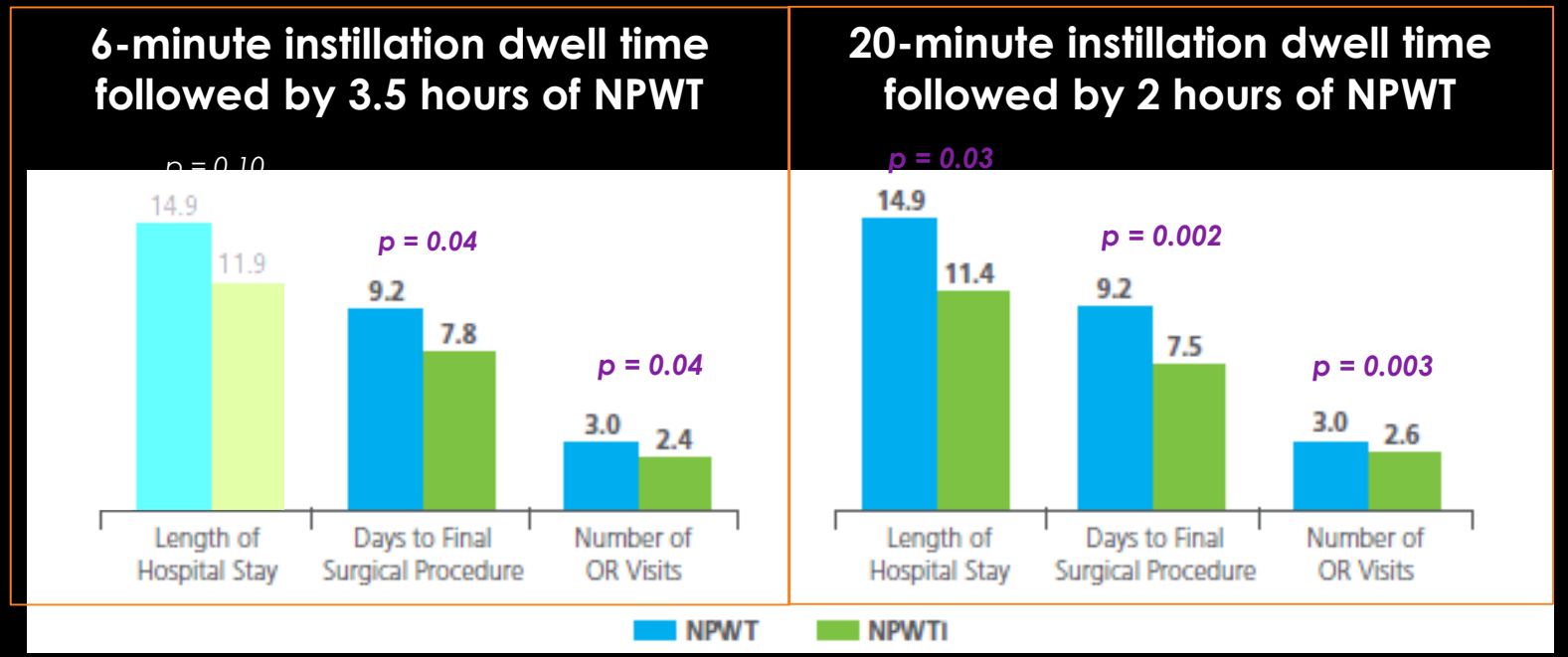
The Impact of Negative-Pressure Wound Therapy with Instillation Compared with Standard Negative-Pressure Wound Therapy: A Retrospective, Historical, Cohort, Controlled Study

- 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)*



COMES

	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

Source: Kim PJ, Attinger CE, Steinberg JS, et al. The Impact of Negative-Pressure Wound Therapy with Instillation Compared with Standard Negative-Pressure Wound Therapy on Surgical-Site Complications and Recovery in Complex Wound Surgery. 2014;133(3):709-716. doi:10.1097/01.prs.0000438060.46290.7a.

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.

(*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

William J. Ennis, DO

Photos courtesy of Dr. Brian Bradow, Peoria, Illinois

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

William J. Ennis, DO

Admission Date:
April 22, 2015

Side view of patient's LEFT shoulder

Measurements: 26x27x1.2

William J. Ennis, DO

April 24, 2015

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

Back view of left shoulder

Side view of left shoulder

William J. Ennis, DO

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

May 4, 2015

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

Facility switched to Mepitel for contact layer

Back view of left shoulder

Measurements: 25x25x0.5

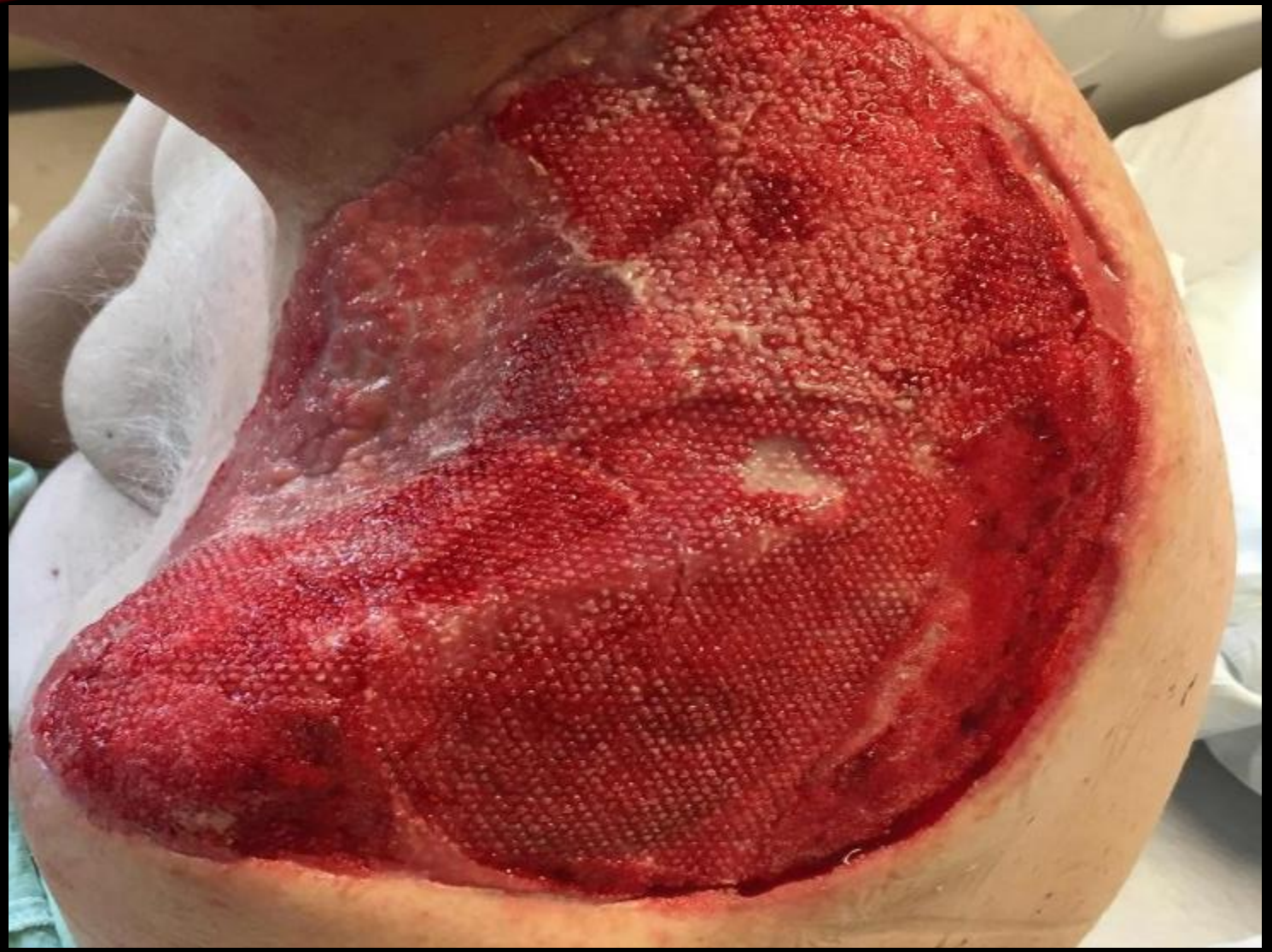
MAY 6, 2015 : Veraflo Therapy discontinued & standard VAC therapy was applied

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

William J. Ennis, DO

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

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



Side view

William J. Ennis, DO

Rear view of left shoulder

Measurements: 22.5x24x0.2

May 11, 2015

Patient discharged from LTAC;

Application of Promogran Prisma
until HHA could apply the ActiVAC

Front view of shoulder

William J. Ennis, DO

Back view of left shoulder

MAY 19, 2015

VAC therapy; Continuous at 150mmHg

Mepitel as contact layer

Measurments: 18.5x22x0.2

Side view of left shoulder

MAY 19, 2015

VAC therapy; Continuous at 150mmHg

Mepitel as contact layer

MAY 23, 2015

Side & Front views of left shoulder

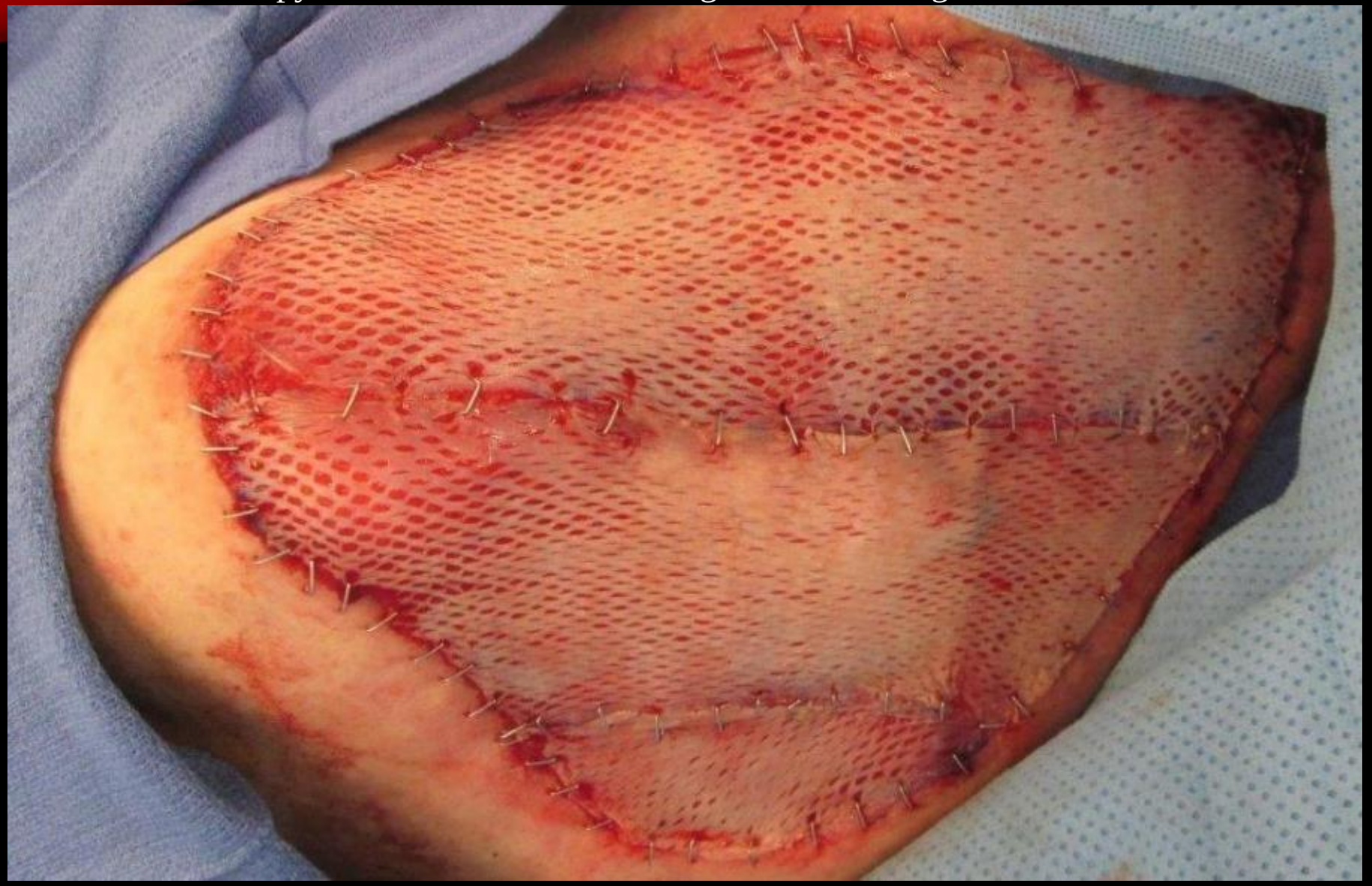
William J. Ennis, DO

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

William J. Ennis, DO

CASE MAY 26, 2016—STSG

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



William J. Ennis, DO

June 2, 2015 : Side view of shoulder

William J. Ennis, DO

June 4, 2015

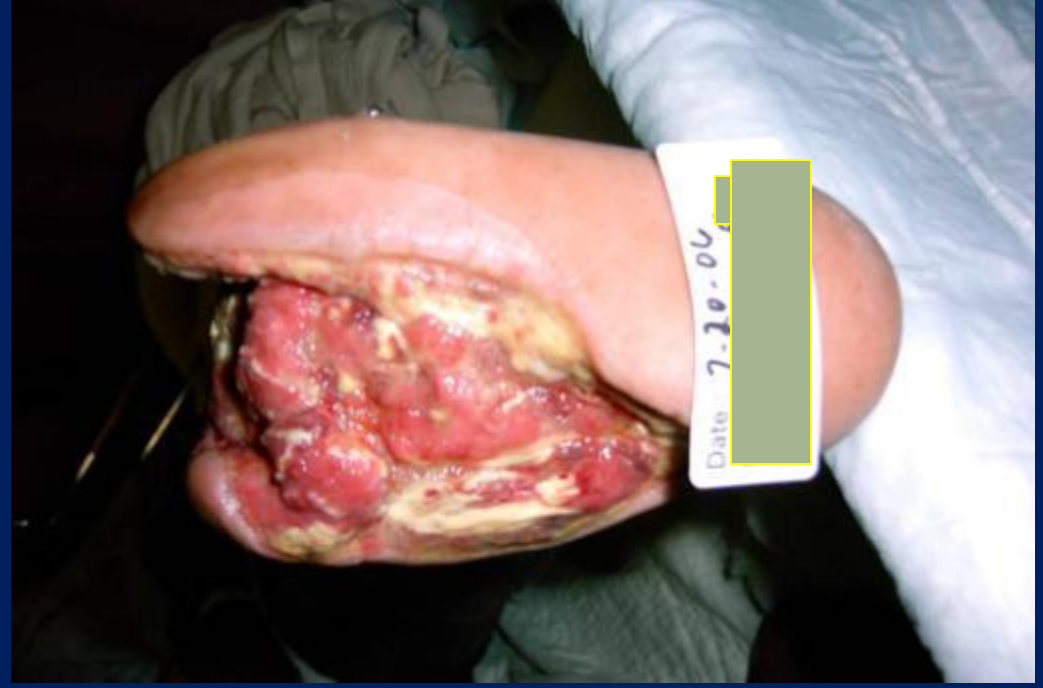
William J. Ennis, DO

PAYMENT, REGULATIONS, VALUE BASED PURCHASING, AT RISK MODELS

William J. Ennis, DO

PATIENT EDUCATION PROGRAM WITH AMERICAN COLLEGE OF SURGEONS

RESEARCH (IF TIME PERMITS)

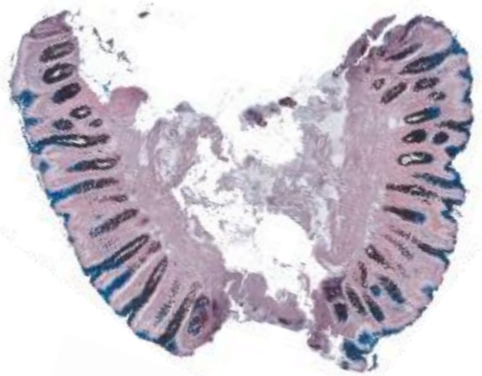



AUG 13 2007

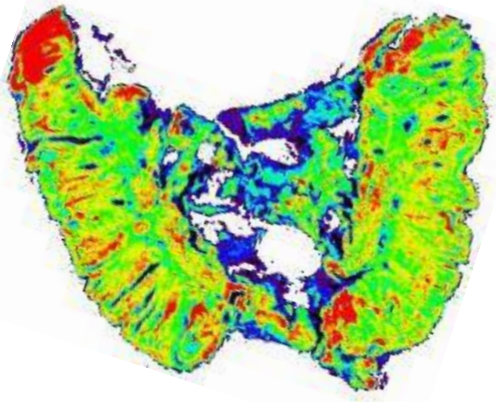
Examining Chemical and Structural Information from Tissues

Molecular and Structural Analysis

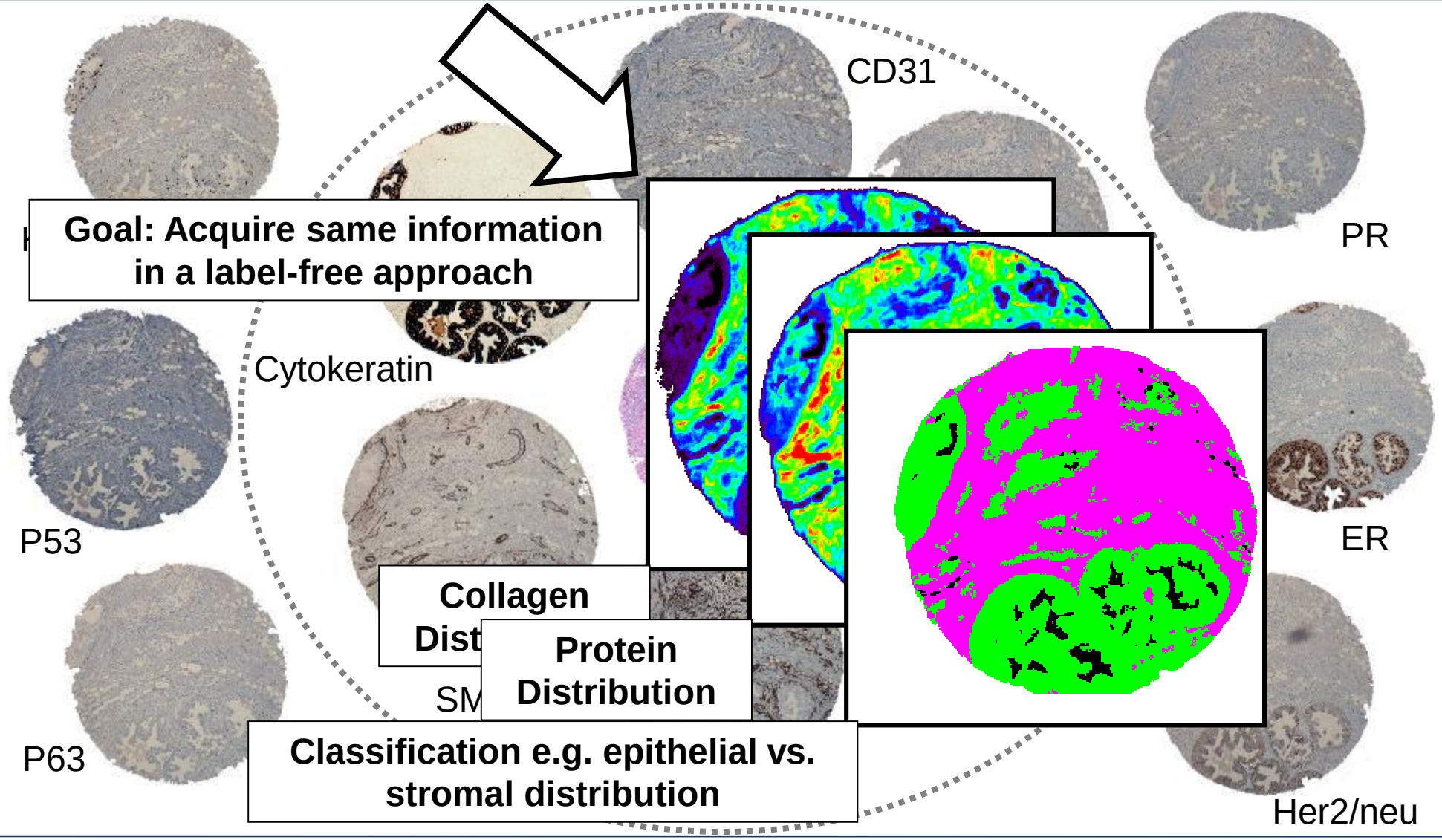
Use stains to visualize and identify molecular information



Chemical Imaging



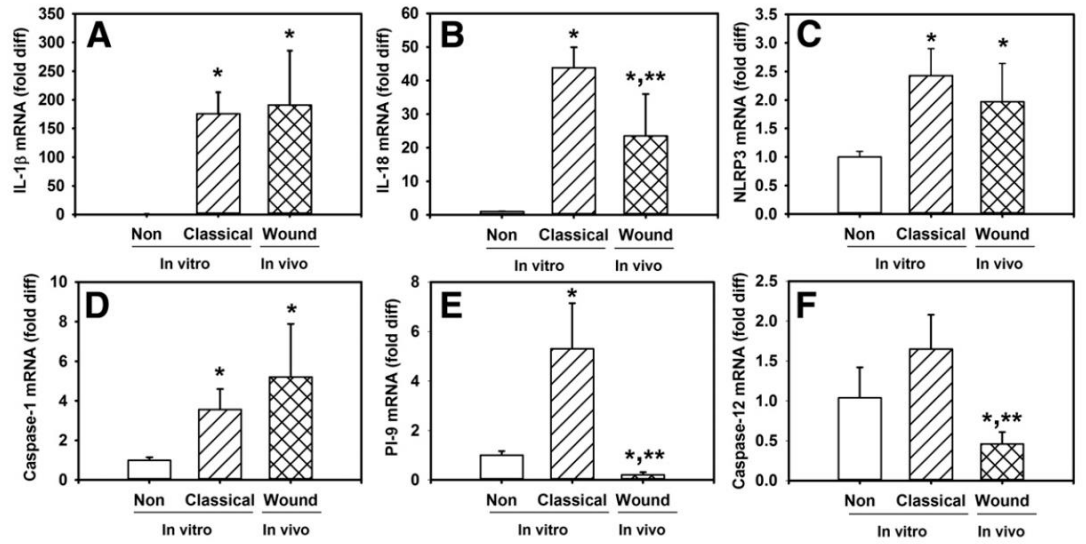
It is Critical to Segment Tissues into Key Cell Types/Components for Tissue Diagnosis



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]



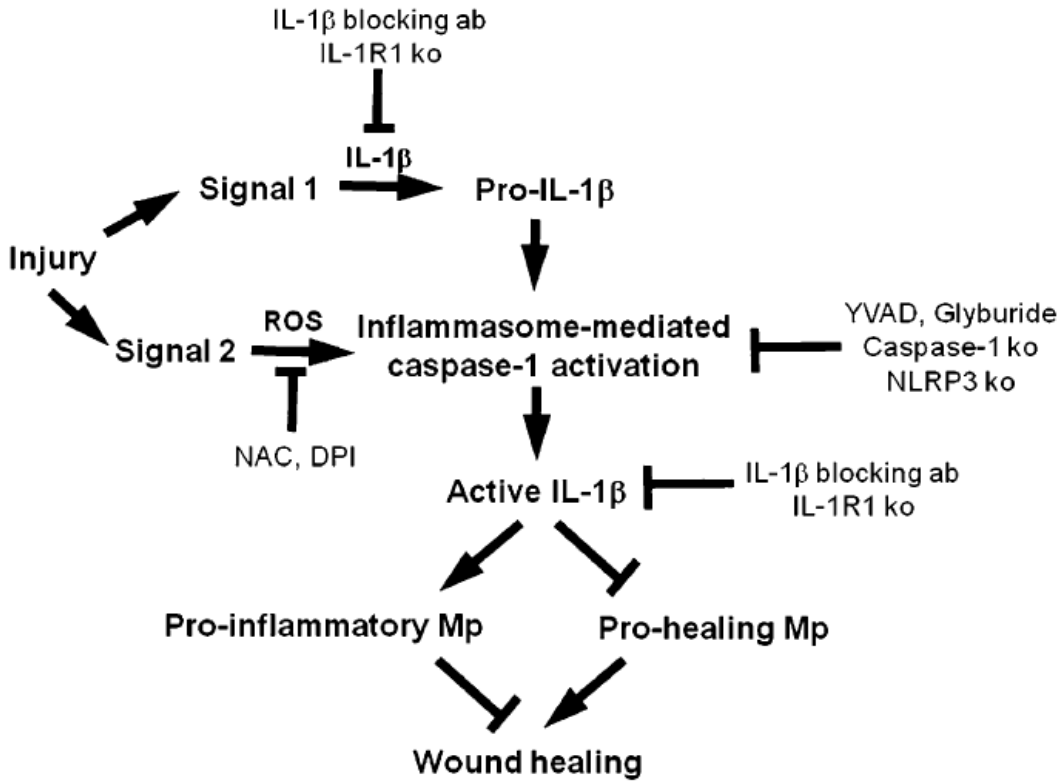


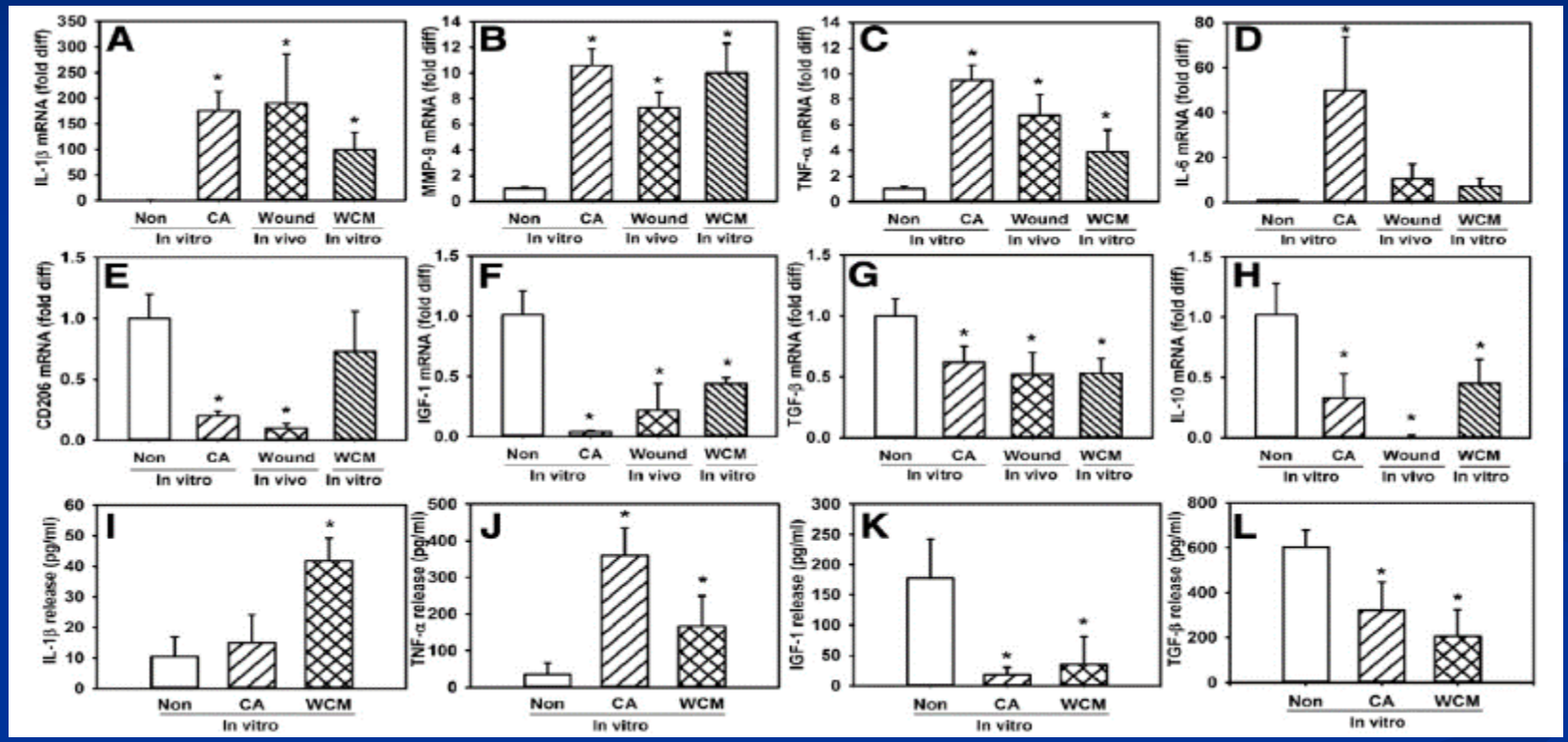
Figure 8—Model of the role of the inflammasome/IL-1β pathway in impaired wound healing in type 2 diabetes. Our data indicate that IL-1β can act as an upstream signal (signal 1) for sustaining inflammasome activity in chronic wound Mp and that ROS are involved in the second signal (signal 2) required for inflammasome activity. Since the inflammasome, in turn, activates IL-1β, this cytokine appears to be part of a proinflammatory positive-feed-back 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.

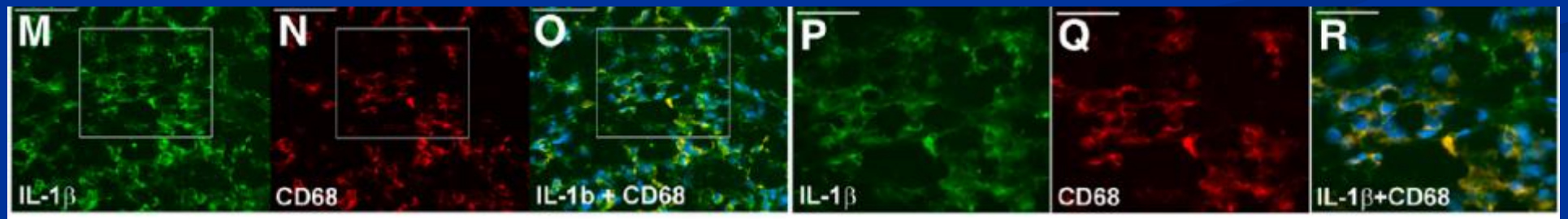
ORIGINAL ARTICLE

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

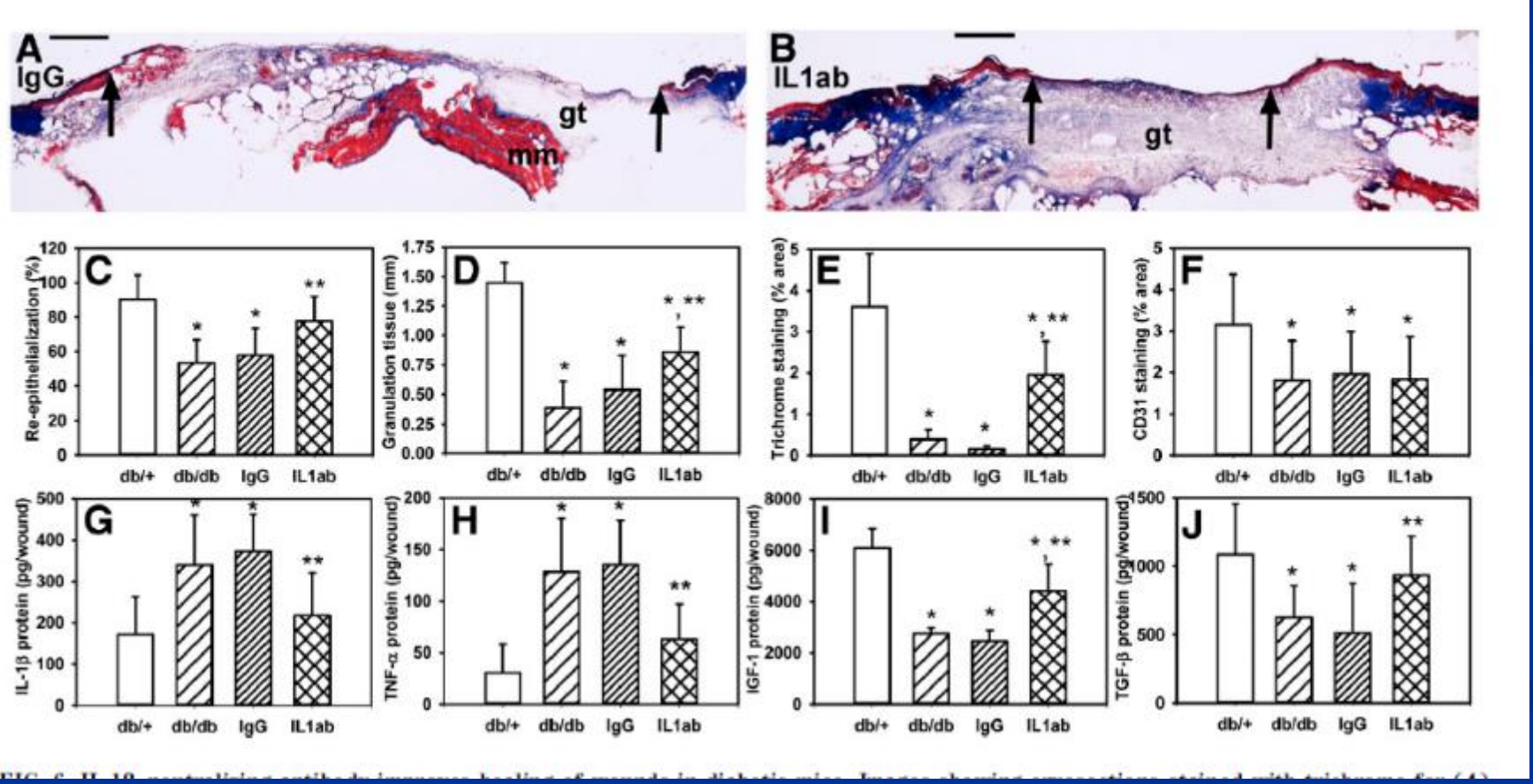
Diabetes 62:2579–2587, 2013

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



review-article

CRITICAL REVIEW

WHS Wound Healing Society

Stem Cells and Healing: Impact on Inflammation

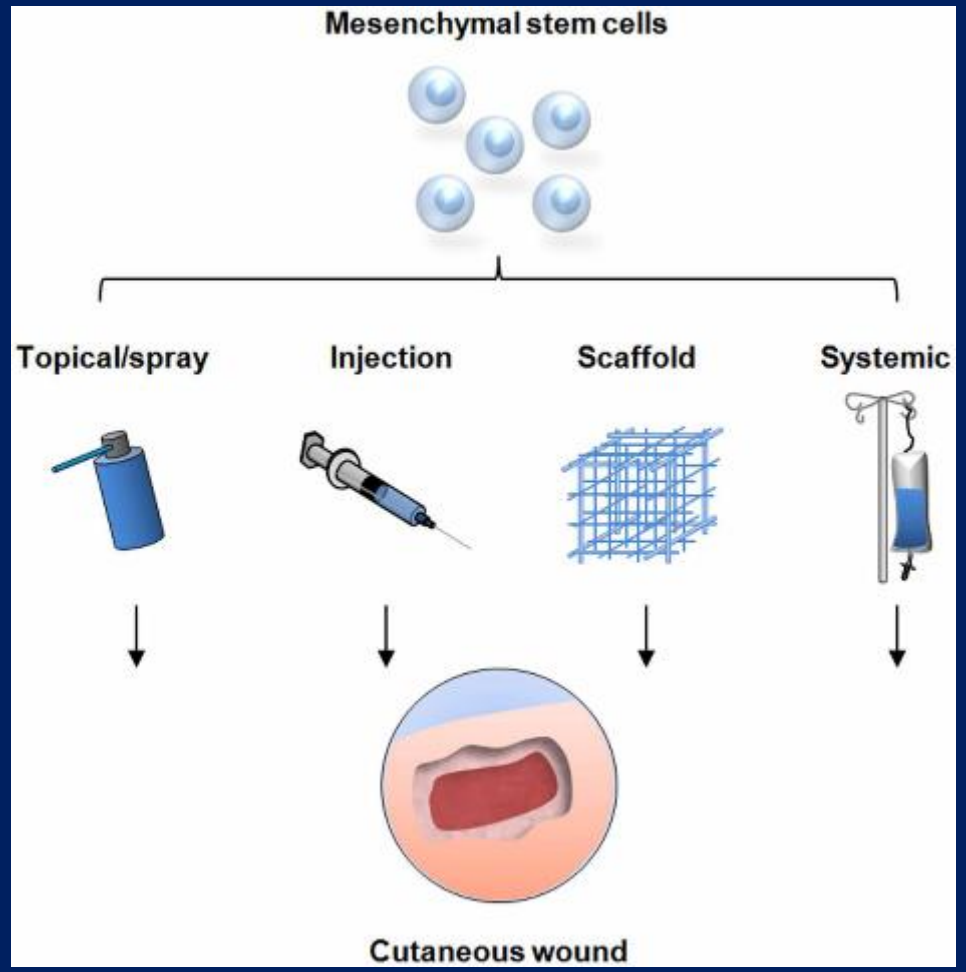
William J. Ennis,[1,2,*] Audrey Sui,[1,2] and Amelia Bartholomew[3]

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

William J. Ennis, DO, MBA

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)



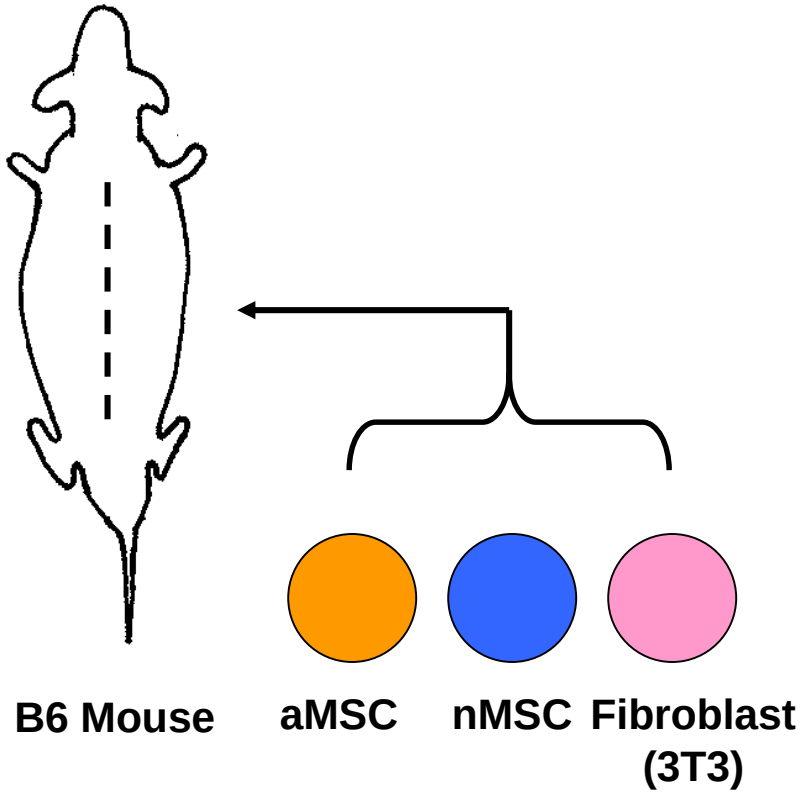
MSC Treatment and Tensile Strength

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



JOURNAL OF SURGICAL RESEARCH 181 (2013) 20–24

ELSEVIER

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,*]

[a] *Department of Surgery, University of Illinois, Chicago, Illinois*
[b] *College of Dentistry, University of Illinois, Chicago, Illinois*
[c] *Cancer Center, University of Illinois, Chicago, Illinois*

MSC and Tensile Strength

4 Treatment Groups

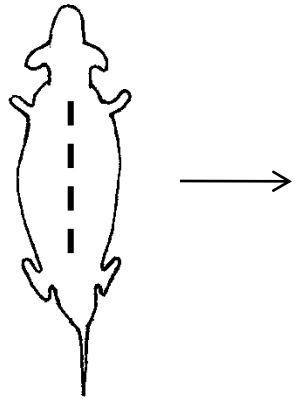
- Allogeneic aMSC (activated)
- Allogeneic nMSC(naïve)
- Fibroblast (3T3)
- Control (HBSS)

3 Cell Doses adjusted to standardized volume 200 microliters

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

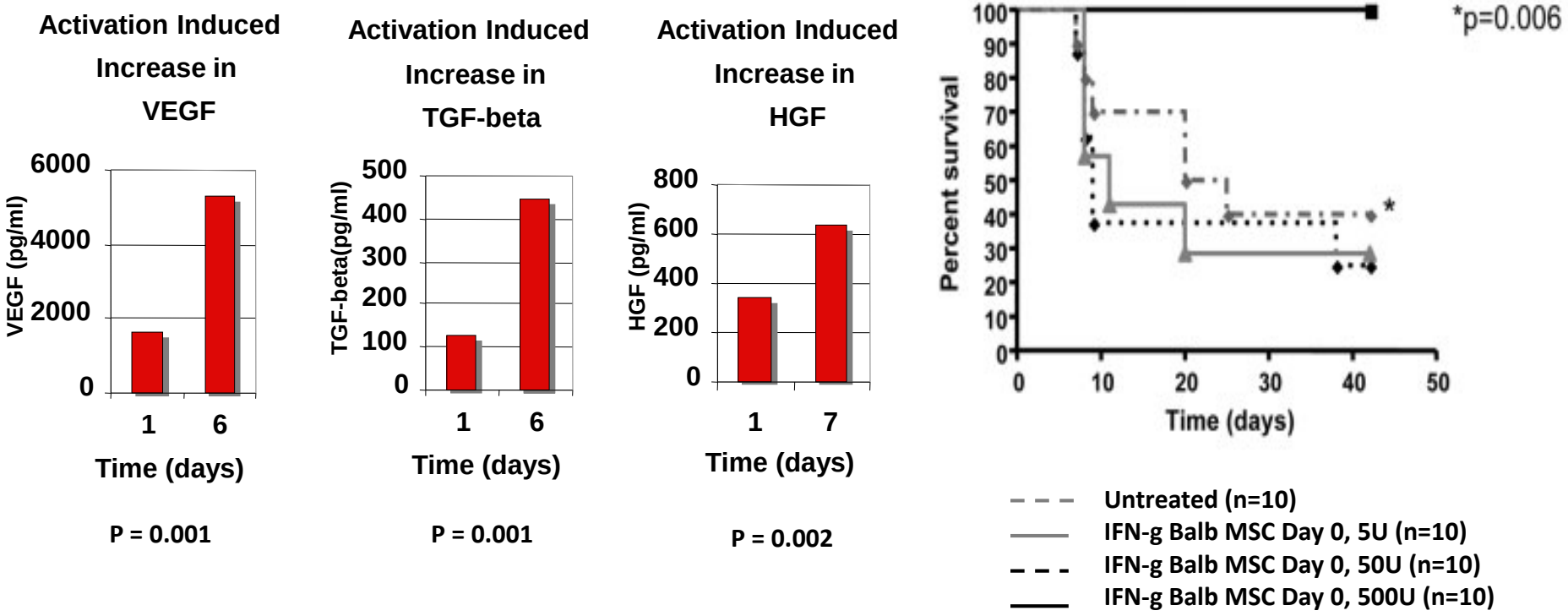
Subcutaneous injection into a 3 cm incisional wound on the dorsum of B6 mice and surgically clipped.

Day 7 - wounds excision and tensiometry



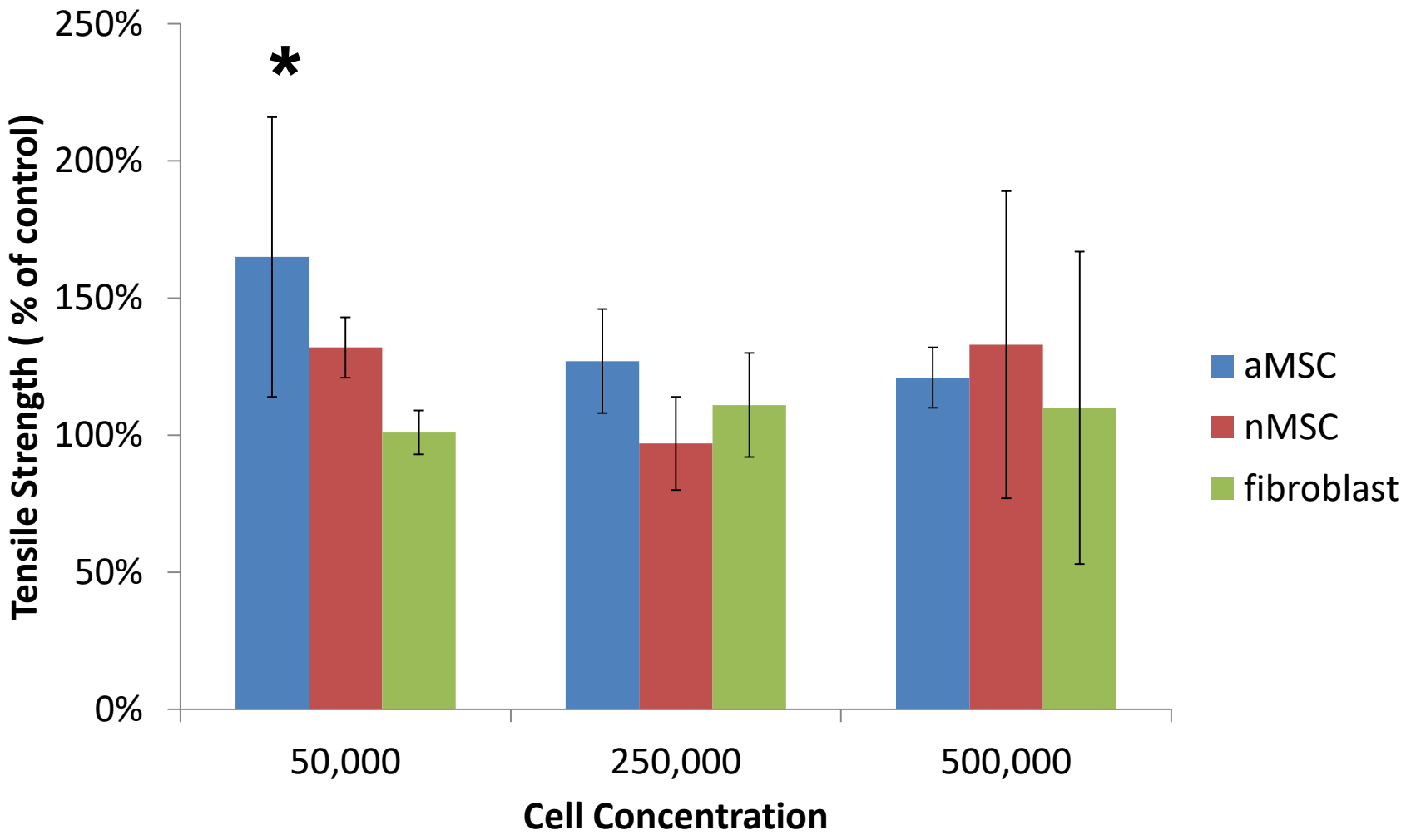
Mark -10 ESM300 Motorized Force and Torque Stand
© Mark-10 Corporation (Copiague, NY) 2010

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



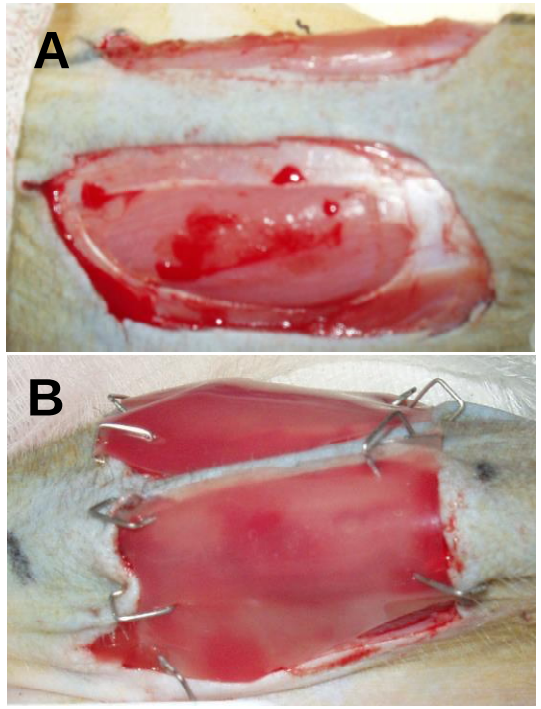
Polchert, D., et al. IFN-y activation of mesenchymal stem cells for treatment and prevention of graft versus host disease. Eur. J. Immunology 2008 38: 1745-55.

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



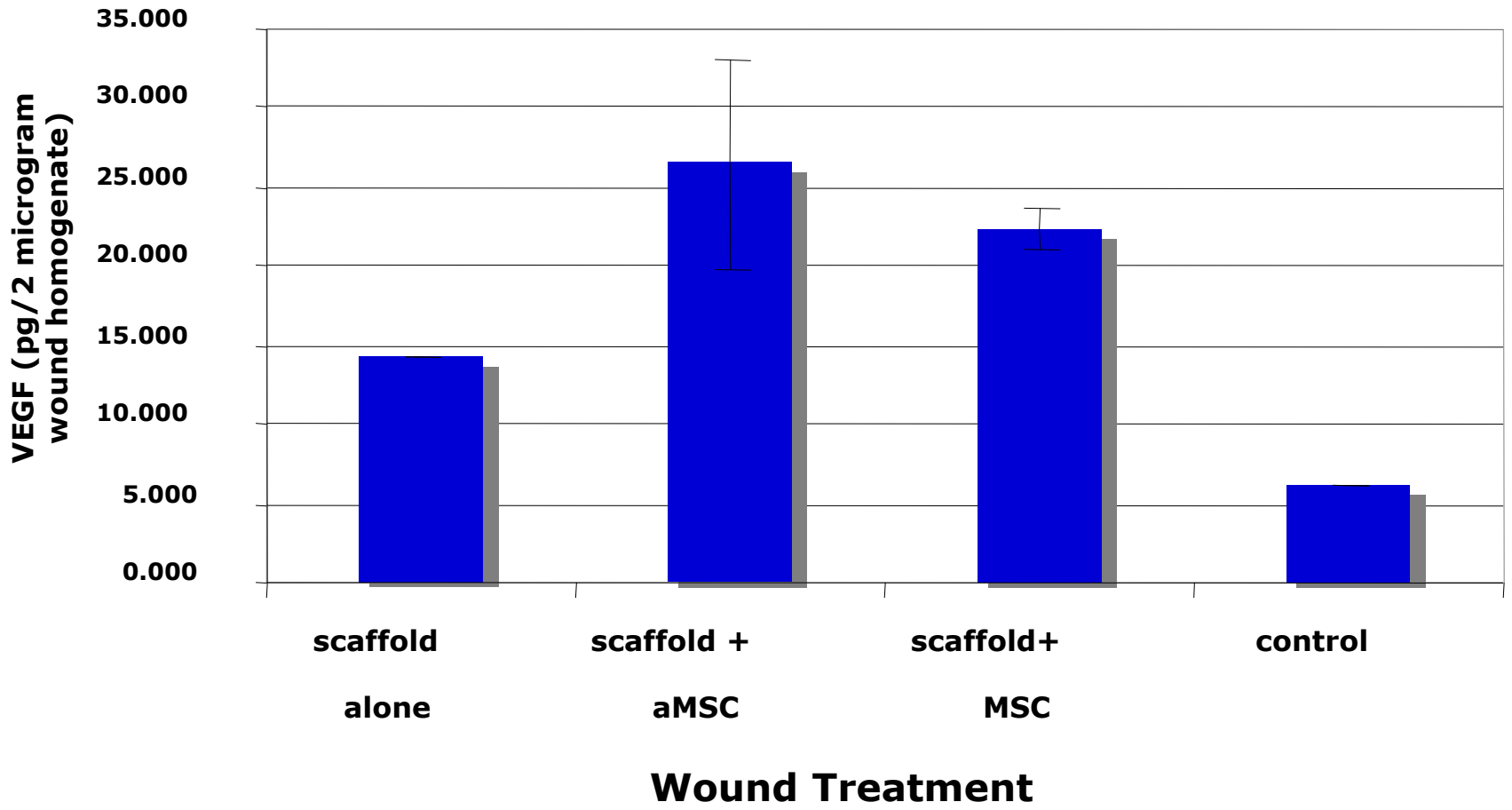
MSC Treatment and Blood Flow

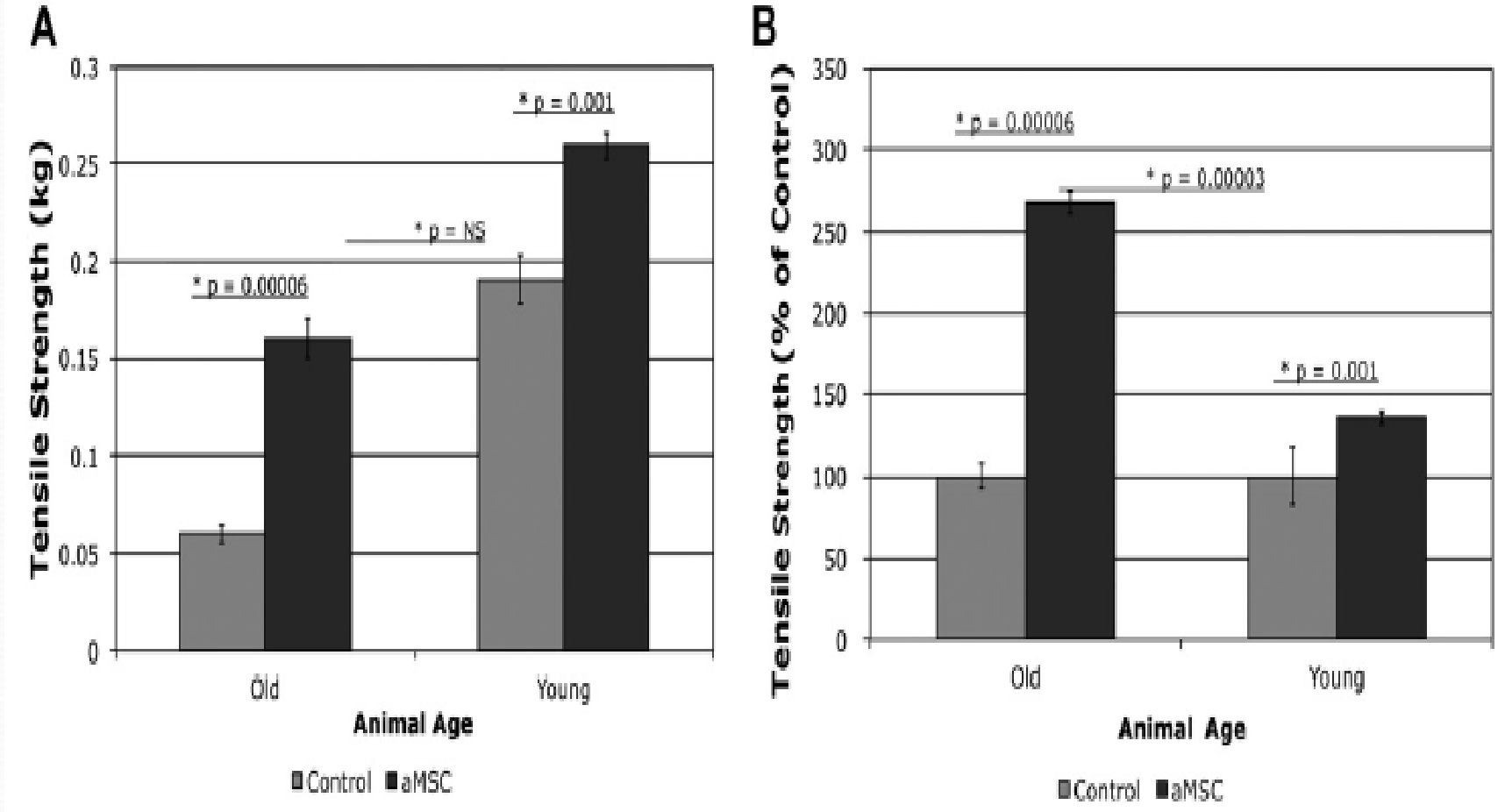
- Diabetic cynomolgus monkey model (n = 3)
- [Insert chart of different glucose readings to show hyperglycemia]
  - 4 (2 x 1 cm) wounds on lateral and medial side of the anterior femoral region
    1. Autologous aMSC with Integra
    2. Autologous nMSC with Integra
    3. Integra alone
    4. Saline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



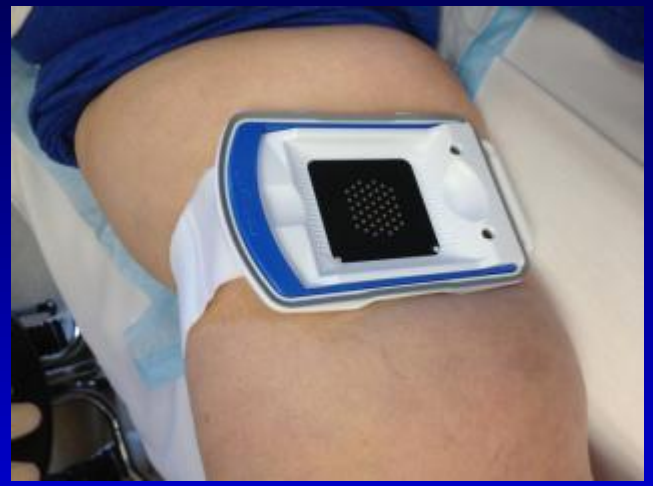
A = control excision wound
B= scaffold with MSC

Excised Nonhuman Primate Wound VEGF Content




A
Tensile Strength (kg)
0.3
0.25
0.2
0.15
0.1
0.05
0
* p = 0.001
* p = NS
* p = 0.00006
Old
Young
Animal Age
Control
aMSC
B
Tensile Strength (% of Control)
350
300
250
200
150
100
50
0
* p = 0.00006
* p = 0.00003
* p = 0.001
Old
Young
Animal Age
Control
aMSC

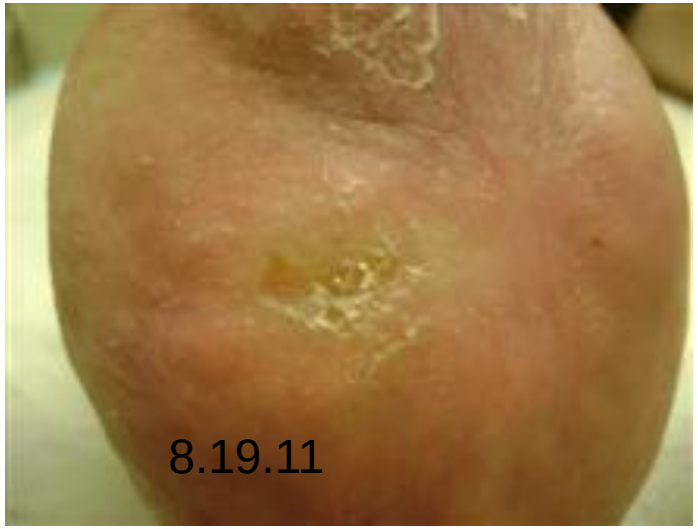
WR 3.15.13




6.30.11


6.27.11


7.18.11


8.19.11

OPEN ACCESS Freely available online

PLOS ONE

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

Eileen M. Weinheimer-Haus[1,2], Stefan Judex[4], William J. Ennis[2,3], Timothy J. Koh[1,2]*

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

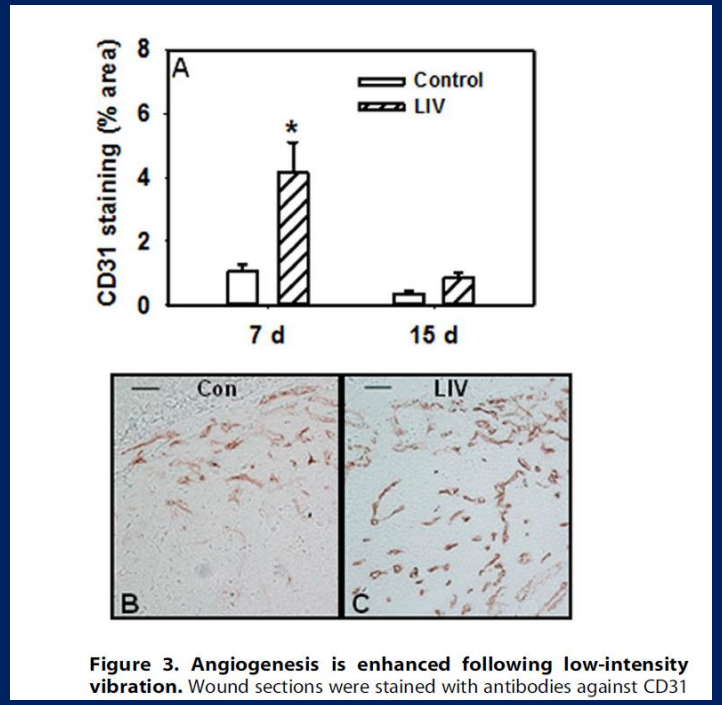
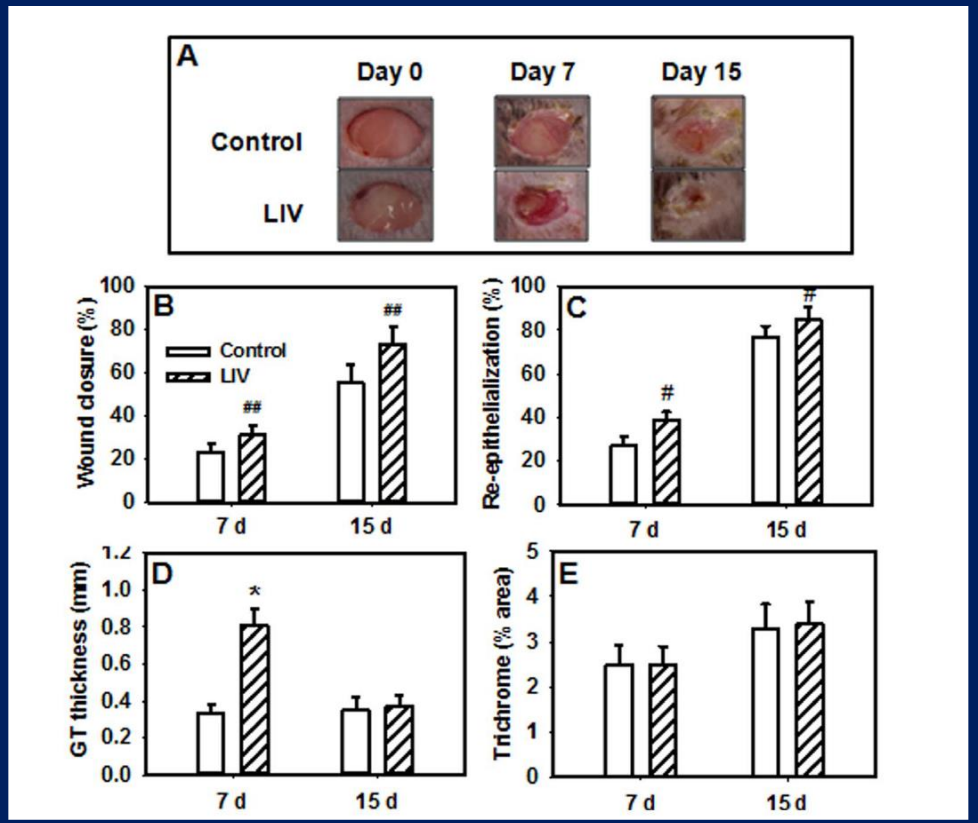


Figure 3. Angiogenesis is enhanced following low-intensity vibration. Wound sections were stained with antibodies against CD31



QUESTIONS/SUMMARY

William J. Ennis, DO