

# The Wound VAC: The Hoover of healing

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# Overview

- Background on wounds
- Biology of wound healing
- Deterrents and aids to wound healing
- Science behind Wound VAC
- Clinic studies supporting Wound VAC

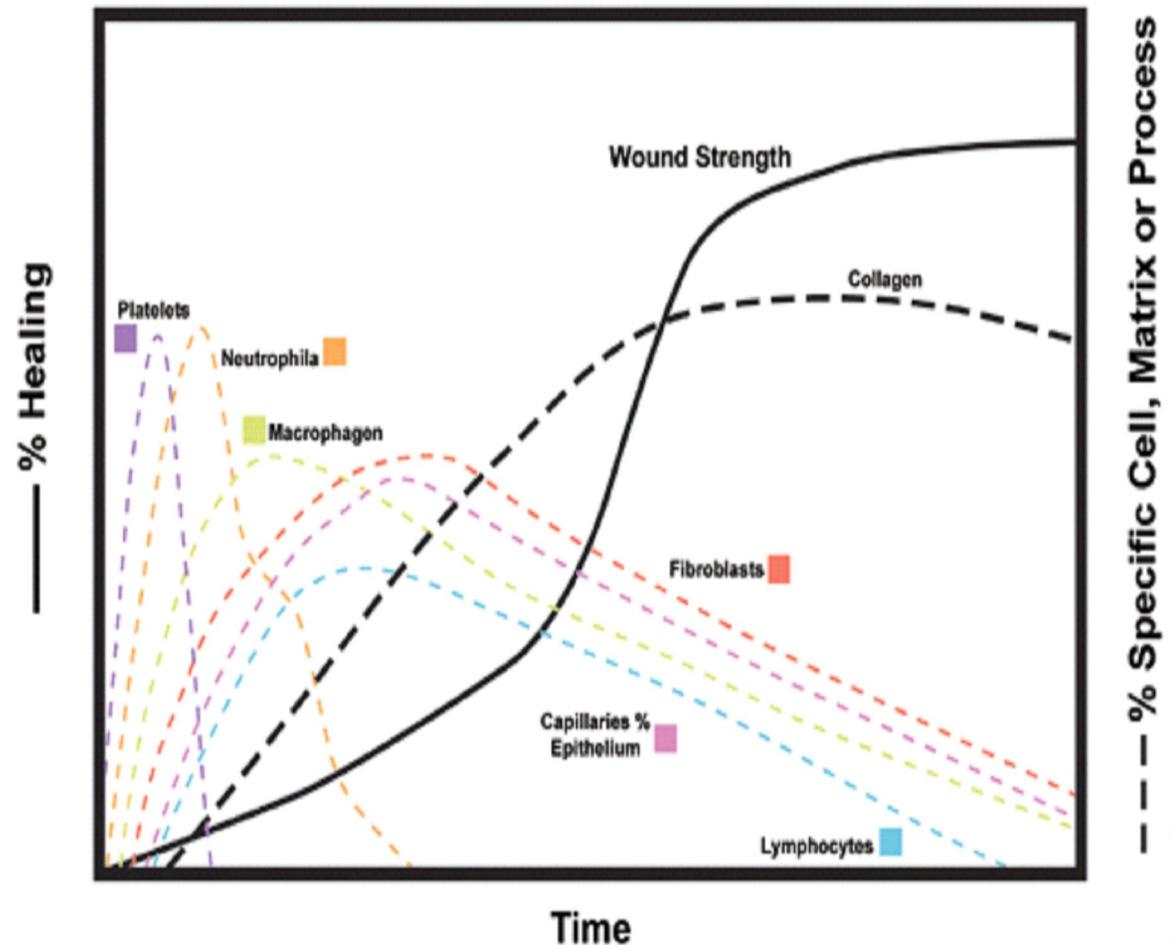
# Why are wounds relevant?

- Wounds are a significant burden
- Chronic wounds alone affect:  
**over 5 million patients**
- Cost of wound:  
**20 billion dollars a year**

# Biology of Wound Healing

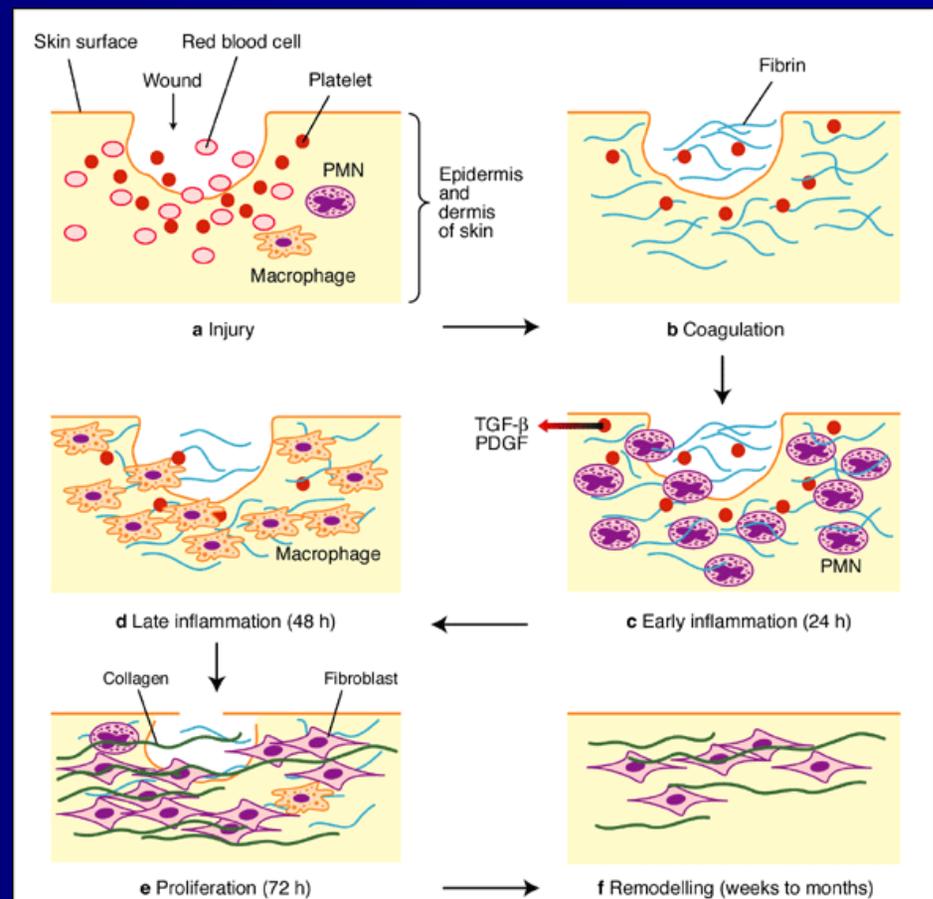
Wound healing phases

- Inflammatory
- Proliferative
- Remodeling



# Inflammatory Stage

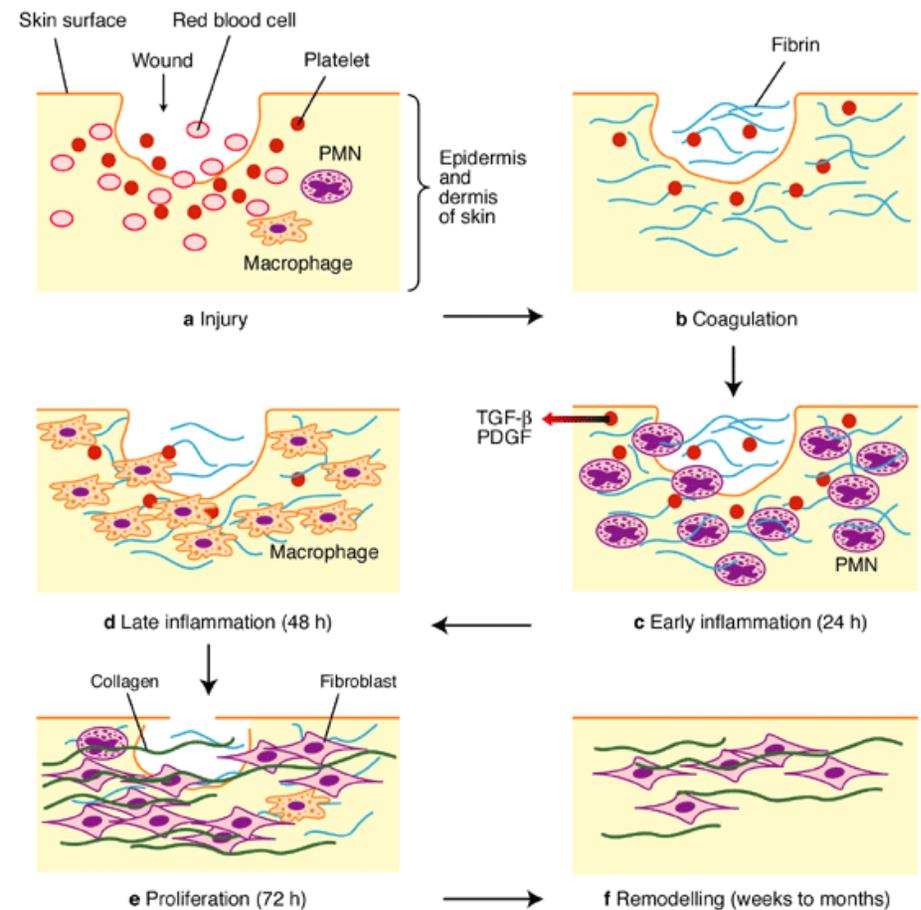
- Days 0-4
- Starts with **Hemostasis**
  - platelets dominate
- Then on to **Inflammation**
  - Leukocytes and macrophages dominate



The phases of cutaneous wound healing

# Proliferative phase

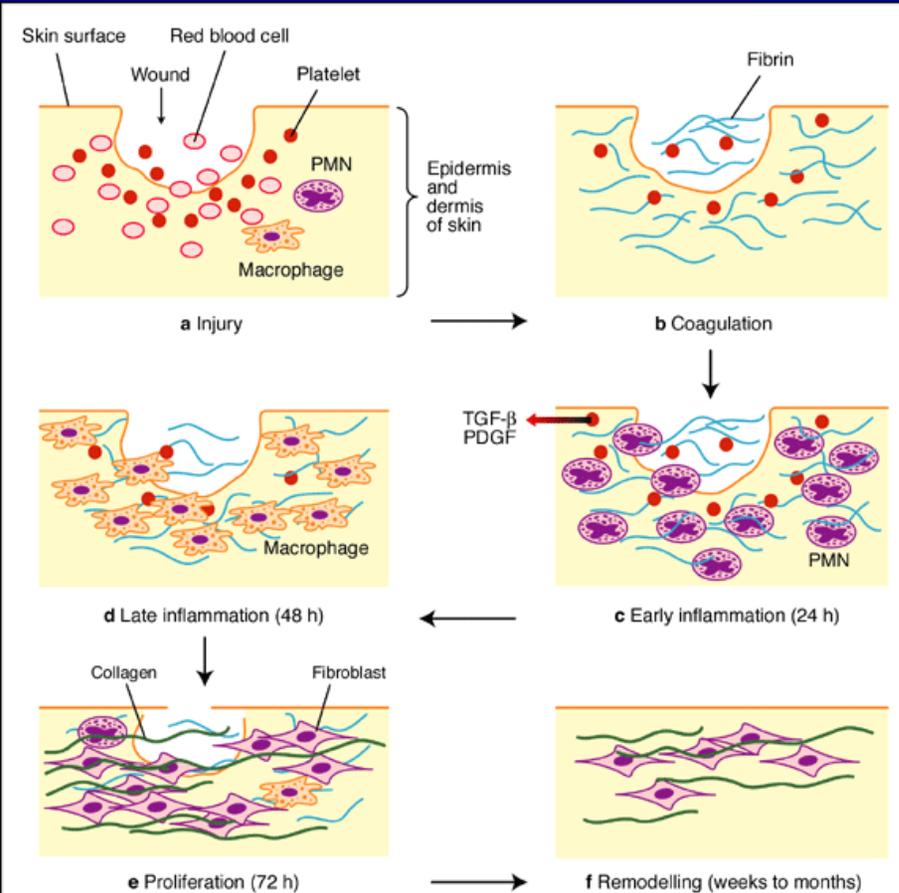
- Days 3-14
- Fibroblasts dominant cell type



The phases of cutaneous wound healing

# Maturation phase

- Days 14 onwards
- Collagen crosslinking and reorganization
- Fibroblasts differentiate into Myofibroblast



The phases of cutaneous wound healing

# Barriers to wound healing

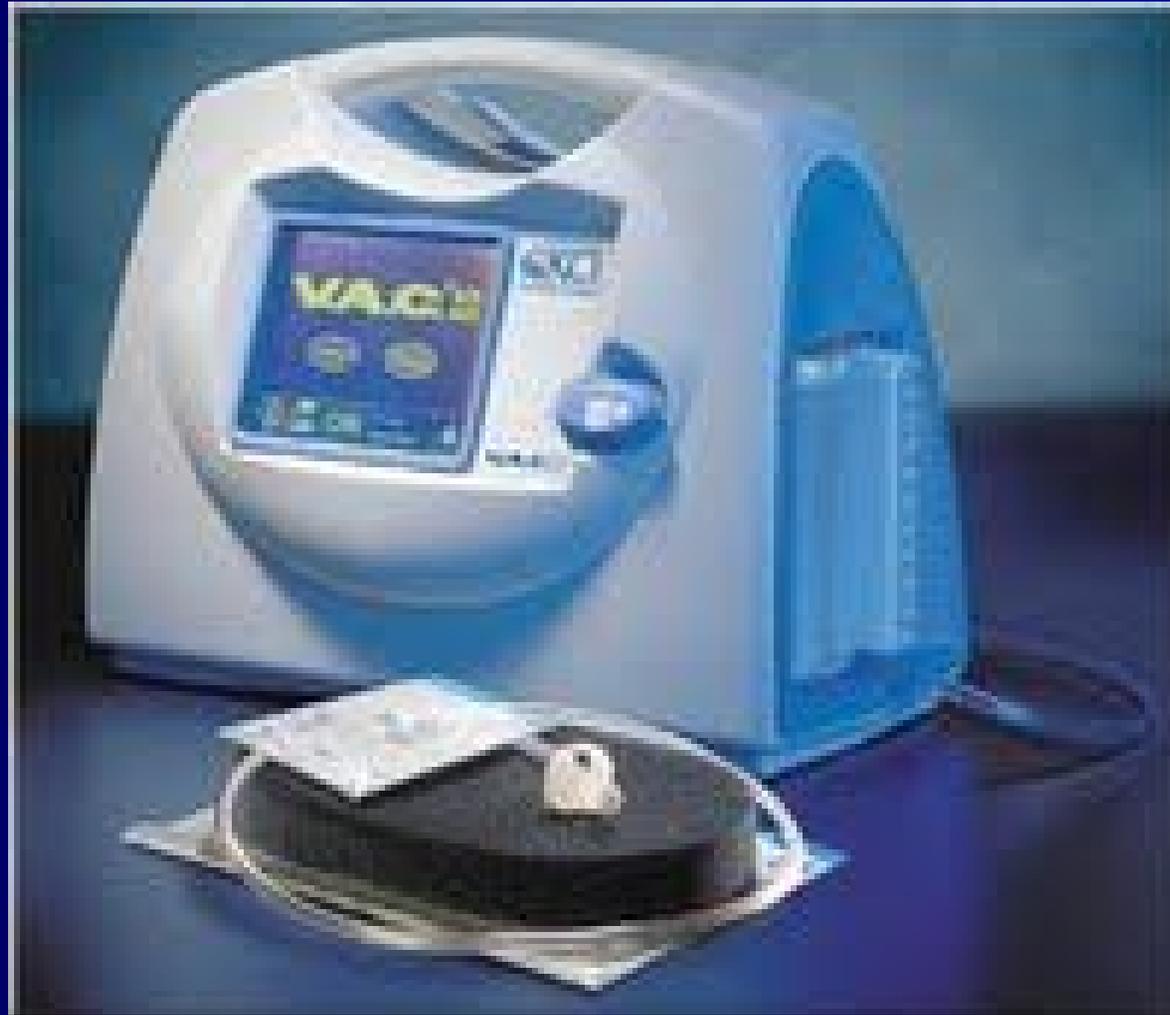
- Infection
  - 100,000 bacteria per gram tissue
- Excess edema or excess dryness
- Poor blood flow
  - Hypoxia due to smoking or disease

# Healing optimization

- Clean and protected environment
- Perfused
  - Tissues getting cells and oxygen
- Moist environment
- Minimize exudate and edema

What can do all this??

# WOUND VAC !!



# The Wound VAC!!

Negative pressure wound therapy NPWT  
Topical Negative Pressure TNP

How it works:

- Polyurethane Foam is placed in wound bed, sealed with occlusive dressing
- Evacuation tube embedded in foam dressing
- Applies localized negative pressure



# Why it works

## Primary effect

- Contraction of wound
- Stabilization of wound
- Removal of extracellular fluid

## Secondary effects

- Increase in blood flow
- Increase granulation tissue
- Increase compliance due to fewer dressing changes

# Basic science research

- Pig model
- On each animal wound treated with V.A.C. compared to Sterile Saline gauze



Morykwas MJ, V.A.C: a new method for wound control and treatment: animal studies and basic foundation. *Ann Plast Surg.* 1997;38(6):553-562

# Basic science research

- Blood flow levels increased **fourfold** when 125 mmHg subatmospheric pressure used
- Significantly **increased rate of granulation tissue** formation occurred with NPWT
- Tissue bacterial counts significantly **decreased** after 4 days of application

Morykwas MJ, V.A.C: a new method for wound control and treatment: animal studies and basic foundation. *Ann Plast Surg.* 1997;38(6):553-562

# Basic science research

- 32 Japanese large-ear white rabbits.
- Left ears were treated with negative pressure wound therapy
- Right ears (control group) treated with petrolatum gauze



Chen SZ: Effects of VAC on wound microcirculation: an experimental study,  
*Asian J Surg* 2005, 28(3):211-7

# Basic science research

- VAC promoted
  - capillary blood flow velocity
  - increased capillary caliber and blood volume
  - stimulated endothelial proliferation and angiogenesis



Chen SZ: Effects of VAC on wound microcirculation: an experimental study,  
*Asian J Surg* 2005, 28(3):211-7

# Clinical Studies

- 1997 study of 300 patients
  - 175 chronic wounds
  - 94 sub acute wounds
  - 31 acute wounds
- Findings:
  - 296 wounds responded to VAC treatment
  - VAC removed chronic edema
  - Enhanced formation of granulation tissue

Argenta LC. V.A.C: a new method for wound control and treatment: clinical experience.  
Ann Plast Surg 1997;38:563-76.

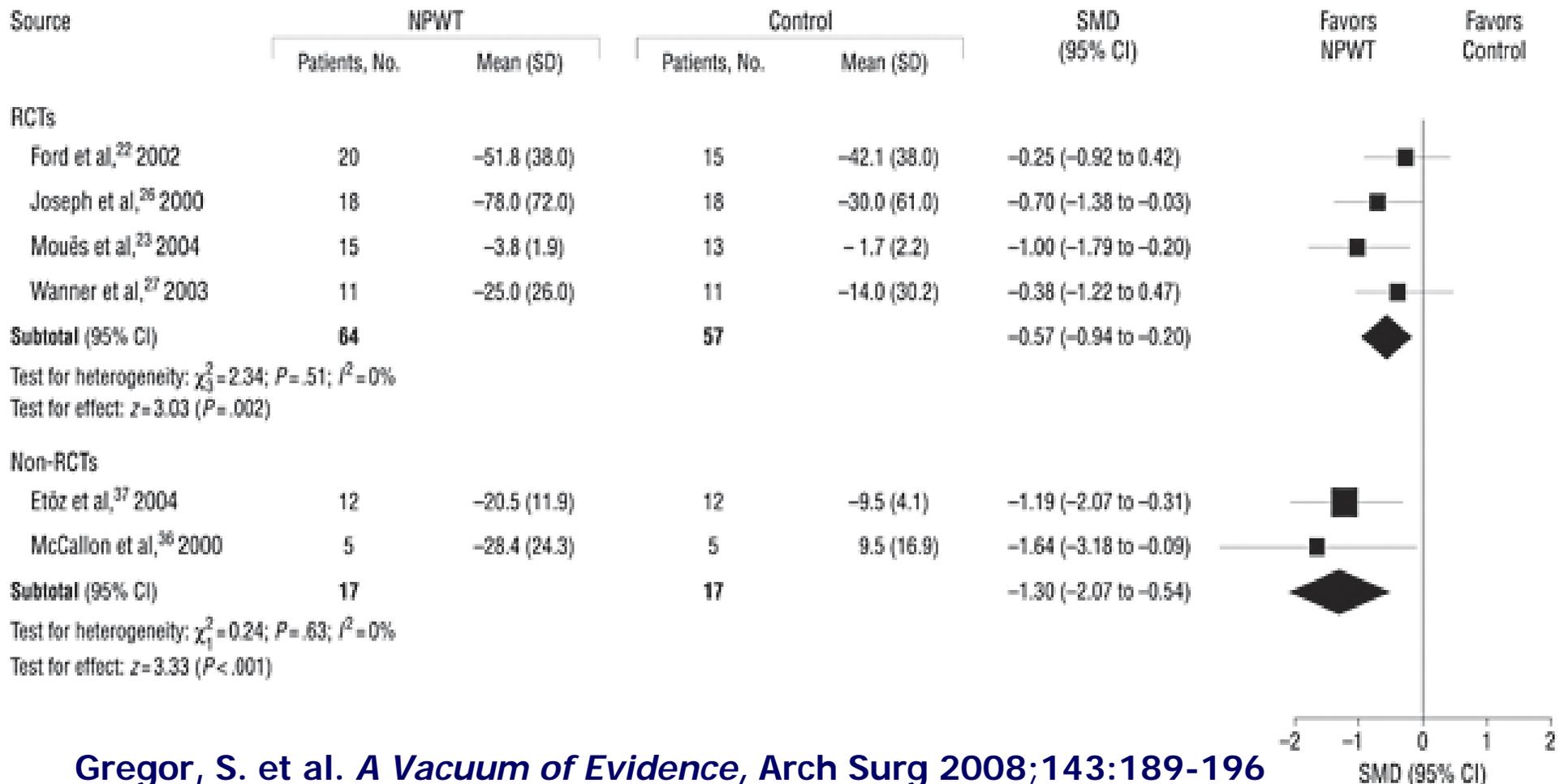
# Clinical studies

- Retrospective study looking at 42 patients
- Variety of wounds
  - Sternal
  - Spinal
  - Lower extremity

# Results

- Sternal wounds:
  - All 12 patients with after CABG closed by 4 weeks, with average of 12 days
- Lower extremity wounds:
  - 13 patients/14 patients responded to therapy

# Clinical evidence: Decrease in wound size



Gregor, S. et al. *A Vacuum of Evidence*, Arch Surg 2008;143:189-196

# Comparison Study

Braakenburg's study

## Conventional

- Daily dressing
- Increases in nursing interventions
- Increased discomfort for patients
- Increase length of hospital stay

## VAC

- 3 times a week
- Lower nursing staff costs
- Overall, Pts more comfortable
- Decrease length of hospital stay
- Faster wound healing in patients with **Diabetics and Cardiovascular disease**

# Sternal infections

- Retrospective analysis of sternal wound infection
- 68 cases
  - 35 patients could be allocated to the vacuum group and
  - 33 patients to the conventional group wet to dry.

Fuchs, U. Clinical Outcome of Patients With Deep Sternal Wound Infection Managed by VAC Compared to Conventional Therapy

With Open Packing: [The Annals of Thoracic Surgery](#) Volume 79, Issue 2, February 2005, Pages 526-531

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# Sternal infections

## End points

- Time interval from sternal infection until freedom of microbiological cultures
- In-hospital stay
- Sternal status at discharge
- Survival rates

Fuchs, U. Clinical Outcome of Patients With Deep Sternal Wound Infection Managed by VAC Compared to Conventional Therapy With Open Packing: [The Annals of Thoracic Surgery](#) Volume 79, Issue 2, February 2005,

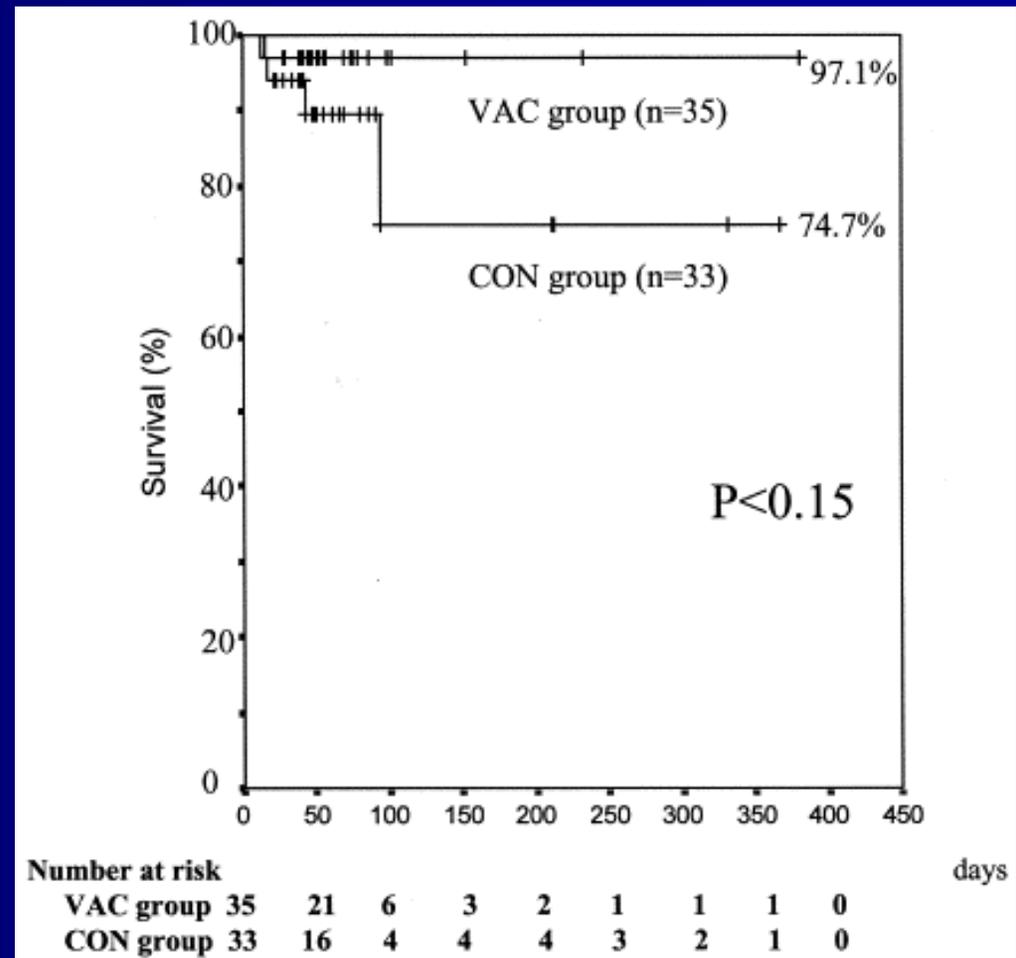
Pages 526-531  
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# Sternal infections

	Conventional dressings	VAC	
Wound healing	28 days	21 days	$p > 0.05$
in-hospital stay	25 days	34 days	$p < 0.01$
d/c with an open sternum	21 out of the 33 patients	10 out of the 35 patients	$p < 0.01$

# Sternal infections

- Survival rate  
97% vs 74%



# Clinical study

## Diabetes

- Randomized control study Diabetic foot amputation wound
- 24 patients assigned to NPWT or standard wound dressing
- End point was time in reaching 90% of wound granulation.
- RESULTS:
  - VAC 18.8 +/- 6 days
  - Standard wound care 32.2 +/- 13.7versus
- Statistically significant difference (P=0.007).

# efficacy



# Contraindications to VAC

- Necrotic tissue
- Cancer in wound
- Fistulas
- Not on blood vessels

# Thoughts on the Future

- Health care cost
- Use in emergencies

# Cost

## Vuerstaek's study

	Conventional n=30	VAC n=30
VAC cost	0	847
Bandage dressing	4770	2391
Personnel	508	583
Nurse	175	124
<b>Total</b>	<b>5452</b>	<b>3881</b>

P=.001

# Cost

- Compared VAC to wet to dry dressing.
- VAC had higher material costs.
- VAC had **lower** number of time-consuming dressing changes
- VAC had **shorter** duration of therapy
- Thus VAC and wet to dry therapy being equally as expensive

# Thoughts on the Future of VAC

- Health care cost
- Use in emergencies

# Trauma

- 88 high-energy soft tissue wounds identified in 77 patients in Balad Iraq
- Patients treated initially with debridement and wound vac placement
- Patients then underwent serial surgical debridement and wound VAC changes
- **The wound infection rate was 0% and the overall wound complication rate was 0%. All patients survived and were discharge with closed wounds**

Leininger BE, Experience with wound VAC and DPC of contaminated soft tissue injuries in Iraq. *J Trauma*. 2006;61(5):1207-11

NOT KCI

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# Go Steelers!

