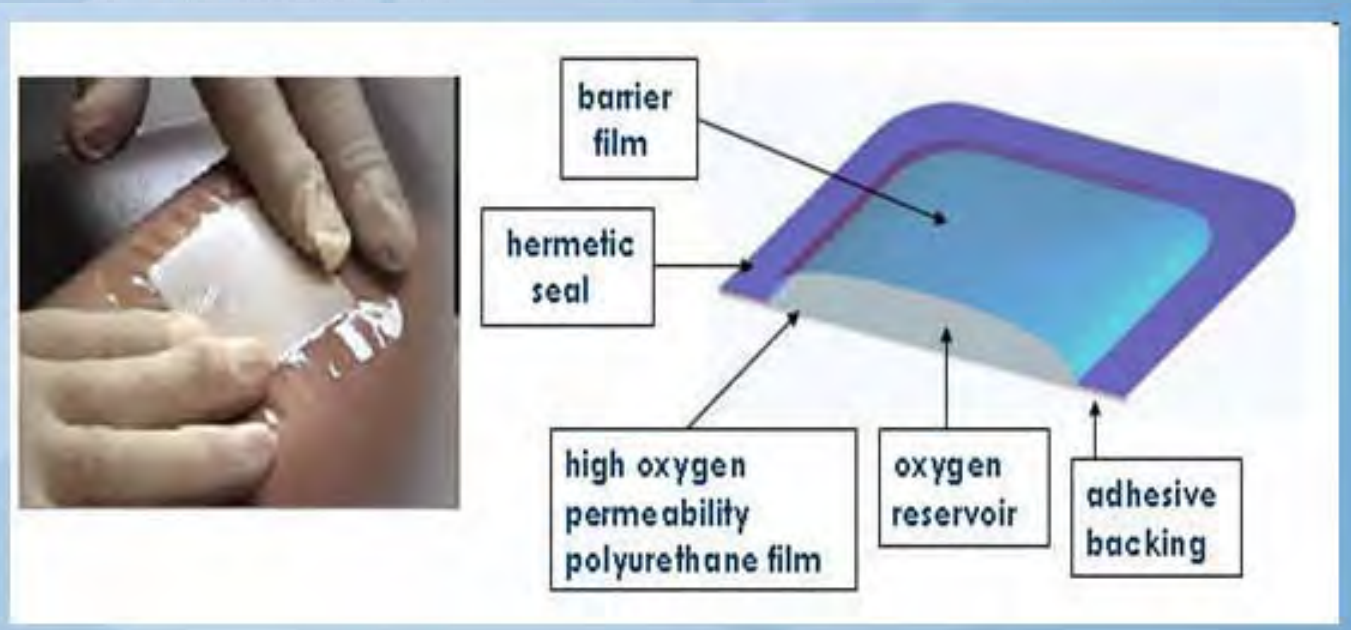
The OxyBand Transdermal Oxygen System

- Transdermal Drug Delivery Patch containing O2
- O2 diffuses across high permeability film, saturates the wound fluid, provides continuous supply
- Feel of conventional dressings or transdermal patch



WebCME

OxyBand
How Does it Work?

- A therapeutic advanced oxygen reservoir device with the capability of delivering sustained oxygen substrate for an extended period of time (up to 5 days) to enhance the wound microenvironment and the benefit is achieved with a single application.
- OxyBand is applied over the wound and provides medical grade oxygen from the reservoir to the wound.
- Oxygen diffuses across a permeable membrane and is occluded from escaping into the atmosphere.

WebCME

Chronic Wounds & Hypoxia

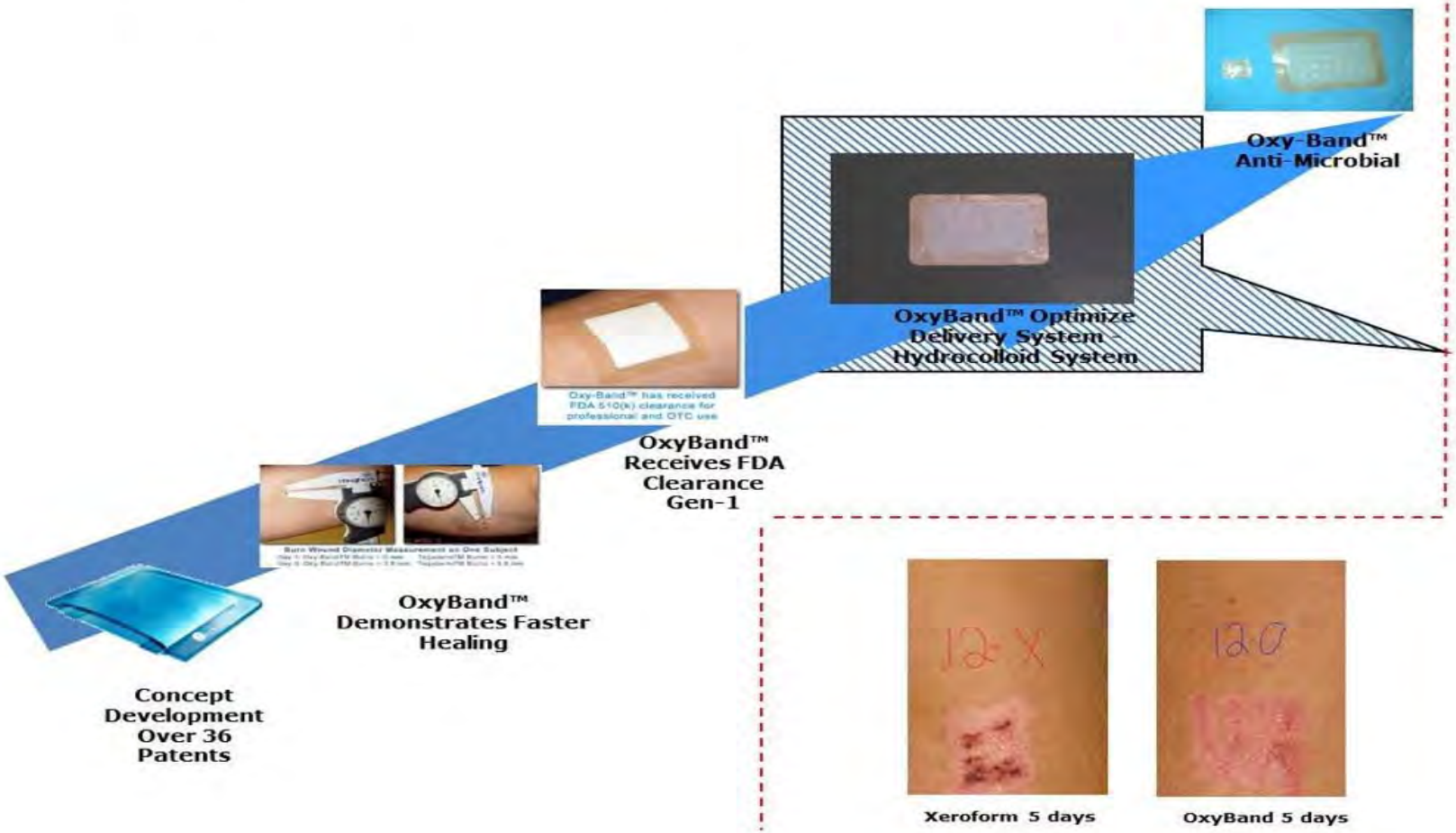
- Chronic wounds are thought to fail to progress through the phases of healing in an orderly and timely fashion due to one or more defects in the healing cascade, including excessive bio burden, uncontrolled inflammation, the presence of stagnant or senescent cells, the lack of essential cytokines or metabolic factors, and inadequate tissue perfusion resulting in tissue hypoxia and deficient oxygen substrate.
- The ability to improve tissue oxygenation in chronic wounds hastens healing. Oxygen enhances white cell bacterial killing and bio burden reduction, stimulates cellular metabolic activity, enhances angiogenesis and promotes fibroblast and epithelia cell proliferation.

- Jeffrey A. Niezgoda, MD, FACHM, MAPWCA, CHWS

WebCME

Sustained delivery of oxygen over 5 days from an advanced reservoir system inside.

From concept to commercial product



WebCME

OxyBand Research & Evidence

- Delivers Oxygen Up To 5 Days, Oxygen Transfer Study
- Delivers Oxygen into wounds (PO2 to 264 mmHg)
- Increases Wound O2 After HBOT - Complementary
- Versus Standard of Care (Randomized Controlled)
  - Significantly Faster Healing, Less Pain
- Versus Placebo (Double Blind Randomized Controlled)
  - Significantly Faster Healing, Less Inflammation, Pain
- Effective Healing, Diabetic & Venous Ulcers (Case Studies)
  - Closure of Non Healing Wounds
- Improves Neutrophil killing of Pathogens
  - Acinetobacter baumannii (In Vitro)
- Oxygen increases the efficacy of Silver efficacy
  - Pseudomonas Aeruginosa & MRSA
- Definitive Army USAISR Pre Clinical & Clinical Trial

"Healing time for donor sites of burn victims can be the difference between life and death. OxyBand outperformed the SOC with respect to significantly less (at least 25%) healing time and 3x less pain. Results are clinically as well as statistically significant."

Kimberly F. Lairet, MD, Leopoldo C. Cancio, MD, Evan M. Renz, MD, David Baer, PhD US Army Institute of Surgical Research

<u>Significantly Faster Healing & Significantly Less Pain, No Infection</u>

WebCME

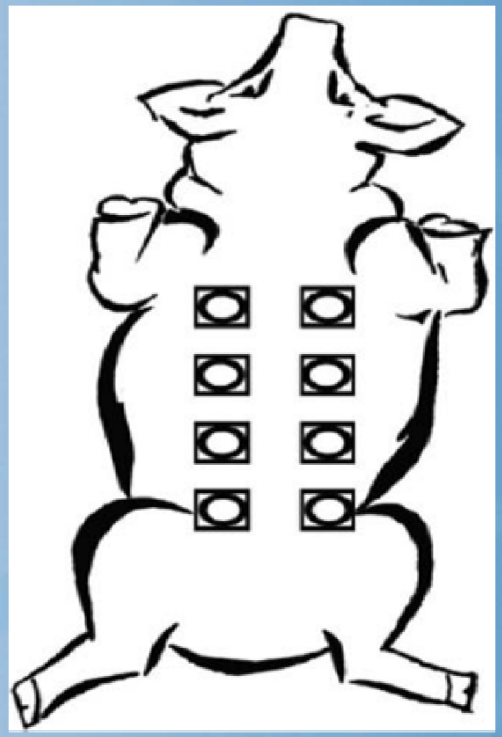
Does OxyBand Increase Dissolved Wound Oxygen (pO2)?

- Hopf et al.,
- Will OxyBand worn in normobaric conditions increase pO2?
- Worn during HBOT result in elevated levels of PO_2 after HBOT?

WebCME

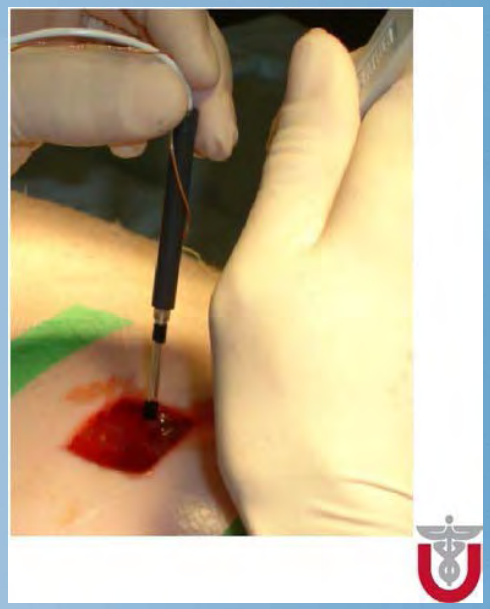
Methods

- IACUC approval
- 2 pigs (HBOT and control)
- Anesthesia
- – During HBOT
  - Diazepam and ketoprofen
- – Otherwise
  - Isoflurane in oxygen (intubated)
- 8 standardized full thickness wounds per pig
- Wounds covered with thin Film or OxyBand dressing



WebCME

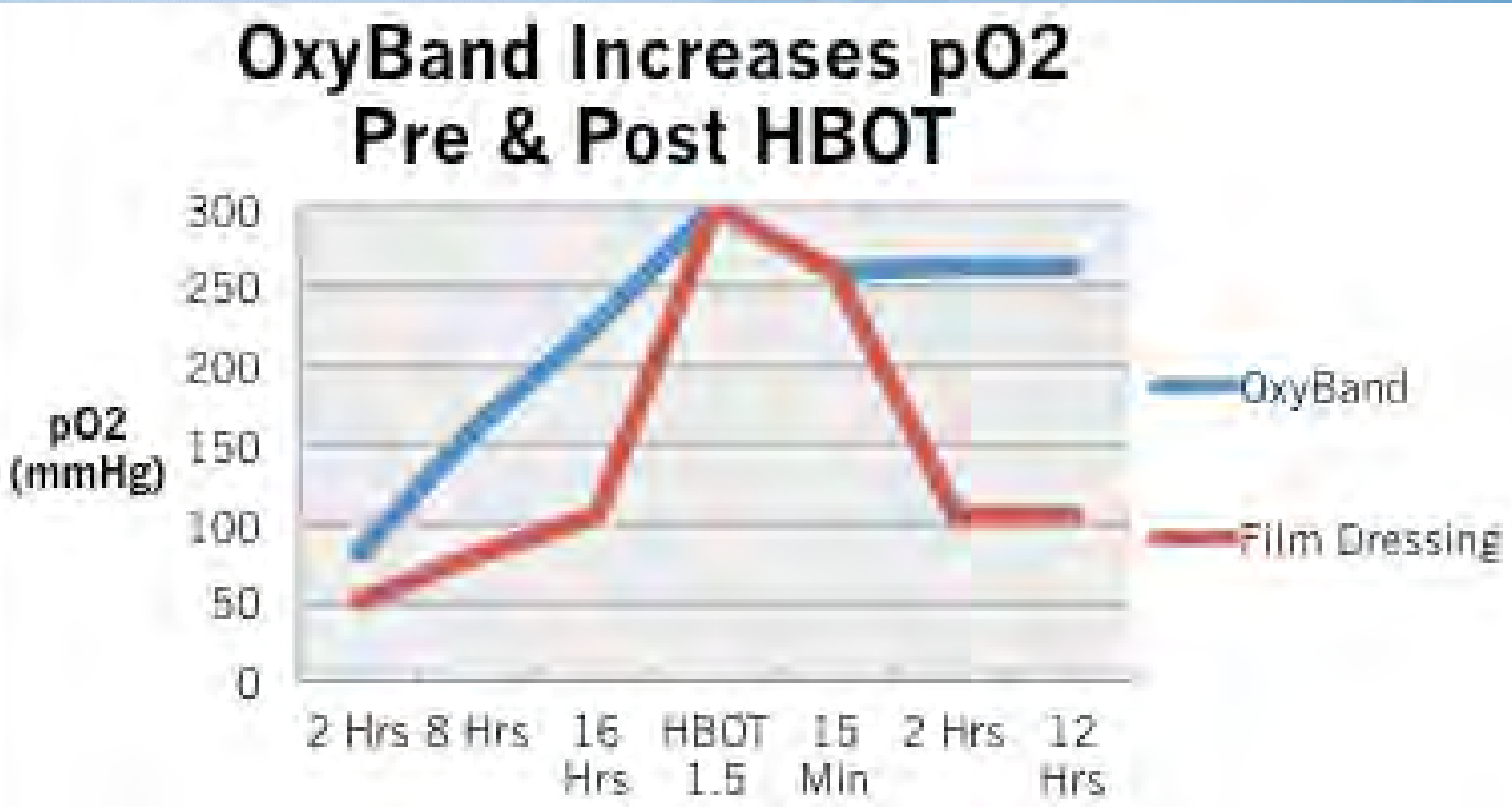
Specifics - Methods



- O_2 measured within wound exudate
- polarographic micro-electrodes
  - MI-730 and OM-4 oxygen monitor,
    - Micro-Electrodes, Inc, Bedford NH
  - Type K thermocouple 5SC-TT-
    - K-36-36 and HH11A monitor,
    - Omega Engineering, Stamford CT
  - 2-3 mm depth wounds
  - 2hr 8hr 16hr after OxyBand & (control)
  - 15m 2hr 12hr after HBOT – OxyBand & Control
- HBOT=90 min at 2 ATA

WebCME

Results - Elevated pO2 - OxyBand vs. Film Dressing, Normobaric & After HBOT



Conclusion

- pO_2 was higher in OxyBand vs. control at baseline
  - – Even given high inspired O_2
- pO_2 (control) remained elevated for <2 h after HBOT
- pO_2 (OxyBand) remained elevated at least 12 h after
  - HBOT (post 12 h not measured)
- Synergies of systemic HBOT and prolonged local oxygen

- **An Oxygen Reservoir Dressing Sustains Elevated Wound pO2 After Hyperbaric Oxygen Treatment**
  Harriet W. Hopf, MD[1], Gerit Mulder, DPM[2], Jay Duchnick, CHT[3], Scott Barnhill, AS, SRS, RLATG

WebCME

Evidence Based - Clinical Trials RCT - OxyBand Vs. Standard Care

Oxy-Band™ vs. Standard of Care Tegaderm™ Dressings

(Wound Diameter)

	Day 1		Day 3		Day 7	
Treatment	**OxyBand**	**TegaDerm**	**OxyBand**	**TegaDerm**	**OxyBand**	**TegaDerm**
(N) Number of wounds	30	30	30	30	30	30
Mean Wound Diameter (mm)	5.00	5.00	2.95	4.32	1.51	2.65
Wound area (pi x r^2 = mm^2)	19.63	19.63	6.83	14.65	1.79	5.51
% Diameter Reduction from Day 1			41%	14%	70%	47%
% Wound Area Reduction from Day 1			65%	25%	91%	72%
% of Wound Area Remaining			35%	75%	9%	28%

*All Day 3 and Day 7 primary endpoints demonstrated statistical significant differences ($p < .001$)

WebCME

RCDB Clinical Trial Results
OxyBand Vs. Placebo – Air Filled Dressing

Photograph 1:
Epithelialization of Wounds; OxyBand™ Vs. Placebo

Photo 1A: OxyBand™ Treated

Photo 1B: Placebo Treated

Photograph 2:
Wound Exudate Levels; OxyBand Vs. Placebo

Photo 2A: OxyBand™ Treated

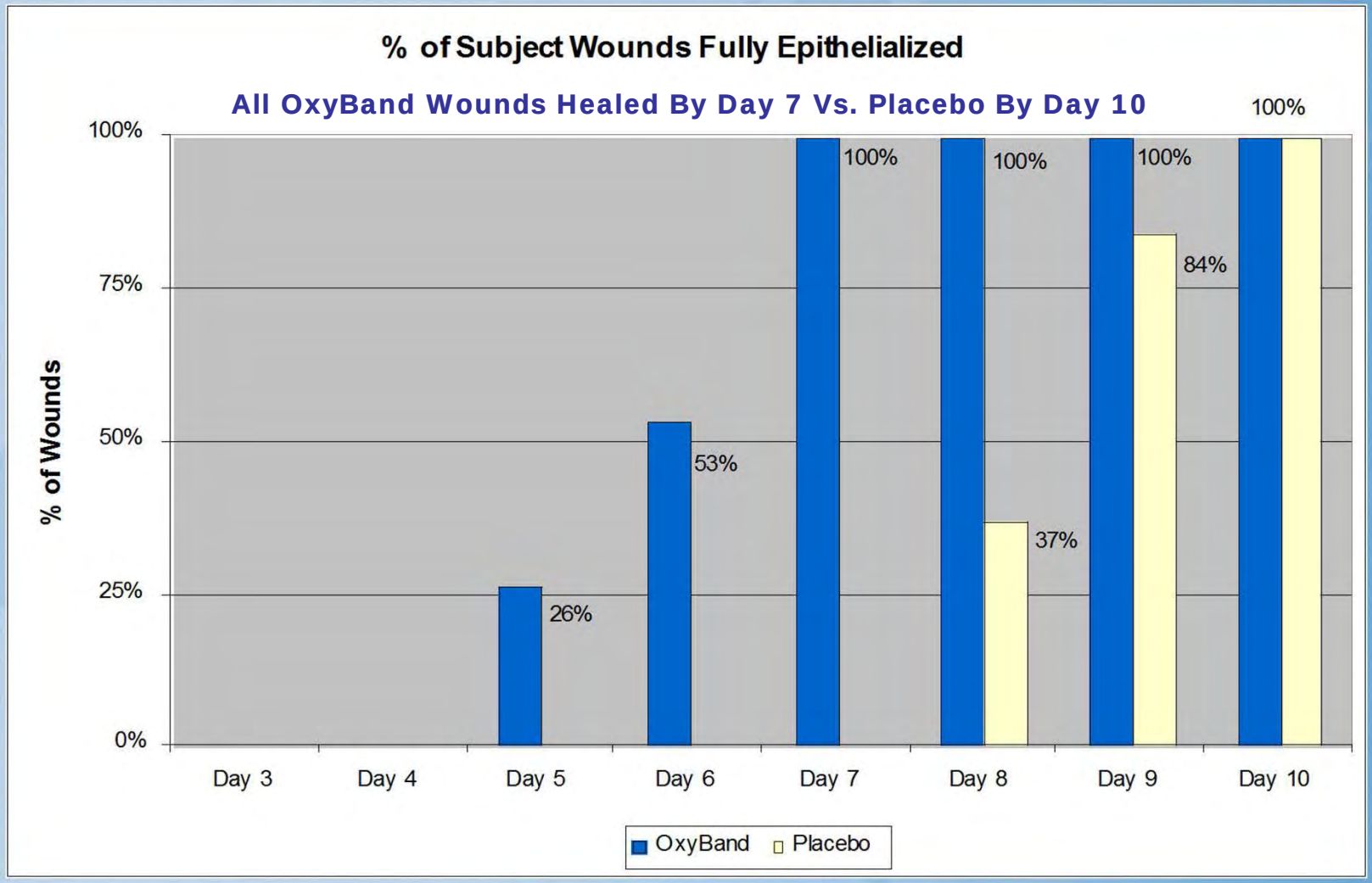
Photo 1B: Placebo Treated

Results showed a significant difference in healing time of 30%

WebCME

RCDB Study: OxyBand Vs. Placebo (air filled)

Significant Difference in the number of days to healing



WebCME

OxyBand & Surgical Wounds
Donor Sites, Post-op, SSI

Example of donor site (skin harvesting) procedure.

Typical appearance of OxyBand dressing on a donor site.

USAISR Clinical Trial – Colonel Leopold Cancio MD (Photo)
Injured US Army Soldier requiring at least two identical donor sites

WebCME

Objective of the DOD Research

- Primary objective, determine if autogenous donor sites heal faster with OxyBand than Control
  - Control Group = Xeroform dressing
- Secondary objective, determine whether the antimicrobial efficacy of silver is affected by higher oxygen levels.
- OxyBand also evaluated increased % O2 on PMN bactericidal killing of Acinetobacter

WebCME

Abstract

OBJECTIVE: Assess the effectiveness of a new oxygen diffusion dressing (OxyBand) compared to standard Xeroform gauze dressings. Time to healing was the major endpoint. Pain scores and cosmetic outcome were also assessed.

METHODS: Prospective, randomized, patient-controlled study of burn patients undergoing harvesting of two donor sites. Patients were followed for 30-45 days to determine the time to re- epithelialization, cosmetic appearance, and pain during healing. Subjects were adult burn patients with less than 30% TBSA (total body surface area) burn admitted to the US Army Burn Center who required excision and grafting of their wounds. 20 patients were enrolled, of which 17 completed the study. Patients underwent harvest of split thickness skin graft in the usual fashion with one donor wound dressed with OxyBand and the other dressed in Xeroform gauze. Wounds were inspected and photographed on postoperative days 4, 8, and then every 2 days until the donor wounds were healed, as determined by a staff burn surgeon or associate investigator. Pain scores at each site were also collected at these visits (rated by patients on a scale from 0-10). After both wounds were healed, patients were seen at a 30-45 day visit to photograph the wounds a final time.

RESULTS: The average time to wound healing for Oxyband was 9.3 +/- 1.7 days, compared with Xeroform 12.4 +/- 2.7 days ($p<0.001$). Pain scores were significantly lower ($p<0.01$) at the OxyBand site compared to the Xeroform site for all measurement points during the healing period (postoperative days 4-12). There was no difference in the cosmetic outcome of the wounds at 30-45 days postoperatively. CONCLUSIONS: This study revealed a significant 3-day decrease in the time to healing with t

Introduction

Clinical Problem:

- Thermal injury: 10% of combat casualties from the current battlefield (OIF, OEF) have burns (Schmidt et al., Am Burn Assn 2012)
- Many of these patients require excision and skin grafting
- In patients with major burns (>20%), wound healing is the key to survival (Nitzschke et al., Am Burn Assn 2012)
  - Successful wound healing → survival
  - Unsuccessful wound healing (*wound failure*) → death
- Donor site healing is often the limiting factor. Inability to reharvest donor sites prevents a rapid pace of wound closure

Technology:

- OxyBand™ dressing (OxyBand Technologies, Woodbury, MN) was developed to provide local delivery of high concentrations of oxygen to healing wounds
- Directionally permeable, gas-emitting reservoir
- Like hyperbaric oxygen, without cost and risk
- Studies on standardized laser burn wounds showed faster healing time compared to a placebo
- 510K-approved by the FDA

Objective

Objective:

- To evaluate the OxyBand's efficacy in comparison with our usual donor site dressing on time to healing (90% confluent epithelialization, in judgment of staff surgeon)
- Secondary endpoints: pain, cosmesis, ease of application

Hypothesis: The mean healing time for wounds treated with the OxyBand dressing will be less than the mean healing time for wounds treated with the Xeroform dressing

Methods

Subjects:

- Adult burn patients with total burn size (TBSA) < 30%
- In need of excision and grafting
- Without critical illness or healing disorder (e.g.: ongoing mechanical ventilation, vasoactive medications, diabetes, peripheral vascular disease, corticosteroids, coagulopathy)

Study design:

- Prospective, single-center, randomized, controlled, open-label
- Subjects served as their own controls, with comparison of simultaneously harvested donor sites on the opposite sides of the body (e.g., both anterior thighs)

Donor harvest:

- Minimum 4 inches by 2 inches x 2 sides
- Goal depth 10/1000 inch; Zimmer air-powered dermatome

Study dressing:

- OxyBand dressings supplied by the manufacturer
- Secured to intact skin around the donor site by the adhesive edge of the dressing
- Replaced if non-adherent or leaky
- Removed and site photographed on days 4, 8, and every 2 days till healed

Control dressing:

- Xeroform gauze (3% bismuth tribromophenate and petrolatum) on fine mesh gauze
- Trimmed as healing occurred underneath
- Bacitracin applied to assist with separation, beginning on post-operative day 14

Photo assessment: Blinded staff surgeon reviewed photos on days 30-45 and subjectively judged which side had better cosmetic outcome

Statistics: A power analysis concluded that 17 patients, providing 34 matched donor sites, would be required to demonstrate a difference in healing time with a confidence level of 95%. Data were analyzed using SAS. Continuous and score variables were compared by Wilcoxon Test. All tests for significance were two-tailed with $\alpha = 0.05$.

Example of donor site (skin harvesting) procedure.

Typical appearance of OxyBand dressing on a donor site.

Application of Xeroform dressing to a donor site.

Comment: Donor site as a model of wound healing

- Uniform wound depth
- Scheduled procedure with patient's own consent
- Well-established healing rate
- Can use identical paired sites
- Rate of healing provides an objective measure of dressing efficacy
- Decreased infection risk as a confounding factor compared to traumatic injuries

Results

- 20 patients were enrolled; 17 completed the study
- Of the 3 who did not, 2 did not require 2 donor sites at time of surgery and 1 was lost to follow-up (after completion of successful healing)
- Of the 17 patients:
  - Mean TBSA = 9.1%
  - Mean age = 35 years
  - 7 military and 10 civilians
  - 14 males and 3 females
- Mean time to wound healing for OxyBand = 9.4±1.7 days (range 6-12); for Xeroform = 12.4±2.7 days (range 8-20) ($p<0.01$).
- No infections
- 2 patients had blisters at final follow up visit at both sites
- Pain: lower in OxyBand site on all post-operative days (days 4, 8, 10, 12) ($p<0.05$ for all timepoints)
- No difference in cosmetic appearance of final photos

Conclusions

In an open-label, prospective, randomized controlled trial of 2 donor site dressings, the OxyBand oxygen- diffusing dressing outperformed the Xeroform dressing with respect to healing time and pain. The reduction in healing time with the OxyBand dressing of 25% was clinically as well as

References

Mustoe, T et al. Transdermal sustained-delivery oxygen improves epithelial healing in a rabbit ear model. Arch Surg 2005; 140(10):998-1004.

Wright, TE et al. The effects of an oxygen-generating dressing on tissue infection and wound healing. J Appl Research 2003; 3(4):363-370.

Kalliainen, LK et al. Topical oxygen as an adjunct to wound healing: a clinical case series. Pathophysiology 2003; 9:81-87.

Yeong EK, et al. Improved burn scar assessment with the use of a new scar-rating scale. Journal of Burn Care and Rehabilitation 1997;18(4):353-5.

Acknowledgements

This study was approved by the Institutional Review Board of Brooke Army Medical Center, protocol ISR #H-09-008, BAMC #I.2009.080.

USAISR performed this study as part of a Cooperative Research and Development Agreement (CRADA) with OxyBand, with funding from the U.S. Army Medical Research and Materiel Command Clinical Trials Task Area. OxyBand received additional funding from the U.S. Army Medical Materiel Agency (USAMMA). The authors gratefully acknowledge the support of Ms. Patricia M. Dubhill and Mr. Greggory Housler of USAMMA; of USAISR Clinical Research Nurse Coordinators, to include Cathy Rauschendorfer, RN, Elsa Coates, MS, RN, CCRN, and Bryan Jordan, RN, MSN; of surgeons Dr. Jonathan Lundy and Dr. Rodney Chan for reviewing photographs; and of ISR Statistician Mr. John Jones.

The opinions or assertions contained herein are the private views of the authors, and are not to be construed as official or as reflecting the views of the Department of the Army or Department of Defense.

WebCME

Published Prospective RCT US ARMY (USAISR)

Kimberly F. Lairet, MD, Leopoldo C. Cancio, MD, Michelle L. Leas, RN, Chaya Galin, RN, David Baer, PhD, Evan M. Renz, MD United States Army Institute of Surgical Research, Fort Sam Houston, TX Evaluation of an Oxygen Diffusion Dressing for Accelerating Healing of Donor Site Wounds

Results

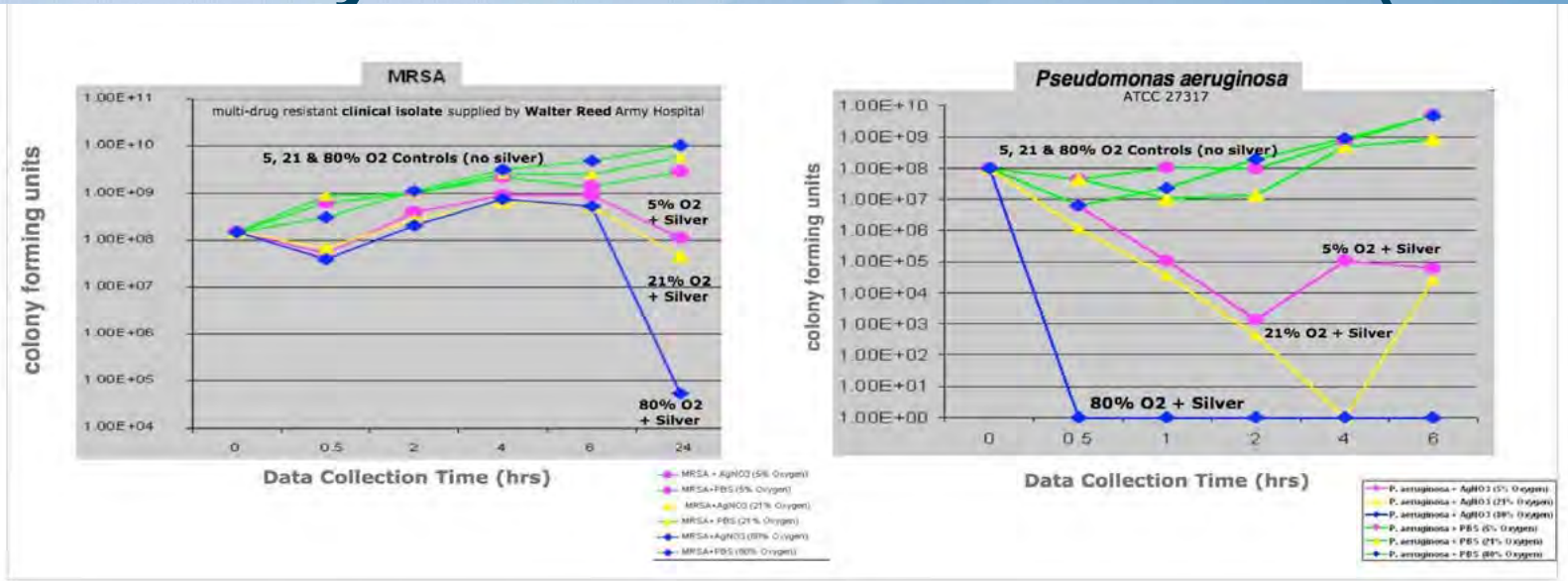
Outcome	OxyBand	Xeroform
Healing Time (Blinded Evaluation of Photographic Evidence) **(p<0.01)**	**9.4±1.7 days (range 6-12 days) No Infection** Significantly Faster Healing w/ OxyBand	**12.4±2.7 days (range 8-20 days) No Infection**
Pain (0-10 Scale on Day 4,8,10,12) (p<0.05)	Day 4, 0.6 Day 8, O.4 Day 10, 0.3 Day 12, 0.2 Significantly Less Pain with OxyBand	Vs 1.6 (~ 3x more pain) Vs 1.4, (> 3x more pain) Vs 0.8, (> 2x more pain Vs 0.5 (> 2x more pain) **Significantly More Pain with Xeroform**

Conclusion

"This study revealed a decrease in the time to healing and patient reported pain OxyBand versus the Xeroform dressing. Accelerating the healing process and reducing pain save limbs and lives which is critical."

Kimberly F. Lairet, MD, Leopoldo C. Cancio, MD, Michelle L. Leas, RN, Chaya Galin, RN, David Baer, PhD, Evan M. Renz, MD United States Army Institute of Surgical Research, Fort Sam Houston, TX Evaluation of an Oxygen Diffusion Dressing for Accelerating Healing of Donor Site Wounds

The Effect of Higher Levels of O2 (80%) on the Efficacy of Silver To Kill Bacteria (in vitro)



Conclusion

- The results of the present study demonstrate 80% Oxygen combined with Silver (Silver Nitrate) is more effective as an antimicrobial against MRSA and Pseudomonas in vitro, than Silver (Silver Nitrate) at either hypoxic (5%) or ambient air (21%) levels of Oxygen. These results suggest there is an additive effect of higher levels of Oxygen to Silver Nitrate in treating MRSA and Pseudomonas. The clinical significance of these results could be very important in the treatment of infected and chronic wounds which are often hypoxic. The results suggest a combination treatment of Silver and high levels of oxygen may perform better as an antimicrobial than silver alone. More studies are needed to determine clinical results and with other wound pathogens.

WebCME

Effect of Oxygen Tension on Neutrophil Mediated Killing of *Acinetobacter baumannii*

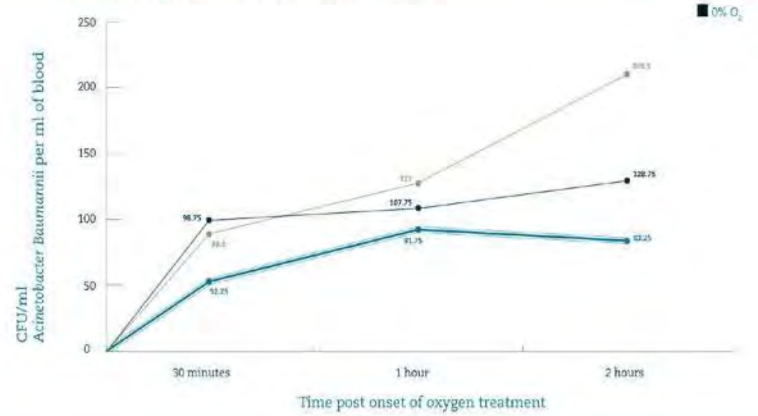
OxyBand™
the HEALING POWER of OXYGEN

Mark Rollins, MD, PhD; • Joseph Tonna, MD, University of California San Francisco School of Medicine, San Francisco, CA and OxyBand Technologies Inc., San Francisco, CA; • Amie Franklin, PhD, OxyBand Technologies Inc., San Francisco, CA; • Stanley Poulos, MD, Plastic Surgery Specialists, Marin General Hospital, Greenbrae, CA

ABSTRACT

More Oxygen = Less Bacteria

The Affect of Increasing Oxygen Tension on Neutrophil Mediated Killing of *Acinetobacter Baumannii*



CONCLUSION

REPRESENTATIVE REFERENCES

BACKGROUND

OxyBand™ Studies & Demonstrated Results

Resistant Wound Infections

Study Methods

RESULTS

DISCUSSION

WebCME

OxyBand Summary of Evidence

- Provides oxygen delivery to wounds
  - 5 days
- Increases wound pO2
- Absorbs fluids
- Sterile barrier to outside contaminants
- Reduces cost
- 3 Clinical Trials have shown significantly faster healing, reduced pain and no infection
- Cleared by the FDA

WebCME


New Re-imbursement rules
Penalties for surgical site infection
Penalties for Chronic wounds
Bundled payments for care
Improved out comes for less $

Clinical Experience

Specific Wound Types

- Surgical Wounds
  - Post operative, Donor Sites, SSSI
- Venous Insufficiency
- Diabetic Foot Ulcers
- Pressure Ulcers

WebCME

Case Studies – Ellis et al.

Chronic Wound after 2 Year of Ineffective Treatment
Concrete Chemical Burn

Chronic 2 Year Wound

OxyBand- 30 Day

OxyBand- 90 Day

WebCME

UCSD – Mulder et al.

- Multiple Case at UCSD showed OxyBand healed chronic wounds
- Example below, Diabetic Wound.
- Patient already had one toe amputated – two years non healing
- After 2 OxyBand Dressing Treatments, One Week, Wound Healed

Before Treatment

After Treatment

OxyBand Treated Chronic Pressure Ulcer On Heel – Ellis et al.

Heel Day 1

Heel Day 10

WebCME

The Future

- Additional Clinical Experience
  - Diabetic Foot Protocol
  - Pressure Ulcer Protocol

WebCME

Pressure Ulcer Protocol

- Pressure Ulcer Prevention
  - Additional Cost of Care
  - Prolonged Hospitalizations
  - Financial Penalties
  - Medical Legal Exposure
- Oxyband uniquely designed to impact Pressure Ulcers
  - Providing Oxygen Substrates to Hypoxic Injury
  - Pressure Redistribution-Relief
  - Prevent Conversion Partial to Full Thickness Wound

WebCME

The Future

- Additional Clinical Experience
  - Diabetic Foot Protocol
  - Pressure Ulcer Protocol
- Compliment to HBOT
- Adjunctive to Cellular & Tissue Based Products (CTPs)
- Indwelling Devices
- Regenerative Medicine

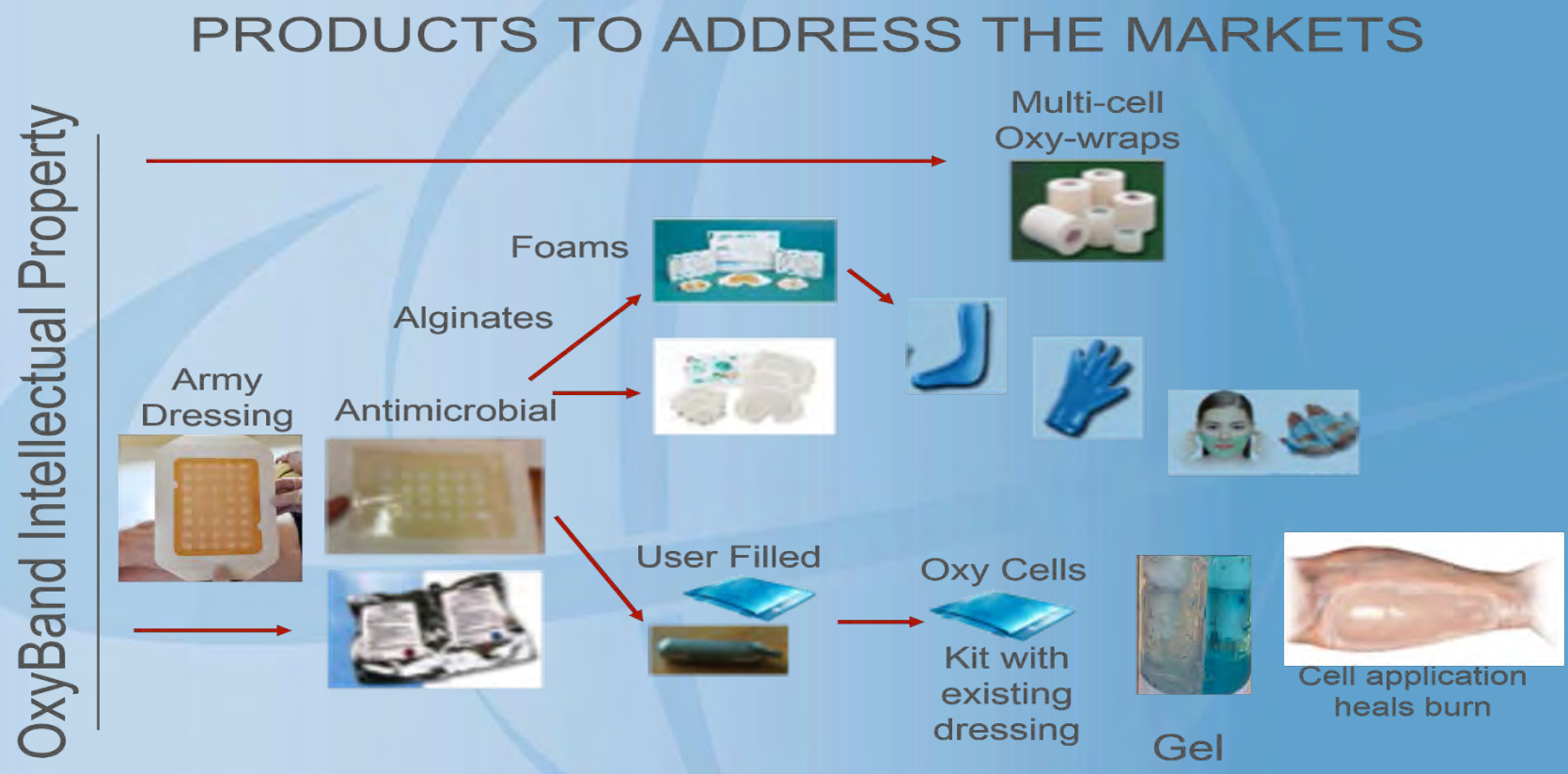
WebCME

Regenerative Medicine

"Oxygen is itself regenerative. Cells in the presence of higher sustained oxygen regenerate. Wound healing is a regenerative process. The USAISR OxyBand Donor Site Study published results demonstrate the benefits of OxyBand in healing of autogenous donor sites which is regenerative healing. 100% healing in significantly less time than standard of care. The results demonstrate OxyBand is a regenerative device."

-Dr. Anthony Atala, MD
Director of the Wake Forest Institute of Regenerative Medicine &
Director of the Armed Force Institute of Regenerative Medicine,
Chairman of Urology Baptist Wake Forest Medical Center

OxyBand
Customizable Delivery Device



- Donor Sites
- Burns
- Venous & Pressure Ulcers
- Incisions

- Abrasions
- Post-Surgical Therapeutic Wound Care
- Diabetic Wound Care

- Partial Thickness Wounds
- Lacerations
- Retinal & Macular Disease
- Cosmetics

WebCME

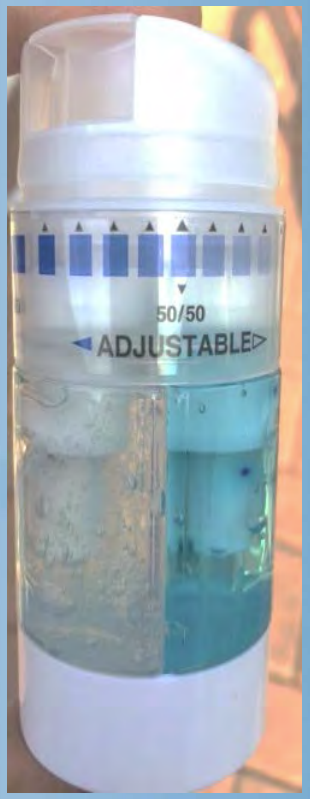
OXYBAND WOUND DRESSING

- Oxygen generating gel - future product
- Value as cosmetic because oxygen stimulates collagen
- Oxygen penetrates skin
- Oxygen heals

OXY**BAND**™

The healing power of oxygen

- Future Standard of Care
- All Surgeries
- Reconstruction
- Chronic Wounds
- Military Medicine
- Regenerative Medicine



Oxygel, finding the healing you need

WebCME