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# Winthrop-University Hospital: Using a Science-Based Approach to Heal Chronic Wounds

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**Specialty:** Wound Care

At Winthrop's Wound Healing Center, an experienced, interdisciplinary team deploys innovative treatments, combining regenerative medicine and hyperbaric oxygen therapy (HBOT) to accelerate healing and advance the science of wound care.

Annually, approximately 6.5 million patients across the United States cope with chronic wounds, according to a study published in *Wound Repair and Regeneration*. Nonhealing, complex wounds may be the result of trauma, surgery or chronic conditions, such as diabetes or arterial disease. A



multidisciplinary team of specialists at Winthrop-University Hospital's state-of-the-art Wound Healing Center incorporates regenerative medicine, HBOT and surgical debridement in evidence-based care protocols to render limb-sparing, lifesaving care. The experienced wound care team works around-the-clock to provide inpatient or outpatient treatment for all wounds.

"This is a unique, academic wound-healing program, with faculty associated with the medical school, fellows and research funded by the National Institutes of Health," says Harold Brem, MD, FACS, Chief of the Division of Wound Healing and Regenerative Medicine in the Department of Surgery at Winthrop-University Hospital and Professor of Surgery at Stony Brook University School of Medicine. "When a patient presents at Winthrop-University Hospital, an interdisciplinary team comprised of a hyperbaric medicine physician, a highly trained full-time wound care physician and a nurse provides world-class care, including a unique combination of regenerative medicine cells and growth factors — applied simultaneously — to promote healing."

### Winthrop Wound Healing By the Numbers

- \$100 million research and academic facility
- 62-member wound healing team
- 50+ years wound care experience among the physician team
- 24/7 accessibility to wound care specialists
- 14 years of National Institutes of Health-funded research
- Surgical procedures within 6 to 24 hours of patient presenting at hospital

### Regenerative Medicine

Winthrop-University Hospital's care protocols utilize individualized regenerative medicine — the application of collagen, recombinant growth factors, human skin cells, platelet-rich plasma, extracellular matrix molecules and stem cells — on every wound to optimize healing.

"Over the past 17 years, there have been major developments in regenerative medicine," says Scott Gorenstein, MD, Clinical Director of the Division of Wound Healing and Regenerative Medicine at Winthrop-University Hospital and Clinical Assistant Professor of Surgery at Stony Brook University School of Medicine. "We went from wound debridement and skin grafts — traditionally painful procedures, fraught with potential complications — to applying regenerative medicine techniques that

promote skin growth and deep-tissue healing. These advancements allow patients to have nearly painless surgeries, faster recoveries and far better outcomes.”

Specialists at Winthrop-University Hospital’s Wound Healing Center are pioneering the simultaneous application of multimodal therapies for all nonhealing wounds. Treatment plans may include combinations of the following:

- **Apligraf:** A cellular skin-collagen-based delivery system that, when placed in a wound such as a diabetic foot ulcer or venous ulcer, accelerates the healing process as it aids closure by stimulating granulation tissue.
- **Extracellular matrix:** A scaffold containing basement membranes and multiple collagens that can be applied over the surface of a wound to bind cells in the tissue, which encourages the growth of new skin cells and aids tissue repair.
- **Growth factors:** Purified growth factors, such as granulocyte-macrophage colony-stimulating factor, are injected directly into wounds to significantly promote cell growth.
- **Leukine:** A medication that activates the formation of blood vessels and enables the growth of new cells, Leukine is vital for generating healthy macrophages, a type of white blood cell, important for wound healing.
- **Negative-pressure therapy:** Applied directly to a complex wound, a vacuum dressing hinders bacterial colonization and promotes growth of new tissue.
- **Platelet-rich plasma:** A medication derived from the patient’s or a donor’s blood that accelerates the formation of healthy tissue after injection into a wound.
- **Stem cells:** This strategy uses material derived from a patient’s adipose tissue that promotes tissue growth.



Dr. Brem performs a wound-healing operation that incorporates the most advanced regenerative medicine treatments, including a combination of human growth factors and cellular- and collagen-based therapies.



After injecting Leukine, Dr. Brem applies Integra, a bi-layered biological skin substitute made of Collagen, to a patient with a nonhealing irradiated surgical wound.

“We construct individualized care plans based on the mechanisms of non-healing of each wound,” Dr. Brem says. “For example, some wounds benefit from growth factors and apligraf applied in conjunction with HBOT. Having

such wide-ranging treatment capabilities available 24/7 is a tremendous resource.”

The team also employs cellular-based therapies with living skin substitutes as well as cryo-preserved skin substitutes such as placental membranes. Collagen products that are animal- and human-based may also be used to stimulate the healing process.

“Identifying the most beneficial combination of therapies for each case requires high levels of expertise from each member on the team,” says Michael Castellano, MD, attending physician in the Division of Wound Healing and Regenerative Medicine at Winthrop-University Hospital. “A synergistic collaborative approach is essential to customize treatment plans that implement a variety of techniques for inpatient and outpatient care of complex wounds.”



Some of the members of Winthrop-University Hospital's Wound Healing and Regenerative Medicine team. As seen here (L-R), Eric Slone, MD, plastic surgeon, full-time Wound Healing Attending Physician; Harold Brem, MD, FACS, Chief of the Division of Wound Healing and Regenerative Medicine in the Department of Surgery at Winthrop-University Hospital; Scott Gorenstein, MD, Clinical Director of the Division of Wound Healing and Regenerative Medicine at Winthrop-University Hospital; and Michael Castellano, MD, attending physician in the Division of Wound Healing and Regenerative Medicine at Winthrop-University Hospital.

## Experience: The Foundation of Complex Wound Treatment

Winthrop-University Hospital's 24/7 Wound Healing and Regenerative Medicine program leverages the expertise and experience of its physician-led team, including:

- **Harold Brem, MD, FACS:** A board-certified general surgeon, Dr. Brem earned his medical degree from McGill University and is a leader in advancing wound-care science, having published more than 100 peer-reviewed publications. He has

published the first protocols for many of the wounds treated today as well as the first surgical techniques. He holds a number of U.S. patents — most notably for discovering new drugs to treat diabetic ulcers and debridement of wound tissue with molecular markers — and has sustained National Institutes of Health funding for 14 years. As Chief of the Division of Wound Healing and Regenerative Medicine in the Department of Surgery at Winthrop-University Hospital, Dr. Brem has focused his efforts on the dedicated 24/7 wound unit and improving outcomes through the collaborative approach used by the Wound Healing Program's interdisciplinary team.

- **Michael Castellano, MD:** Board-certified in general surgery, Dr. Castellano earned a medical degree from New York Medical College. With insight gained from 20 years of experience treating wounds, including four years in the military, Dr. Castellano leads the wound care surgical services at Winthrop-University Hospital.
- **Scott Gorenstein, MD:** A graduate of New York Medical College and Fellow of the American College of Emergency Physicians, Dr. Gorenstein is board-certified in emergency medicine and hyperbaric medicine. As the Clinical Director of the Division of Wound Healing and Regenerative Medicine, Dr. Gorenstein's research and clinical focus is in using regenerative and hyperbaric medicine to treat complex wounds. Dr. Gorenstein also serves as Clinical Assistant Professor of Surgery at Stony Brook University School of Medicine.

## Hyperbaric Medicine

Effective as a stand-alone treatment, HBOT can also enhance regenerative medicine treatments when used simultaneously. At Winthrop-University Hospital, this strategy is the standard of care.

“Although HBOT is not a new treatment, the modality has traditionally not been applied,” Dr. Gorenstein says. “We've implemented this methodology to enhance outcomes.”



Scott Gorenstein, MD, Clinical Director of the Division of Wound Healing and Regenerative Medicine at Winthrop-University Hospital, is seen with hyperbaric chambers that are specialized for the treatment of complex wounds.

As one of the mechanisms of healing, HBOT enables patients to breathe up to 10 times as much oxygen into their bloodstreams, oxygenating the wound and stimulating cellular growth. During 90-minute sessions, patients enter the hyperbaric chamber, which is pressurized to as much as three times normal air pressure, and breathe pure oxygen. Therapeutic regimens vary depending on the condition, but patients may receive 20 to 40 HBOT treatments as part of a wound-healing regimen. For increased comfort, each chamber is equipped with a flat-screen television and DVD player.

“Hyperbaric chambers used to function independently from the wound team — and still do in many places around the country,” Dr. Brem says. “We’ve built an integrated program that is completely focused on patient outcomes and truly makes a difference in patients’ lives.”

## Care for Radiation Wounds

The latest research at Winthrop-University Hospital's Wound Healing Center examines the role of hyperbaric oxygen therapy (HBOT) in treating radiation wounds caused by cancer care — some of the most difficult and complex wounds to heal, according to Scott Gorenstein, MD, Clinical Director of the Division of Wound Healing and Regenerative Medicine at Winthrop-University Hospital and Clinical Assistant Professor of Surgery at Stony Brook University School of Medicine.

“Strict, multimodal protocols including HBOT can successfully heal radiation wounds,” he says. “We are among the first facilities in the country to examine the efficacy of a wide variety of products, including stem cells and novel technologies, in clinical trials.”

The program’s success is due to a philosophy founded upon the science of wound care.

“We’ve studied vascular endothelial growth factor in the lab for years,” says Harold Brem, MD, FACS, Chief of the Division of Wound Healing and Regenerative Medicine in the Department of Surgery at Winthrop-University Hospital and Professor of Surgery at Stony Brook University School of Medicine. “We found its mechanism of action actually worked against human cells, so we determined a delivery system in which it can be more effective.”

Michael Castellano, MD, attending physician in the Division of Wound Healing and Regenerative Medicine at Winthrop-University Hospital, underscores the importance of cellular biology when constructing treatment plans.

“Treating wounds at the cellular level requires a meticulous process that begins at clinical presentation and is illuminated in surgery,” Dr. Castellano says. “We have a high volume of patients, and discovering the pathology of the wound is what we do best.”

## Advanced Surgical Intervention

Wound patients presenting at Winthrop-University Hospital are immediately evaluated by the Wound Healing Center's surgical team, led by Dr. Castellano. Rapid triage is a critical step for the most complicated cases and can be the difference in saving a life or limb.



Michael Castellano, MD, attending physician in the Division of Wound Healing and Regenerative Medicine at Winthrop-University Hospital, performs a wound-healing operation.

“We examine all wounds on an urgent basis, and surgical treatment is a priority,” Dr. Castellano says. “Our goal is to operate within one to 24 hours, depending on the severity of the wound and the amount of resuscitation needed.”

Some wounds — especially those with necrotizing fasciitis, known as flesh-eating bacteria — require immediate surgical debridement, notes Dr. Castellano, who surgically removes all affected tissue.

“We treat all wounds, but we immediately act to save life and limb for those patients who present with potentially fatal conditions, such as sepsis,” Dr. Castellano says. “Once the infection is controlled, and the patient is stabilized, we may perform additional regenerative medicine operations.”

### 24/7 Multidisciplinary Team

Around-the-clock accessibility to the dedicated 62-member Winthrop-University Hospital Wound Healing team means that patients with the most critical conditions can receive immediate specialist attention — a vital aspect of comprehensive wound care, as many patients have underlying conditions that exacerbate and perpetuate non-healing wounds.



Three of the eleven full-time, dedicated Wound Healing Center physician assistants and nurse practitioners.

“This patient population is different from the typical patient who suffers an acute injury,” Dr. Castellano says. “They are often the most ill, have the most comorbidities and may have had nonhealing wounds for years. Having

wound care experts who understand how these wounds affect the heart, lungs, kidneys and other parts of the body is a boon for patients.”

Diabetes, depression, arterial disease or any number of conditions may prevent wound closure. Having immediate access to other specialties within the hospital ensures holistic treatment plans that fully address the patient’s wounds and comorbidities.



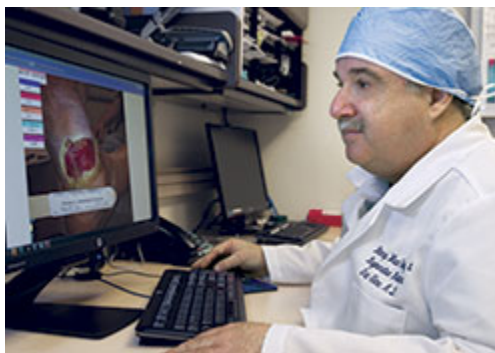
Nurses and other members of the Wound Healing Support Team are highly trained in the art of wound-healing surgery. They are also trained to meet the sensitive needs of elderly, disabled or diabetic patients undergoing wound surgery.

“We are a 24/7 program with dedicated patient beds for inpatient care,” Dr. Brem says. “Our multispecialty team includes physiatrists, cardiologists, nephrologists, plastic surgeons, podiatric surgeons, vascular surgeons, pathologists, endocrinologists, psychiatrists, nurses, physician assistants, nurse practitioners and wound physicians — any of whom we can call upon at any time. We work synergistically to treat the whole patient.”

### Better Outcomes for Complicated Cases

Evidence-based wound care protocols delivered promptly by specialized experts enhance outcomes in even the most challenging cases, such as those involving necrotizing fasciitis and Fournier’s gangrene.

“These conditions traditionally have mortality rates between 20 and 70 percent,” Dr. Gorenstein says. “Our



Eric Slone, MD, plastic surgeon, full-time Wound Healing Attending Physician, reviews a patient’s diabetic foot ulcer on the wound EHR. Dr. Slone evaluates the wound to plan



ability to expedite surgical debridement and implement HBOT as soon as possible — in the middle of the night, if necessary — have reduced mortality rates to less than 5 percent. HBOT is a critical treatment tool for necrotizing fasciitis and Fournier’s gangrene because it helps kill bacteria and decrease toxin formation, which are the mechanisms behind such high mortality rates.”

which regenerative medicine product to use. He will discuss this with the other surgeons at the weekly patient care faculty meeting.

Even with 20 years of experience treating complex wounds, Dr. Castellano points to one specific patient success story to illustrate the impact of Winthrop-University Hospital’s Wound Healing Center.

“Uncontrolled diabetes had affected the patient’s cognition and led to chronic wounds, leading her to present with necrotic feet,” Dr. Castellano says. “When the skin is compromised, a wound acts as an open portal into the body. We immediately began antibiotics and completed a partial amputation that saved most of the feet. After a treatment plan comprised of regenerative medicine, HBOT, and Apligraf, the patient went to rehabilitation. Not only did her feet heal, but she also regained cognitive function.”

### Wounds Treated at Winthrop-University Hospital Wound Healing Center

- Arterial ulcers
- Chronic, nonhealing wounds
- Diabetic foot ulcers
- Fournier’s gangrene
- Necrotizing fasciitis
- Osteomyelitis
- Pressure ulcers
- Steroid ulcers
- Surgical wounds
- Venous ulcers
- Wounds related to radiation therapy or sickle cell disease

Many patients who experience the healing care provided at Winthrop-University Hospital’s Wound Healing Center defy expectations, given that they often suffer from critical comorbidities. Decubitus ulcers associated with complications from diabetes can lead to deep muscle and bone damage if left untreated.

“A patient presented with stage IV decubitus ulcers and underlying chronic osteomyelitis, for which there was no defined care protocol,” Dr. Gorenstein recalls. “In conjunction with orthopedic and plastic surgeons, we surgically removed significant portions of the pelvic bone and used regenerative medicine and HBOT to heal the severe bedsores. Most patients in this

condition are paralyzed, and the mortality rates range between 70 and 80 percent. One year later, after tailored therapy, this patient's wounds remained healed. Our research and expertise have allowed us to expand the abilities of this program to take care of the sickest, most complicated wound patients.”

### Establishing Evidence-Based Wound Care Protocols

The principles underlying the wound-care protocols at Winthrop-University Hospital are based upon data compiled by the Wound Healing Center team led by Harold Brem, MD, FACS, Chief of the Division of Wound Healing and Regenerative Medicine in the Department of Surgery at Winthrop-University Hospital and Professor of Surgery at Stony Brook University School of Medicine. During 14 years of research funded by the National Institutes of Health, Dr. Brem has published more than 100 peer-reviewed works, retained multiple patents (with more pending) and advanced wound care technologies.

To track patient progress and prove treatment efficacies, protocols and outcomes are entered into a clinical wound database.

“We involve patients in their care and our research, and each patient receives a copy of the healing progress report,” Dr. Brem says. “We track more than 100 variables for each patient, including their medications, blood sugar levels and age — all of which are unique to each patient and factor in the healing process.”

Scott Gorenstein, MD, Clinical Director of the Division of Wound Healing and Regenerative Medicine at Winthrop-University Hospital and Clinical Assistant Professor of Surgery at Stony Brook University School of Medicine; and Michael Castellano, MD, attending physician in the Division of Wound Healing and Regenerative Medicine at Winthrop-University Hospital, track variables and develop clinical protocols that improve outcomes.

“Entering variables into the clinical wound database helps determine the most effective treatments by tracking past successes,” Dr. Gorenstein says.

*For more information about the Wound Healing Center at Winthrop-University Hospital, visit [winthrop.org](http://winthrop.org) and [complexwoundhealing.org](http://complexwoundhealing.org).*

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