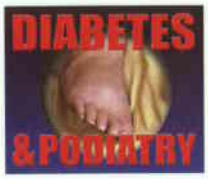

Autologous, Blood-Derived Tissue Grafts for the Treatment of Wounds

The authors present a new method of wound healing.

By R. Alex Dellinger, DPM, and Jay D. Holland, M.D.

Chronic wounds are taxing on patients, the healthcare system, and society as a whole. It has been estimated that one percent of Americans will suffer from a chronic wound at some point in their lives. It is now estimated that 10 billion dollars are spent annually in direct costs treating such wounds. While most wounds heal uneventfully with supportive, conservative care, many persist despite such diligence. Wound care products represent a four billion dollars per year market, further attesting that many treatment modalities or alternatives exist. The SafeBlood Graft™ procedure, an advanced, autologous, blood-derived tissue graft ("ABTG") procedure, has evolved over the last several years to provide physicians and their patients with an efficacious, wound-flexible, and economical alternative.

Wounds that have been recalcitrant to other therapies such as hyperbaric oxygen, VAC therapy, and Regranex™ have shown improvement with this graft procedure.

Autologous, Blood-Derived Tissue Graft Procedure

The ABTG procedure delivers an autologous, blood-derived tissue graft developed to seal, fill, and augment the body's natural cellular delivery system in responding to a wound. Using the ABTG, doctors have experienced accelerated healing rates in many types of wounds, including neurotrophic, diabetic, venous stasis, brown recluse spider, decubitus and dehiscences. Wounds that have been recalcitrant to other therapies such as hyperbaric oxygen, VAC therapy, and Regranex™ have shown improvement with this graft procedure. Also of note, the ABTG procedure has been used to augment bony arthrodeses and to reduce swelling and pain from elective cosmetic surgeries.

The ABTG protocol includes a relatively simple physician-directed medical procedure. It is regularly performed in the operating room, the physician's office, and treatment rooms in satellite and long-term, acute-care settings. It begins with the collection of as little as 20 cc. to as much as 400 cc. of whole blood. The blood is then processed with special equipment to sequester the "buffy coat", a thin, dense white band containing circulating leukocytes, platelets, pleuripotent stem cells, and plasma proteins. When activated with a proprietary activator, this seques-

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New Concepts

"New Concepts" is a forum for the presentation of new technologies and products which have been the subject of clinical study. Readers should be aware that Podiatry Management does not specifically endorse any of the technologies, concepts, or products being discussed.

trate manifests a semi-solid, flexible and malleable, living, blood-derived graft. After thorough sharp preparation of the wound, the graft is molded into the wound, secured and dressed. In wound applications, the procedure takes approximately 60 minutes to perform.

History of Autologous Blood-Derived Processes Used in Wound Care

Dating back to approximately 1909, physicians recognized the benefits of "fibrin glue." Bergel and a few years later, Grey(1), discovered the adhesive properties of fibrin in liver and cerebral hemorrhage. Soon after, Cronkite et al. combined fibrinogen and thrombin to successfully fixate skin grafts.[1] Fibrin glue found applications in ophthalmic, cardiovascular, orthopedic, neurologic, ENT, plastic, and general surgical arenas.

As the use of homologous blood became a greater concern in the early 1970's, surgeons began using "fibrin gel," an autologous derivative of fibrin glue with a lower fibrinogen concentration. Both fibrin glue and fibrin gel were derived from platelet-poor plasma ("PPP"). By the late 1970's, physicians began recognizing the importance of platelets and their function in wound and tissue repair, leading to the evolution of "platelet gels." PPP was replaced by platelet rich plasma ("PRP"), primarily representative of the buffy coat with its platelets and leukocytes separated in the centrifugation process. The activated buffy coat evidences higher platelet concentrations and lower fibrinogen concentrations than in fibrin glues or gels.

The Science Behind the Procedure

As evidence and products surrounding the wound healing process have continued to evolve, the delivery of key cellular and system components at the wound site has emerged as a significant factor in the wound-healing process. Insoluble fibrin strands, collagen matrices, fibroblasts, and growth factors figure prominently in the natural healing cascade and synthetic, product-delivered attributes. Additionally, the potential benefits of applying marrow-harvested or circulating stem cells to damaged tissue is becoming more prominent in clinical literature.[2]

The platelet initiates and plays a major role in the wound healing process.[4,5] Small proteins, known as growth factors, are contained in and carried by alpha-granules released by the platelets, controlling and regulating many wound healing processes. Platelet-derived growth factor (PDGF) is one such protein released by platelet granules during wound healing. PDGF stimulates the proliferation of many cells, including connective tissue cells.[3] Growth factors are responsible for many wound-healing functions, including increased tissue vascularity (angiogenesis), pluripotent cellular chemotaxis, collagen synthesis, fibroblast proliferation, and epithelial synthesis. Most importantly, however, the same growth factor, depending on the presence or absence of other peptides, may display either stimulatory or inhibitory activity within the same cell.[5] This last point may raise concerns on the use or application of singular growth factors, and was pivotal in the development of the autologous, blood-derived tissue graft procedure.

Growth factors are responsible for many wound-healing functions.

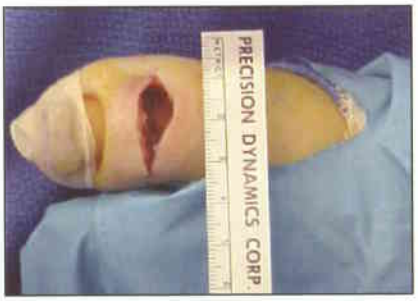
Procedure Protocols

The procedure is the key. The ABTG procedure is the essence of the current evolution in research and practice, reflecting a care-integrated medical procedure supported by a standardized protocol, proven equipment and procedure kits, and knowledgeable clinical and reimbursement guidance. The "continuum of care" approach supported by the protocol integrates an in-depth H & P evaluation, patient education regarding nutrition and personal habits, and a process-focused regimen from evaluation through discharge.

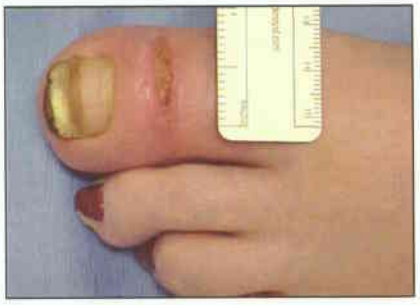
By following the continuum of care scenario incorporating the graft, we have consistently evidenced positive outcomes as depicted in the following cases.

CASE STUDIES

Osteomyelitis in Great Toe



This patient is a 55 year old female who presented with a diabetic ulcer on the plantar medial aspect of the hallux interphalangeal joint of the hallux. Her diabetes was not controlled and her glucose consistently was above 250 g/dL. She developed osteomyelitis of the base of the distal phalanx and the head of the proximal phalanx. Osteomyelitis was confirmed with MRI. Her primary care physician and surgeon recommended a hallux amputation and intravenous antibiotics. She refused amputation. IV antibiotics were administered. She had heard about the ABTG procedure through



a friend and sought this therapy as an attempt to prevent amputation. She was advised that the procedure had never been attempted in patients with confirmed osteomyelitis. She was further advised that an

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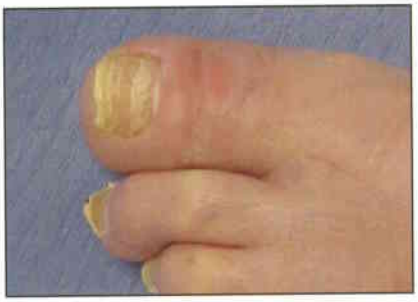
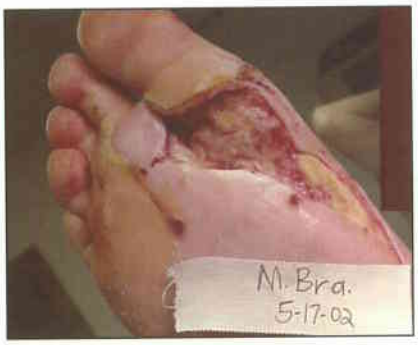
amputation might be necessary. The surgery involved resection of the proximal third of the distal phalanx and the distal third of the proximal phalanx through two converging semi-elliptical incisions oriented transversely on the dorsal aspect of the HIPJ. The bone was resected to normal looking, "hard" bone. At this point, the wound was thoroughly irrigated with normal saline.

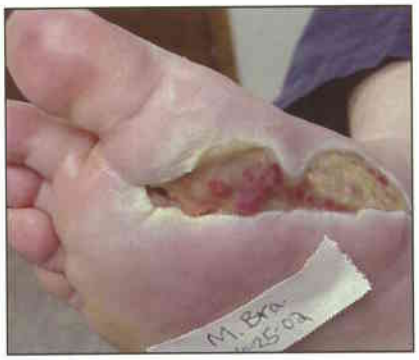


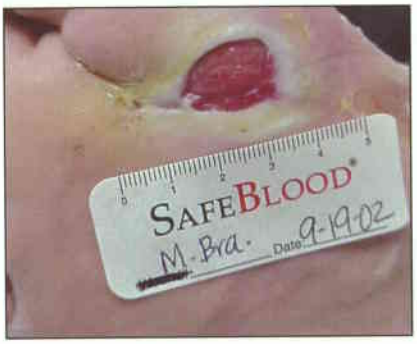
Next, the ABTG procedure was performed and the entire wound cavity was filled with the graft material. No retention sutures were used or primary closure performed. The wound was dressed with Tegaderm™ and gauze. It was undisturbed for five days. Her results were immediate. She improved rapidly and as the photographs show, she was healed in five weeks. Intravenous antibiotics were continued for 12 weeks. Follow-up MRI showed a resolution of the bone infection. Further, she retained her great toe without retraction and with excellent cosmesis.

Necrotizing Fasciitis

This gentleman is a long-standing diabetic with neuropathy. He developed a severe necrotizing fasciitis. He was admitted to the hospital and placed on intravenous antibiotics. He underwent surgery to resect necrotic tissue. He had large cavities within





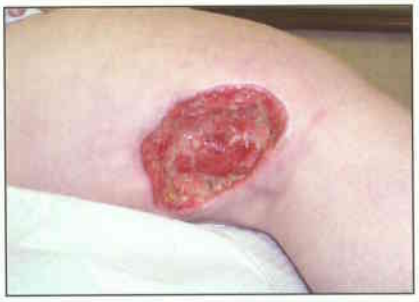


the wound and exposed deep structures. After resolution of the acute infection and stabilizing the wound, he underwent the ABTG procedure in an attempt to regranulate the wound bed and speed epithelialization. The first procedure was performed on 5/17/02. The wound size was 13 cm x 3.5 cm x 2.5 cm. He improved rapidly. Granulation tissue built rapidly in his wound and in 5 weeks was almost to the surface. The wound measurements on the 6/25/02 photo were 10 cm x 1.7 cm x 0.3 cm. He had a second procedure on 7/9/02 and continued to improve. At four months, on 9/19/02, the wound was only 1.4 x 1.2 x .2 cm. The proximal aspect of the wound was healed with no pronounced scarring. This patient continued to work, would not stay off his foot, and was very non-compliant throughout his course of treatment.

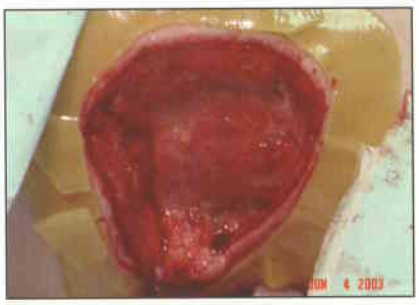
Brown Recluse Spider Bite

This patient was a forty-eight year old white female in excellent health. She received a recluse spider bite superior to the popliteal fossa of her left leg. Her primary care physician prescribed Dapsone & steroids but there was no improvement in the wound. Two days post incident she was referred to the ER and remained in the hospital for three days. Subsequently, she was seen by a plastic surgeon who carried out sharp excision of the wound resulting in an open wound approximately 10 x 7 x 4 cm. on 5/22/03. Her follow-up instructions were to pack the wound with moist saline gauze until granulation sufficient to support a flap evidenced, estimated at up to six months.

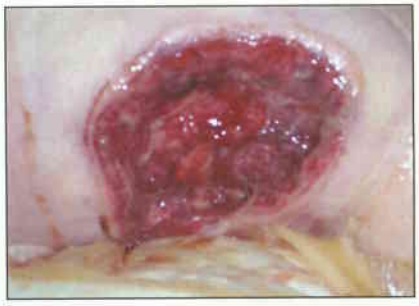
She presented for ABTG consideration on 6/3/03. The wound was clean and in good condition, measuring 11 x 7 x 2-2.5 cm. deep (4cm. center); approx. vol. 200 cc.



The patient returned on 6/4/03 to receive the graft procedure. The wound was sharply excised to provide an open, receptive graft bed and the ABTG procedure was performed at that time. The approximate volume of the prepared wound site was 250 cc. The wound was dressed primarily with TegaDerm™ and covered with a gauze wrap.



The patient returned on 6/8/03 for a pre-vacation re-exam. The wound was clean with no odor and with good new granulation tissue. Measurements were 9 x 7 x 1.4 cm. The volume was calculated at 88.2 cc. (a 65% reduction in four days) The wound was dressed with Tegaderm™ for five days. The patient dressed the wound until the next visit.



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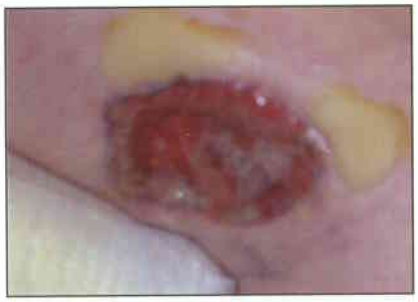
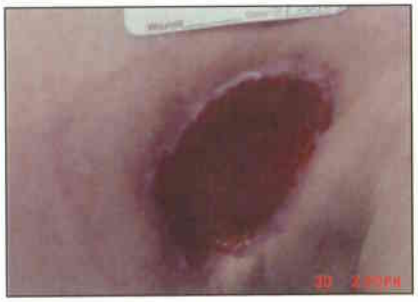
Tissue Grafts...

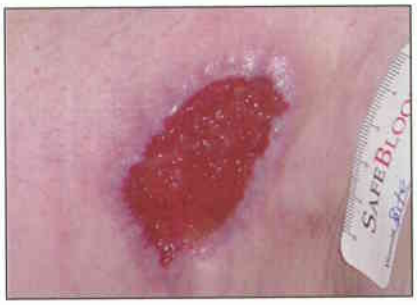
She presented for a re-exam on 6/16/03. The wound was clean with good granulation, 8.2 x 5.3 x 1-1.4cm: with approx. volume of 52 cc. A second and final graft application was applied, the wound again dressed for one week with Tegaderm™ and gauze, and patient care for two weeks.



On 6/30/03 the wound was progressing rapidly, closing 66% from the previous treatment [6.1 x3.8 x. 8 cm.] and a volume of approximately 18.5 cc. and was clean and solid. The wound was again dressed for one week with Tega-derm™ and gauze.

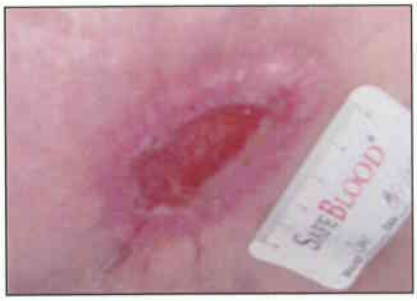


On 7/7/03 the wound was progressing well, 5.2 x 3.3 x .3 cm. with approx. volume of 5.15 cc.

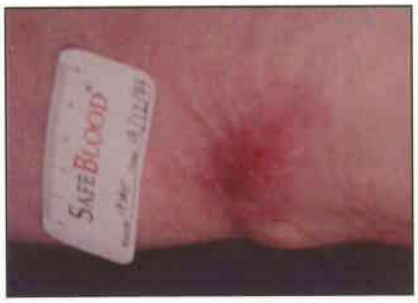


On 8/1/03 the wound was flush with the skin. There was no erythema and the skin integrity was good. The surface (epithelial layer) was open 4 x 2 cm. with no measurable depth. The wound covering was switched to a simple Telfa™ dressing.

It's a grafting procedure without donor site healing required.



The patient has not returned for additional follow-up, but has dressed and cared for her wound personally. A follow-up photo was taken on 9/12/03. The wound is closed and the natural color is returning. She reports no pain. No flap procedure is expected.



Points significant to this case study include that:

The initial dressings were applied weekly with no patient contact; no antibiotics were given after the graft(s) were applied; the patient noticed only minimal pain initially; and the patient was able to return to work shortly after the procedure.

Conclusion

The ABTG procedure represents an autologous, advanced therapy to bolster the wound care armamentarium. It's a grafting procedure without donor site healing required. We have found it to be efficacious, economical and easily integrated into patient care plans. For more information please contact SafeBlood Technologies at www.safebloodtech.com, or at 800.854.4855, or circle reader service #152. ■

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Dr. Dellinger (left) is a 1997 graduate of the Ohio College of Podiatric Medicine. He completed a PSR-24 at PHS Mt. Sinai East Hospital in Cleveland, OH and entered private practice in Little Rock, AR. He currently practices at The Center for Wound Healing at Southwest Regional Medical Center in Little Rock and is a partner at Foot & Ankle Associates of Central Arkansas. He is also co-medical director for SafeBlood Technologies.

Dr. Holland graduated from the University of Arkansas Medical School in 1980 and completed his family practice residency in 1983. He has actively participated in the development of chronic wound care protocols and techniques of evaluation, preparation and implant of the SafeBlood Graft™. He serves as the Medical Director for Wound Care at Select Specialty Hospital and as a wound care advisor and physician at SemperCare Hospital, Little Rock, AR.