



The More Things Change, the More They Remain the Same

Here's an historical review of diabetic wound care.

BY JOHN M. GIURINI, DPM

Introduction

In 1915, Dr. Elliott P. Joslin opened the William Nast Brodbeck Cottage clinic for the treatment of diabetic patients.¹ It was situated next door to the New England Deaconess Hospital in Boston, Massachusetts. In 1922, he was the first to administer insulin in New England to Miss Elizabeth Mudge, a 41-year-old woman who weighed 74 pounds. After six weeks, she gained 31 pounds, was walking four miles a day, and went on to live 25 more years.

Dr. Joslin understood firsthand the complications resulting from uncontrolled diabetes, including those affecting the foot. In 1928, he appointed Dr. John F. Kelly to supervise a foot clinic for diabetic patients at the Brodbeck Cottage.² He also appointed Dr. Kelly to the staff of the New England Deaconess Hospital, the first podiatrist appointed to the medical staff of a major hospital. With the subsequent recruitment of Drs. Leland McKittrick and Frank Wheelock, a general surgeon and vascular surgeon respectively, Dr. Joslin had assembled the first multidisciplinary team for the care of the diabetic foot, a model that serves as the cornerstone of care today.

Seventy-five years later, it appears that much has changed in the management of diabetic foot disease. But has it really? Over the past 90 years, there have been major advances in the diagnosis and treatment of

peripheral vascular disease. Foot surgery in the diabetic patient, once verboten, is now considered standard of care, including major reconstructive procedures. There are now more wound care products on the market than any of us can name, ranging from simple topical dressings to advanced cellular and biologic products. This article will explore this his-

unusual for patients to be admitted until their wounds and infections were healed and they were actually able to walk out of the hospital. At that time, the daily rate for a hospital bed was \$10 per night.¹ These foot lesions were likely purely neuropathic ulcerations as vascular evaluations and interventions for ischemic ulcerations were extremely limited. Isch-

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tory and how things have changed. In the end, we may discover that management and treatment of diabetic foot disease has changed little from the days of Drs. Joslin, Kelly, McKittrick, and Wheelock.

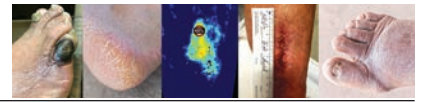
The Early Years

When the George F. Baker Clinic opened in 1934, Dr. Kelly had very limited resources to care for the diabetic foot. Treatment likely consisted of palliation of pre-ulcerous lesions such as corns and calluses. Wounds were likely dressed with the popular topical antiseptics of the day, iodine and mercurochrome. Off-loading was achieved with crutches, wheelchairs, or admitting patients to the inpatient side of the Baker Clinic. It was not

emic wounds would typically result in major amputations.

Techniques for off-loading and topical wound care products have advanced significantly over the years. As it's no longer possible to keep patients in the hospital for extended periods of time, alternate off-loading techniques and devices have been developed. Total non-weight-bearing with crutches or a walker remains the most effective means to alleviate plantar foot pressures in the diabetic foot. However, compliance with these is very low. Therefore, compromises in the form of total contact casts, off-loading accommodative pads, or specialized post-operative shoes are used to decrease these forc-

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es. Each of these has been shown to be effective with its own advantages and disadvantages.⁶⁻⁸ Therefore, the practitioner is advised to choose these carefully.

As previously stated, local wound care consisted of whatever antiseptic solution was available at the time, most often topical povidine iodine or mercurochrome. While they were presumed to be effective in keeping wounds clean, little was known about local toxicity. Even today there are few studies that specifically look at the in vivo toxicity of either of these products. The past 25-30 years has seen an explosion of products on the market for diabetic ulcerations. These include medicated gauze, hydrogels, growth factors, medical grade honey, biologic products such as living skin equivalents, amniotic membranes in various preparations, even stem cells.

Transmetatarsal Amputations

The next significant development in the history of diabetic foot care occurred when Dr. Leland McKittrick joined the diabetic foot team. Trained as a general surgeon, Dr. McKittrick developed an interest in the diabetic foot. He developed a diabetic foot surgery service that at the time was primarily focused on major limb amputation. Then, in 1949, he presented his results of a novel procedure that resulted in preservation of limb length and a walkable foot not requiring a prosthesis: the transmetatarsal amputation (TMA).³ Between July 1944 and January 1949, Dr. McKittrick performed 215 TMAs for distal gangrene or infection. One hundred and fifty-five went on to completely heal. Sixty patients failed their TMA and required a more proximal amputation. There were only two deaths. The overall limb salvage rate was 72%, which is truly remarkable considering the inability of the surgeon to objectively assess perfusion beyond clinical assessment and the limited availability of antibiotics to control infection. This procedure rapidly caught on and was given the name the "Deaconess Operation". It continues to be a viable and valuable procedure today.

While the TMA spared many diabetic patients loss of limb from infection or neuropathic ulcerations, there remained one cohort of patient who were not helped by this procedure. There were few options for patients with peripheral vascular disease (PVD) as there was a lack of understanding of the disease process

abietic peripheral vascular disease involved arteries below the knee but spared the pedal vessels. Based on Wheelock's earlier work and paper and experience with using the greater saphenous vein as a graft, vascular surgeons began performing more distal bypasses, first from the femoral artery to the anterior

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itself. Additionally, there were no objective ways of measuring arterial flow and, consequently, there were no interventions to correct any obstructions. In the mid-50s, Dr. McKittrick brought on a young associate, Dr. Frank C. Wheelock, who developed an interest in the diabetic foot as well and specifically in arterial insufficiency.

In 1961, Dr. Wheelock presented a paper at the New England Surgical Society (NSS) in Manchester, Vermont that would change the way we assess and manage diabetic foot problems forever.⁴ He reported on 54 diabetic patients who underwent arterial reconstruction for gangrene and rest pain. Eleven patients underwent aortoiliac reconstruction via endarterectomy or bypass using bank graft while 43 patients underwent femoral to popliteal reconstruction. Nine of the eleven patients had excellent long-term patency and limb salvage. One patient thrombosed the graft at 14 months and one month expired in the immediate post-operative period. Of the 43 patients undergoing more distal procedures, 38 had immediate initial success. Of the five immediate failures, there were four thromboses while in the hospital and one death. Overall, these early results were considered excellent, resulting in either limb salvage or local, minor amputations (toes or TMA). Another seminal development was the use of the saphenous vein as a conduit for vascular reconstruction.

Another finding that Dr. Wheelock observed was the fact that di-

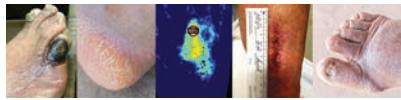
tibial or dorsalis pedis arteries but eventually from the popliteal artery to the anterior tibial/dorsalis pedis. Several long-term outcome studies documented the feasibility, long-term patency and success of this procedure.^{9,10} This also allowed podiatric surgeons to perform more local foot-sparing procedures, including reconstructive procedures which were not previously permitted.¹¹⁻¹³ This ushered in the era of limb salvage surgery as we know it today. Today, endovascular procedures are being performed routinely for limb salvage, but open bypass procedures still have their place.

The Era of Proactive Wound Care

Treatment of diabetic foot ulcerations took another significant leap forward in the mid- to late '90s when David Knighton published his first article regarding platelet-derived wound healing factor (PDWHF) for use in diabetic foot ulcerations.¹⁴⁻¹⁶ He described obtaining a sample of blood from the patient and isolating the platelet layer which was used as a topical dressing on the patient's ulceration. This platelet layer contained a variety of factors believed to promote healing of diabetic ulcers. From this early work, a number of medical advances developed. Platelet-derived growth factors (PDGF) are now being bio-engineered for use on diabetic and venous stasis ulcerations as well as for bone healing and repair of ligaments and tendons.¹⁷⁻¹⁹

In addition to these developments,

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the creation of a network of wound centers was significant.²⁰ Because procurement of PDWHF required specialized equipment and personnel, it was most economical that these procedures be performed in specialized centers. These centers employed physicians, nurses, and technicians trained in wound care. This included not only treatment with PDWHF but wound debridement, various off-loading techniques, and dressing products. Soon, wound care centers were being established around the country with great regularity.

In addition to PDGF and other topical growth factors, other products and treatments would soon be developed for the treatment of diabetic foot ulcers, such as living skin equiv-

Surgical Off-loading and Reconstruction

Much of the 1990s and early 2000s was spent developing new topical wound products and dressings. These products were developed to address various wound characteristics such as excessively dry wounds or moist wounds or wounds with varying amounts of fibrotic tissue. In spite of these advances in wound care, many wounds would still not heal or would recur. It was during the late 1990s and early 2000s that we started to see a greater shift to “surgical off-loading”: surgical interventions for non-healing or recurrent ulcerations or unstable Charcot joint deformities. Prior to this time period, surgery on the diabetic foot was controversial. Diabetic patients were

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alents, negative pressure wound therapy (NPWT), and hyperbaric oxygen treatment (HBOT).²¹⁻³⁰ We were now moving into the era of proactive wound care. The establishment of wound care centers was significant not so much for its use of PDWHF but rather for the development of a well-defined protocol on how to evaluate and treat different ulcerations, protocols initially espoused by the New England Deaconess Hospital and Joslin Diabetes Center. Namely, these included: debridement of wounds, evaluation and treatment of impaired blood flow, treatment of infection, and off-loading of plantar wounds. In addition, control of diabetes through medication, exercise, and diet were also part of the treatment algorithm. This quickly became the standard of care for the treatment of diabetic foot ulcerations as well as other types of ulcerations. This was codified in a consensus statement published by the American Diabetes Association in 1999.³¹

often advised by their primary care physicians or endocrinologists to avoid all foot surgery for fear of infection or lack of healing, resulting in amputation.

Yet, those of us working in academic medical centers with the support of a multidisciplinary team were seeing a completely opposite picture. When properly evaluated and managed by a team knowledgeable in diabetic foot disease, diabetic patients not only healed their surgical sites but would also heal their previously recalcitrant ulceration. This resulted in limb salvage rates as high as 85%.³²⁻³⁴ Papers published from these academic centers documented not only their experience but also the value of the multidisciplinary approach. Today, it is uncommon for a diabetic patient with an ulceration to be denied surgery simply because of diabetes.

Charcot joint disease was first described in 1863 as a bizarre pattern

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of bone destruction in patients with peripheral neuropathy. Today, diabetes is the leading cause of this complication. In the past, treatment of this

treat the diabetic foot than they did 75 years ago in the era of Drs. McKittrick and Wheelock—from special dressings and advanced wound products/devices to advanced surgical techniques. Yet the basic princi-

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complication consisted of prolonged periods of non-weight-bearing and immobilization in the hopes of arresting the process. Often, this resulted either in a rigid foot with a rocker-bottom deformity and risk of ulceration or instability of the foot requiring lifelong management with custom shoes and braces. Surgery was almost never a part of the treatment algorithm. If it was, it was typically confined to simple “bump and run” procedures, i.e., resection of bony prominences causing ulcerations.^{35,36}

This philosophy began to shift in the late 1990s and early 2000s.³⁷

⁴⁰ Reconstruction of mal-alignments in the form of midfoot, hindfoot, and ankle fusions was being successfully performed, resulting in more stable lower extremities being resistant to ulcerations. Limbs that previously would have gone on to below-knee amputations were now able to be braced, functional, and salvaged. This shift in management of the Charcot foot was the result of a number of developments in the 2000s: improved understanding of the mechanics and natural progression of the deformity, improved pre-operative imaging, improved surgical training, and improved fixation devices and techniques.^{41,42}

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Where Are We Today?

Podiatric physicians today have many more tools in their toolbox to

principles have not changed: evaluate the blood flow, treat the infection, and offload the ulceration. The when, how, and what modalities used can sometimes be confusing, but the wound care specialist would do well to always remember the basic principles. As wound care specialists, we have all had the experience of seeing patients with longstanding, chronic wounds where one or more of these principles were not followed. Without adherence to these principles, it does not matter what is applied to the wounds. As

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Dr. Larry Harkless always said, “It doesn’t matter what you put on the wound. It’s what you take off the wound that matters, namely non-viable tissue and pressure” (personal communication). **PM**

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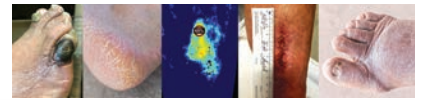
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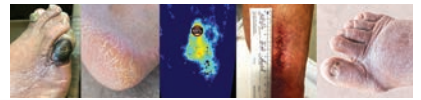
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