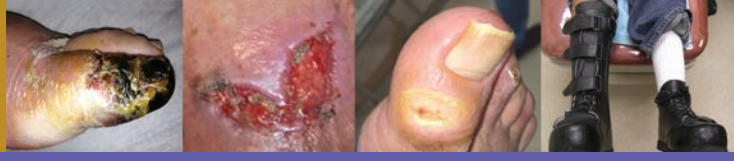
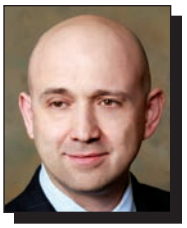



David Armstrong, DPM


Nicholas Bevilacqua, DPM


Robert Frykberg, DPM


Adam Landsman, DPM


Alexander Reyzelman, DPM


Stephanie Wu, DPM

Fighting the Good Fight: Wound Care and Podiatry 2017

Our experts discuss the latest trends in this area.

BY MARC HASPEL, DPM

There is no greater area of medicine where podiatric physicians can exhibit their skillful expertise on the multi-disciplinary stage than in wound care. DPMs, working as part of the healthcare team, have embraced the role of being wound care leaders in a variety of settings: their offices, hospital clinics and operating rooms, nursing home facilities, and wound care centers. At every one of these locations, they are charged each day with the life-saving task of healing wounds, preserving limbs, and saving valuable healthcare dollars.

Of course, the successful practice of wound care encompasses a wide expanse of modalities and techniques. From performing basic wound debridement to handling vast new surgical techniques with external fixation, from promptly recognizing neurovascular conditions to ordering state-of-the-art topical wound healing products, sound wound care practice demands a comprehensive working knowledge of all aspects of medicine in order to be effective.

PM has invited six acknowledged leaders in the wound management/diabetes arena to discuss a mix of issues related to the current practice of wound care. They generously shared their insights into this important wing of podiatric medicine.

Joining this roundtable panel:

David Armstrong, DPM is a university distinguished professor of surgery and director of the Southern Arizona Limb Salvage Alliance at the College of Medicine at the University of Arizona.

Nicholas Bevilacqua, DPM currently practices at North Jersey Orthopaedic Specialists in Teaneck, New Jersey. He is fellowship-trained and board certified in foot surgery and reconstructive rear foot and ankle surgery by the American Board of Foot and Ankle Surgery and is a fellow of the American College of Foot and Ankle Surgeons.

Robert Frykberg, DPM is the chief of podiatry at the Phoenix VA Health Care System in Phoenix, Arizona, and is an adjunct professor, Midwestern University Program in Podiatric Medicine and professor of Practice, University of Arizona College of Medicine-Phoenix. His research and writing interests are in diabetic foot disorders, including ulcers, wound care, infections, and the Charcot foot. He was the 2011 recipient of the prestigious Roger Pecoraro Award from the Foot Care Council of the American Diabetes Association.

Adam Landsman, DPM is chief of the division of podiatric surgery for the Cambridge Health Alliance, and is an assistant professor of surgery at Harvard Medical School. He has been in practice and serving as a biomedical engineering consultant for over twenty-five years, and has published more than eighty peer reviewed papers.

Alexander Reyzelman, DPM is the co-director of the UCSF Center for Limb Preservation. He's also an associate professor at the California School of Podiatric Medicine at Samuel Merritt University. He's board cer-

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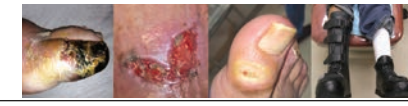

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tified in foot surgery by the American Board of Podiatric Surgery.

Stephanie Wu, DPM is the associate dean of research, professor of podiatric surgery and applied biomechanics, professor, Center for Stem Cell and Regenerative Medicine, and director, Center for Lower Extremity Ambulatory Research (CLEAR) for the Dr. William M. Scholl College of Podiatric Medicine at Rosalind Franklin University of Medicine and Science. Dr. Wu has more than 150 book chapters and peer reviewed publications and has served as principal investigator in more than forty clinical research trials. Dr. Wu is also a highly regarded lecturer at national and international forums, having given over four hundred presentations in over forty countries.

PM: *Wound debridement comes in many forms, from surgical to enzymatic to Versa-Jet to maggot therapy. How do you choose the most appropriate vehicle?*

Frykberg: It depends on the quality and severity of the wounds, the patients, the vascular statuses, the presence of infection, as well as the settings, e.g., the operating room versus the clinic. If patients present in the clinic with fibrinous superficial wounds with slough and modest degrees of necrosis, sharp debridement utilizing a scalpel or curette will be performed. Home care will frequently follow with daily collagenase applications. We will do this even in patients with modest degrees of ischemia if we feel that immediate hospitalization (or revascularization) is unwarranted. In mildly infected patients, we will do the same, but rely more on sharp rather than enzymatic debridement.

For debilitated or non-surgical candidates in a skilled nursing facility or nursing home setting, we might consider maggot therapy to gently debride the wound. For hospitalized patients with deep infection, sharp debridement will always be used. We reserve the hydro-jet device for subsequent debridements, when there is an extensive amount of necrosis or devitalized tissue. We are using ultrasonic debridement more often to fine tune our debridement after having previously sharply debrided necrotic wounds. The ultrasound debridement is frequently repeated until wounds are ready for delayed closure. We will also use ultrasound debridement to prepare otherwise satisfactory healing wounds for skin grafting or prior to placing dermal, amniotic, or cellular implants on wounds to expedite closure.

For debilitated or non-surgical candidates in a skilled nursing facility or nursing home setting, we might consider maggot therapy to gently debride the wound.—Frykberg

Reyzelman: I mostly use surgical debridement as it's the fastest, and the most reliable, method. However, I also use enzymatic debridement on patients who either can't tolerate surgical debridement, or when surgical debridement is not indicated. Many times, I use a combination of debridement techniques in order to accomplish the goal. For example, I use appropriate dressings that promote autolytic debridement when surgical debridement is too painful. Since surgical debridement is usually performed once weekly, I find it may be important to continue some type of debridement throughout the week on a daily basis, with either enzymatic or autolytic debridement techniques.

Landsman: My choices depend on where patients are being seen. In the clinic, the debridement is usually more superficial, and focuses on stimulation of bleeding in the wound bed, and reducing peri-wound callus. When there is extensive necrosis, I still use maggot therapy and enzymatic debridement, since I find this difficult with just a scalpel and/or tissue nipper. More recently, I too have started to use the ultrasonic type of debridement devices with some early success. On the other hand, in the operating room, debridement techniques are dictated by the depth of the wound and extent of debridement needed. I like to use Versa-Jet or similar devices for wounds with more necrotic tissue. Moreover, I use pulsed lavage with antimicrobial solutions to clean the wound.

Wu: The type of modality I select depends on the patient, vascular status, the wound characteristic, and the type of debridement. In general, debridement can be categorized as surgical/excisional and maintenance debridement. Instruments for sharp dissection, Versa-Jet, and contact ultrasound are often selected for surgical or excisional debridement. Enzymatic and autolytic debridement are commonly selected for maintenance debridement. Enzymatic or autolytic debridements are more appropriate for patients who have peripheral artery disease where revascularization is not possible and who are not candidates for surgical or excisional debridement.

Bevilacqua: Sharp debridement with a scalpel remains my gold standard in the office for debridement of uninfected wounds. I am aggressive in removing all fibrotic and necrotic tissue; however, I may consider enzymatic debridement as a supplement to remove any remaining fibrotic tissue. In the operating room, I use the Versa-Jet hydro-scalpel during incision and drainage cases as well as for debridement and debulking partial foot amputations. The hydro scalpel allows for layered debridement, and this device is also my go-to tool for preparing a wound bed for split-thickness skin graft.

PM: *How does vascular testing fit into your wound care/diabetic treatment plan?*

Armstrong: Our group has worked hard to evangelize the "toe and flow" model of podiatric and vascular surgery as one team. This above

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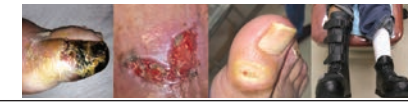

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all else is a game-changer in how we address the acute-on-chronic disease of the high-risk extremity. I think that prompt, good quality hemodynamic testing (i.e., toe pressures/waveforms) along with good quality tissue perfusion testing (i.e., skin perfusion pressure/hyperspectral/transcutaneous oximetry) are helpful and important in advance of vascular intervention.

Landsman: We check circulation for every patient who presents with a wound, but also for all diabetic patients. If pulses are non-palpable, then we also do a Doppler exam and frequently segmental pressures. We also assess skin perfusion with an infrared spectroscopy device. This recognition of peripheral arterial disease and its contribution to ulcer healing is critical in order to save limbs.

I am a big proponent of microvascular as well as macrovascular testing.—Wu

Wu: Non-invasive vascular testing is an essential part of the physical exam administered to every patient who presents with a chronic wound. In general, patients don't go to doctors right away if they have a wound. They try to heal the wound themselves for a period of time, often months, before finally deciding that they need help. We need to assess and address the impeding factors in order to ultimately help the patients heal. Inadequate vascularity is, for the most part, a correctable component to healing and is one of the basic factors that need to be ruled out when assessing wounds.

I am a big proponent of microvascular as well as macrovascular testing. Adequate macro vascularity does not equal adequate micro vascularity. Ankle brachial indices can often be falsely elevated because of calcifications, and an ABI of > 0.9 does not necessarily mean adequate vascularity. While there are pros and cons to the currently available microvascular assessment tools, it's important to take that extra step to assess micro-vascularity, and not assume adequate local perfusion based on macro-vascular assessments alone.

Reyzelman: I have a very low threshold in ordering non-invasive arterial studies for my patients who present with chronic non-healing ulcerations. During the past two decades, there has been a shift from strictly neuropathic ulcerations to more ischemic and neuro-ischemic ulcerations. Early device has been a game changer for us since it measures perfusion of skin across the entire surface of the foot. Not only is it helpful for predicting local deficits in perfusion, it also helps us to plan skin flaps when amputations become necessary.

Frykberg: I routinely obtain baseline non-invasive arterial studies for all ulcerated patients and closely follow the ADA consensus panel guidelines on peripheral arterial disease published in 2003, and then again in the 2008 Comprehensive Diabetic Foot Examination Task Force paper. I recognize that the presence of pulses, or absence thereof, are generally not sufficient to properly evaluate the vascular status of an ulcerated diabetic patient. While segmental limb pressures and ankle-brachial indices are basic measures evaluated, we also pay close attention to pulse volume recordings, toe systolic pressures, skin perfusion pressures, and transcutaneous oxygen measurements. I always carry a hand-held Doppler in my lab coat so that I can also evaluate the arterial signals for myself. More often than not, monophasic Doppler signals require vascular referral, or angiography, for further evaluation for the need for vascular intervention.

Q ***PM:*** *Why don't we work harder to get to closure and use split-thickness skin grafts more?*

Armstrong: I think it is really important to nurse a wound. As a team, we have to manage drainage, pain, and a little bacterial load. We also, however, need to doctor a wound. Skin grafting has been dramatically under-utilized in the high risk diabetic foot and in the high risk extremity in general. I urge my colleagues to really consider this. Our goal should not just be wound care, but wound closure. That's, in fact, real care. Then, we can focus on extending ulcer-free days in remission.

Bevilacqua: After achieving a granular wound bed, the physician should follow the plastic surgery ladder, which includes basic and advanced techniques for closure. Basic techniques include split thickness skin grafts. More advanced techniques include random, pedicle and free flaps. The majority of wounds can be closed using basic techniques.

Reyzelman: The availability of advanced tissue products during the past ten years has clearly led to the decline of split-thickness skin grafts use. Location of the wound plays a role as well. I believe that patients with foot ulcers/wounds that are located on the weight-bearing surfaces of the foot should avoid these grafts, and that patients do better via secondary intention healing. I continue to use split-thickness skin graft for our larger wounds that are not on the weight-bearing surface of the foot.

Landsman: I think that the evolution of biologics has led us to the point where the value of the traditional split-thickness skin graft is less clear. Cryopreserved skin allografts provide all of the collagen and growth factors necessary. Similarly, the amniotic products provide a completely distinct mix of growth factors, which may stimulate wounds to heal. Additionally, new technologies such as Medline Autologous Regeneration of Tissue and KCI Cellutome give an alternative approach to harvesting autologous tissues without the donor site morbidity associated with split-thickness skin grafts.

Wu: Currently published meta-analyses show that while split-thickness skin grafts have upwards of one hundred percent success rates in burn pa-

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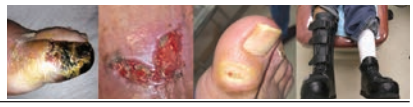

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tients, there is minimal research available studying split-thickness skin grafts in patients with diabetes or venous ulcers. In fact, current data tend to support the use of certain bio-engineered alternative tissue products due to efficacy demonstrated by well-designed, large, randomized clinical trials.

Bioengineered alternative tissue products are often used in lieu of traditional split-thickness skin grafts because of the associated donor site morbidities, in addition to concerns over efficacy in diabetic and venous wounds. Patients with chronic wounds, when given a choice, generally prefer something out of a box versus creating additional wounds on their body. This trend, or perception, may change as new advances in technology would allow harvesting skin grafts with minimal to no donor site morbidity.

Frykberg: I agree that we should be using split-thickness skin grafting more often than we have traditionally done. Perhaps this is a function of prior training, habit, or variability in state licensures. Several states preclude podiatric physicians from operating above the ankle and, thereby, prohibit taking a skin graft even from the calf. Interestingly, this is my preferred site for harvesting grafts on such patients since it is far more convenient than the thigh. Obvious cosmetic concerns in some patients will of course determine the host sites for harvesting the skin graft. Over the last several years, we have increased our frequency for applying split-thickness skin grafts to appropriate wounds and routinely bolster the grafts with negative pressure wound therapy.

PM: *How do you go about deciding whether to use (or not use) an advanced biologic? And what parameters do you use to select the specific biologic appropriate for the wound?*

Frykberg: This is somewhat arbitrary, although we do try to use the four week, fifth percent rule as recommended in numerous practice guidelines. Our initial advance modality will most often be negative pressure wound therapy. When the wound bed is appropriate, we will add a biologic. Complex wounds with exposed deep structures will most often be covered with a cryo-preserved amniotic membrane with viable stem cells, or a natural collagen-based structural graft/implant. For the latter, we are moving to a piscine (fish) dermal matrix that has a similar structure to human dermis and is less costly than other dermal implants (porcine, bovine, equine, ovine).

Sometimes, we will combine the two or use them sequentially. Tissue-engineered products are also appropriate at this juncture and have demonstrated efficacy in closing difficult wounds. We always prefer to use those products that have undergone formal trials or prospective study showing their efficacy and/or their effectiveness in managing such wounds.

I begin to use a biologic as soon as I feel that a wound has become stagnant and is not progressing.—Landsman

Landsman: I begin to use a biologic as soon as I feel that a wound has become stagnant and is not progressing. My decision on a specific biologic usually is based on my best guess as to what is needed to jump-start the wound. If there is a great deal of granulation tissue, I will try to stabilize it with a de-cellularized collagen. If the wound is non-progressive, but otherwise looks normal, I usually use the cryopreserved skin allograft, which provides lots of everything that normal skin needs to heal, and is my first line of therapy in at least seventy-five percent of the cases. If there is still no progress, I may try to kick-start things with an amniotic product. If erythematous, I choose a foamed collagen to try as a sacrificial material to burn out matrix metalloproteinases. Lately, I have also been using esterified hyaluronic acid to stimulate angiogenesis and stem cell migration.

Wu: I too recognize that a commonly used criteria in deciding the need for an advanced biologic is the percent change in ulcer area after four weeks of good wound care. This is, of course, based on Peter Sheehan's 2003 landmark article. This tool has been widely adapted as a pivotal clinical decision point for identification of patients, who may not respond to standard care.

Wound characteristics including location, size and depth, supporting evidence, insurance coverage, and patient tolerance are all factors that can affect selection of a specific advanced wound healing modality. Currently available advanced biologics come from different sources, vary in size, thickness, and characteristics. I try to match the needs and limitations of a wound with appropriate characteristics of a specific product to ultimately convert a deep wound to a superficial wound and a superficial wound on to a closed wound.

For example, I had a patient with a non-healing wound on the distal aspect of a traumatic Lis Franc amputation stump. The 0.6 cm deep wound was between two osseous prominences so that negative pressure wound therapy did little to help fill in the wound with granulation tissue. In this case, a thicker acellular regenerative dermal matrix was used to help convert the 0.6 cm deep wound to a superficial 0.2cm wound that subsequently progressed on to healing.

Bevilacqua: The treatment of diabetic foot ulcers is multi-factorial. The foundation of treatment is infection control, recognition of vascular disease, and implementing a non-compromising off-loading plan. Implementing these basic tenets with appropriate debridement, we should expect a weekly reduction of wound surface area. Sheehan, et al., conducted a prospective, controlled trial

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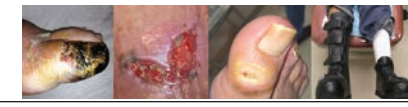

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on diabetic foot ulcers that were not complicated by ischemia or infection. After providing good clinical care, featuring debridement and off-loading, the researchers found that wound area changes over a four-week period can strongly predict wound healing over a twelve-week period.

If the ulcer size fails to reduce by half over four weeks of good fundamental wound care, the patient is unlikely to achieve wound healing over a reasonable time and requires more advanced therapies (Sheehan, P., et al. *Diabetes Care,* 2003). Again, split-thickness skin grafting is my gold standard for wound closure; however, if not indicated, I'll consider cell-based technologies for granular wounds, and acellular matrix-based grafts to provide a scaffold for deeper wounds.

PM: *Understanding that total contact casting remains the gold standard of wound care off-loading, why do many doctors seek off-loading alternatives, and which ones do you prefer?*

Armstrong: I think that we all have to compromise with our patients. I certainly do. That said, I try compromise as little as possible. The total contact cast remains our go-to off-loading tool for simple plantar forefoot ulcers. Moreover, we like some of the newer generation cast walkers that can be rendered irremovable.

Wu: We published a study back in 2008 that found less than two percent of the nine hundred geographically diverse centers that provided treatment for diabetic foot ulcers across the United States utilized total contact casting. Some of the main factors affecting utilization included time required to apply the total contact cast, and patient tolerance of the total contact cast. Possible alternatives to total contact casting include the instant total contact cast that has been shown by studies to offload the foot just as well as the total contact cast, and soft contact casting for patients who are unable to tolerate either of the former.

Reyzelman: Total contact cast is not a preferred method of off-loading by the patient, and I believe that it's probably the biggest reason that it's not used as often as we would like. It also requires skill and patient compliance in order to prevent cast complications. In our facility, we use a combination of off-loading devices and attempt to tailor them to patients based on their activities, lifestyles, and compliance. Most frequently, we use a below-the-knee walking boot with a felt/foam off-loading pad adhered to the patient's foot.

Frykberg: Application of total contact casts requires a certain skill and time allotment in most cases. I suspect that this is why they are not used as much as they might otherwise be. Nonetheless, in several prior studies, irremovable cast walkers have been shown to be as effective as total contact casts in healing plantar diabetic foot ulcerations. The problem is obviously that most such devices are not made irremovable, perhaps due to the need for daily dressing changes, and that patients will not strictly adhere to appropriate off-loading as recommended. In cases involving infected wounds, complex wounds, neuro-ischemic wounds, or those requiring negative pressure wound therapy, the removable devices are certainly warranted.

Landsman: Although total contact casting has been the gold standard, I have had numerous cases where secondary wounds have developed. The reasons for selecting an alternative are the time commitment needed to apply a total contact cast, the costs involved in the materials to do one, and the fear of complications including development of new wounds. Patients typically do not like it due to the weight and inconvenience of it. My preferred alternative is felted foam, and fabrication of a healing sandal in the office.

Bevilacqua: I use the instant total contact cast in my practice. Applying a total contact cast is time-consuming, and if not done correctly, may result in pressure sores. An instant total contact cast is a removable boot rendered irremovable, and wound healing efficacy and cost-effectiveness of the instant versions have been demonstrated in several randomized controlled trials (Armstrong DG, et al. *Diabetes Care,* 2005).

PM: *What is your recommended treatment of Charcot joint disease?*

Wu: Currently, the medical treatment for Charcot neuro-arthropathy is really aimed at off-loading the foot, treating the bone disease, and preventing further foot fractures. Off-loading with an irremovable total contact cast or instant total contact cast during the active stage of Charcot is an important management strategy to help prevent or minimize the progression to deformity. Immobilization is generally continued until the edema and erythema has resolved, and the temperature of the affected foot is within 2°C of the contralateral foot. This is followed by protective weight-bearing after the active episode, with prescription boots, braces, or shoes. Some have recommended Achilles tendon lengthening or gastrocnemius recession concomitantly with total contact casting to improve alignment and reduce forefoot pressure.

Anti-resorptive medications are often advocated to help with excessive osseous turnover in patients with active Charcot, even though there is little evidence to support their use. Of the anti-resorptive medications, I prefer intranasal calcitonin over bisphosphonates because it acts directly to reduce bone turnover, it only inhibits osteoclasts, and it has a safer profile in patients with renal failure. More studies, however, are needed to better guide the use of pharmacological therapies.

Surgery is generally reserved for cases of bone infection, unstable or severe deformity, and for osseous prominences that cannot be successfully accommodated with therapeutic footwear or devices.

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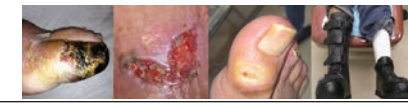

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Frykberg: I follow the 2011 International Consensus on the Charcot foot published in *Diabetes Care*. This review clearly discusses the pathophysiology, diagnostic studies, and various treatment modalities that are applicable for this entity. Other than neuropathic ankle joint fractures, initial medical/conservative management is recommended including off-weighting and casts or removable fixed ankle walkers. I believe that pharmacological and biophysical adjunctive therapies cannot be given strong recommendations because of insufficient data or conflicting study results. Ankle joint Charcot arthropathy is considered primarily a surgical disorder after resolution of acute inflammation and edema. Nonetheless, this disorder is highly complex and complications should be expected. Great care and caution is necessary, but with respect for the magnitude of this disorder, surgery can certainly be undertaken in appropriate persons at the opportune time.

Reyzelman: For the most part, we believe in a more conservative approach, which includes immobilization, ostectomies, and tendon balancing. There are certainly situations that require open and external fixation; however, patient selection is critical. In summary, I believe that less is more when treating patients with Charcot.

Bevilacqua: Ideally, this diagnosis is not delayed, and the treatment for acute active Charcot is strict immobilization and off-loading. Off-loading is the most important management strategy to preserve the architecture of the foot/and or ankle and prevent deformity. Patients are followed closely for clinical assessment, and serial radiographs are performed to assess healing and alignment. The duration of off-loading is guided by the clinical assessment of healing based on resolution of swelling and redness. Dermal thermometry is useful to help monitor skin temperatures. Patients are transitioned to protective weight-bearing after an acute episode in a protective boot, and this is followed by therapeutic footwear.

Surgical intervention in considered in the inactive Charcot to correct deformity that cannot be successfully accommodated with therapeutic footwear, bracing, or a Charcot Restraint Orthotic Walker.

Armstrong: The fact is that most of our Charcot patients do not require surgery. Of the twenty percent that do, two-thirds of them get away with some tendon balancing and exostectomy. One third require some sort of osteotomy and external fixation. We

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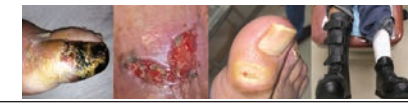

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have been gravitating to IM nails lately for ankle Charcot.

Q ***PM:*** *Diabetic neuropathy remains a particularly tough clinical challenge. What are your diagnostic tests and treatments of choice?*

Wu: The International Neuropathy Guidelines define diabetic peripheral neuropathy as the presence of symptoms and/or signs of peripheral nerve dysfunction in people with diabetes after the exclusion of other causes. There is no pathognomonic test for diabetic peripheral neuropathy. Other common causes of peripheral neuropathy such as alcoholism, medications, B12 deficiency, and uremia need to be ruled out.

Most screening instruments for diabetes peripheral neuropathy, including 5.07/10g Semmes Weinstein Monofilaments, are non-invasive, inexpensive, sensitive, and highly predictive of clinical endpoints. Subjective signs and symptoms, along with a thorough physical exam, including deep tendon reflexes, motor strength, proprioception, and vibration sense are essential in the clinical evaluation of DPN. One single instrument, however, may not be sufficient for sensory testing. History-symptom questionnaires such as the Michigan Neuropathy Screening Instrument and the Diabetic Neuropathy Symptom Score are helpful with subjective symptoms. Nerve conduction study is the most sensitive for detecting early changes in diabetic peripheral neuropathy; however, it may not provide actionable data or change the course of treatment, and may not necessarily be a screening instrument.

Currently available medications for diabetic peripheral neuropathy are aimed at symptomatic relief. Pregabalin and duloxetine are both FDA-approved for painful diabetic peripheral neuropathy. Pregabalin is by far the most extensively studied drug in diabetic peripheral neuropathy. It also has no drug interactions and is ideal for patients with polypharmacy. Duloxetine is the only agent FDA-approved for major depressive disorder as well as for painful diabetic peripheral neuropathy. There is a third drug FDA-approved for diabetic neuropathic pain—Tapentadol extended release, a novel centrally-acting opioid analgesic. Because of the high risk for addiction, however, along with weaker evidence for its use, Tapentadol ER is reserved for third line treatment. It should be noted that recent studies appear promising for alpha-lipoic acid, an antioxidant that can potentially help correct the underlying pathogenesis of diabetic microvascular complications including neuropathy. Further studies are, of course, needed.

Landsman: In the office, I rely on Semmes-Weinstein, sharp/dull, and reflex measurements. When in doubt, I usually consult neurology for more definitive testing. My treatments to date are primarily gabapentin, Lyrica, or alpha lipoic acid. The alpha lipoic acid can also be used in combination with either the gabapentin, and is thought to potentiate this medication. The side-effects of alpha lipoic acid are very minimal, including no dizziness, and the cost is very low, so many of my patients prefer this.

Frykberg: Diabetic neuropathy is multi-dimensional, and is an important risk factor for most diabetes-related foot disorders. If a patient walks into your office or clinic with a foot ulcer without a limp, that patient has neuropathy. As Paul Brand implied, pain is the gift that nobody wants, and, nonetheless, is a gift from God. The diagnosis at this point has been made, and the loss of protective sensation will not be reversed to any significant degree. It is in the earlier stages that diagnosis is more critical, especially since progression can be hindered and primary diabetic foot prevention measures can be instituted. Aside from the simplistic monofilament exam, I also recommend using the time-tested tuning fork exam to detect diminished sensation. Another popular clinical diagnostic test is the Ipswich Touch Test first put forth by Gerry Rayman from Ipswich, UK. The neuropad has been confirmed as a good clinical indicator for autonomic neuropathy, through identifying anhidrosis, in association with peripheral sensory neuropathy, and is easily done in the office setting.

I don't believe that Achilles lengthening should be performed on all patients with forefoot amputations.—Reyzelman

While there are several more exotic diagnostic testing instruments available, a simple biothesiometer has been well established not only as a method to detect diminished sensation, but also as a predictor for ulceration risk. This can easily be used in any clinical setting for such assessments. We do not routinely perform diagnostic epidermal nerve fiber density biopsies for our patients, nor do we perform corneal confocal microscopy to follow the progression of neuropathy. Nonetheless, both methods have gained increasing popularity, and have a good deal of evidence to support their use.

As far as treatment goes, it has been established that tight diabetes glucose control was by far the most important treatment to prevent progression of the disease. Painful neuropathy can be treated and improved with a variety of established medications based on rigorous clinical trials. We routinely use tricyclic antidepressants, gabapentin, pregabalin, and duloxetine for such patients.

Armstrong: We also start with a simple Ipswich touch test. It has been found to be as accurate as a biothesiometer/monofilament. We have not performed many epidermal biopsies, but I like the idea of having something that's histologically quantifiable.

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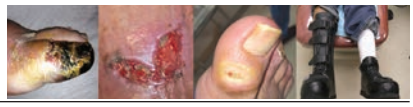

Wound Care *(from page 106)*

Q ***PM:*** *Considering the impact that forefoot amputation has on equinus, do you agree that Achilles tendon lengthening be performed with all forefoot amputations, and why or why not?*

Frykberg: No, I do not agree with this statement. Personally, I do not routinely lengthen the Achilles tendon unless an equinus is present at the time of surgery. If recurrent ulcers occur after an amputation has healed, even without significant equinus, I will consider a primary or adjunctive Tendo-Achilles lengthening. The only amputation that I believe must routinely have the Achilles tendon addressed is the Chopart amputation. For this procedure, we perform an Achilles tenotomy rather than lengthening.

Bevilacqua: The loss of some of the extensor tendons leads to muscle imbalance, and after transmetatarsal amputation, an equinovarus deformity is a commonly reported complication. I routinely perform a Tendo-Achilles lengthening or a gastrocnemius recession to address the equinus component.

Wu: I believe that patients should be evaluated individually as many patients present with varying degrees of equinus. In most cases, Achilles tendon lengthening may be the obvious choice. The addition of selective plantar fascia release, however, may be required in certain cases while gastrocnemius recession may be better suited in others.

While studies have found Achilles tendon lengthening to help reduce plantar forefoot pressures, an aggressive Tendo-Achilles lengthening can lead to complications such as calcaneal gait, tendon rupture, and heel ulceration. It's best to decide on the procedure in a case-by-case basis as opposed to a blanket procedure for all forefoot amputations.

Reyzelman: I don't believe that Achilles lengthening should be performed on all patients with forefoot amputations. Achilles lengthening is not a risk-free procedure, and over-lengthening can have dire consequences. One of the most difficult ulcers to treat is the one that develops on the plantar aspect of the calcaneus as a result of over-lengthening or complete transection of the Achilles. In our facility, we perform a fair number of these procedures, but only in patients who actually have equinus. Many patients have plenty ankle dorsiflexion and do not require an Achilles lengthening.

Landsman: Although the logic of combining Achilles lengthening (or release) in conjunction with forefoot amputation is apparent, it is still critical to measure each patient before performing tendon surgery. If the patient is highly flexible and has good range of motion at the ankle, the addition of a Tendo-Achilles lengthening may result in new heel ulcers and a calcaneus gait pattern.

Armstrong: I'm not sure everyone needs a Tendo-Achilles lengthening following a transmetatarsal amputation or ray resection, but many can benefit. The same goes for good quality tendon transfers on flexible deformities. We like tibialis anterior (not split, whole) transfer into the third cuneiform or cuboid.

Q ***PM:*** *Eliminate everything except one or two things from your medical/surgical armamentarium in terms of tissue repair and wound healing—what would remain?*

Armstrong: I think many people know how excited we are about evaluating new technologies. The hard part is marrying that excitment with an equal dose of cynicism. We tend to ask of each new technology whether it can make our patients' lives, and ours for that matter, easier. When we do that, we are often left with just two things: negative pressure wound therapy and standard split-thickness skin grafting. The first is to help us vertically address the depth of the wound, while the latter is to help in epithelialization. Even with eliminating much of our other technologies, we'd be okay with those two.

Landsman: I would retain cryopreserved skin allografts because I truly believe that it is the most complete treatment option we have for most wounds. I would also keep my scalpel (and would try to sneak in some Plastizote to line shoes) because I believe that debridement and off-loading are the cornerstones of diabetic foot ulcer management.

Reyzelman: I agree. I would keep surgical debridement and felt/foam off-loading.

Frykberg: I would go with negative pressure wound therapy and one advanced tissue substitute, either an acellular dermal tissue or a cellular product such as cryopreserved viable amniotic wound matrix.

Bevilacqua: I too would choose negative pressure wound therapy, but add external fixation. I lean on negative pressure wound therapy to manage complex wounds, and I employ it most often in the operating room after open partial foot amputations. It results in more rapid and robust granulation tissue, and my results are consistent with previous published randomized controlled trials, faster healing time, and reduced second amputations. Secondly, I would also select external fixation, specifically circular frames are a logical choice when treating Charcot foot and ankle deformities, especially in cases with open wounds or those complicated with concomitant osteomyelitis. External fixation allows for placement of fine wires away from the affected bones and joints and provides uniform compression for skeletal stability. External fixation provides soft tissue and osseous stability and allows access to the soft tissue throughout the recovery. **PM**

Dr. Haspel is senior editor of this magazine and past-president of the New Jersey Podiatric Medical Society. He is a member of the American Academy of Podiatric Practice Management.