



TCCs & DAMA in Obese Patients with Lymphedema

Here's how to achieve rapid closure of a DFU.

BY ANTHONY TICKNER, DPM AND JEFFREY JENSEN, DPM

Introduction

Diabetic foot ulcers (DFUs) are one of the most significant and devastating complications of diabetes with a prevalence of 4-10% in the diabetic population.^{1,2} DFUs open for more than 30 days are independently associated with 4.7 times increased risk of infection³ and foot ulcers precede 85% of lower extremity amputations in diabetics.^{4,6} These statistics contribute to the financial burden of diabetes complications, with Barshes, et al. reporting DFU care at \$17,000,000,000 when peripheral arterial disease is included and \$11,000,000,000 when treating DFU with neuropathy alone.⁷ Skrepnek, et al. reported that DFU costs for ED visits and inpatient care was \$8,780,000,000 in 2014.⁸ Those diabetics with comorbid conditions such as arterial/venous insufficiency, hypertension, and lymphedema are at even greater risk of impaired wound healing.^{9,10}

The management of diabetic foot ulcers is a major therapeutic challenge to achieve the goals and reduce the burden of care in an efficient and cost-effective way. The basic principles of wound care include assuring adequate perfusion to heal, debridement to remove non-viable tissue, wound dressings to protect the wound and maintain an appropriate moist environment, infection surveillance and prompt management, and off-loading to redistribute weight and eliminate repeated trauma

to the wound area.¹¹ Managing these variables is not an easy task. In 2014, Fife, et al. reported from the U.S Wound registry that from 2008-2013 in 96 clinics in 23 states, only 4,896 out of 221,192 clinic visits for diabetic foot ulcers had off-loading documented in the charts.¹²

Even though Snyder, et al.¹¹ in their consensus document in 2010 stated, "From a practical standpoint, more widespread adoption of effective

when and which advanced wound care products should be used to stimulate recalcitrant wounds to move toward closure.

Knowing that total contact casting (TCC) has most consistently demonstrated the best healing outcomes and is a cost-effective treatment,¹⁶ and knowing that some wounds are extremely difficult to heal with total contact casting alone, it is often necessary for clinicians to

**DFUs open for more than 30 days
are independently associated with 4.7 times
increased risk of infection and foot ulcers precede 85%
of lower extremity amputations in diabetics.**

off-loading modalities would make the most improvement in DFU healing," we do not know when to effectively intervene with advanced technologies to enhance hard to heal wounds. For example, even with implementation of basic principles, as much as 70% of ulcers will fail to respond and will require more sophisticated intervention to stimulate closure.¹³ The International Working Group on the Diabetic Foot has conducted two systematic reviews of the evidence and effectiveness of interventions to enhance the healing of chronic diabetic foot ulcers.^{14,15} There remains a scarcity of data to describe

use their own clinical judgment as to the appropriate care to render and to be flexible and innovative in application of wound management principles to address the unique needs of each patient.

Case Study

FB was a 62 year-old man who was referred to the Saint Vincent Hospital Wound Care Center. He was 6 feet 9 inches tall and morbidly obese, weighing 500 pounds (BMI 53.6), with significant bilateral lymphedema. His calf circumference at presentation was more than

Continued on page 78



Figure 1: Initial application of DAMA



Figure 2: DAMA covered with non-adherent layer and absorbent foam dressing

Lymphedema (from page 77)

70cm. He was referred to the center for a non-healing ulcer of the right heel, which despite routine visits for wound care, had persisted for more than one year. Off-loading had been previously attempted, but between his weight and leg girth, all efforts

flow and venous return, exacerbating the lymphedema. He went on to use a walker and diabetic shoes with modified inserts prior to our involvement. Our mission then was to find a means to off-load the wounded foot, return FB's mobility, thereby improving his psycho-social status and close the plantar wound—all without sig-

Total contact casting (TCC) has most consistently demonstrated the best healing outcomes and is a cost-effective treatment.

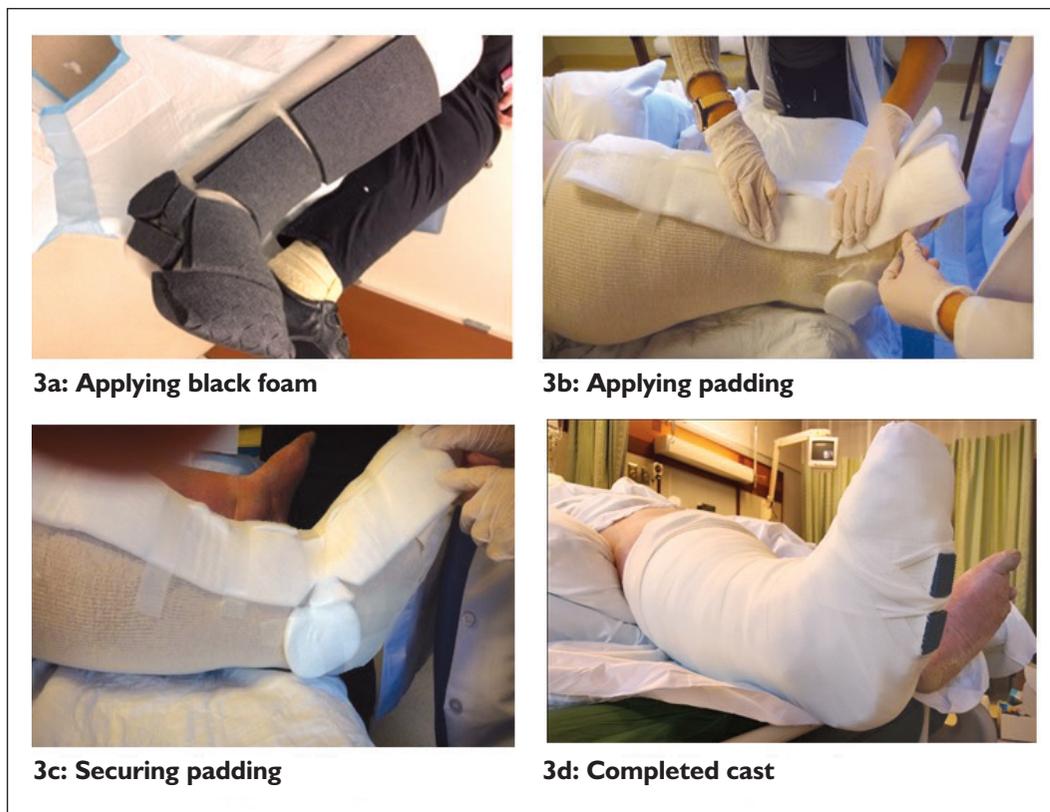
that permitted mobility had failed, so he was off-loaded in a wheelchair. This plan was very short-lived as his body habitus and the need for a specialty wheelchair decreased his mobility, challenged his ability to perform activities of daily living, and inhibited his social interactions.

Additionally, the wheelchair added to the inherent knee flexion, further compromising both his arterial

nificantly worsening his lymphedema.

The plantar wound measured 2.4x2.4cm (Length x width) and 1 cm deep (Figure 4). The ulcer was sharply debrided, removing the surrounding callus and exposing a beefy red granulation tissue wound bed. Absent signs of infection, a piece of dehydrated amniotic membrane allograft (DAMA)* was applied to the wound (Figure 1), covered with a non-adherent dressing, and then a super absorbent foam dressing** (Figure 2), which was secured to the surrounding skin. After consultation with the author's wound care teams, it was decided that a TCC would provide FB with the rigid support he needed while still permitting ambulation. A TCC*** was applied, albeit it required the contents of 2-3 kits to provide sufficient padding and casting material to build a cast (Figures 3a-3d) that would provide mild compression as well as adequate weight re-distribution in the rigid, mobile system.

Continued on page 80



3a: Applying black foam

3b: Applying padding

3c: Securing padding

3d: Completed cast

Figure 3: Application of TCC (a) Applying black foam over application (b) applying padding (c) Securing padding (d) Completed TCC



Lymphedema (from page 78)

Routinely, decongestive therapies such as compression bandaging, manual lymphatic drainage, and physical exercise are used to improve dermal lymphatic plexus lymph flow. Controlled studies have demonstrat-

and resolution of the edema coupled with limited ambulation.^{12,20}

In this case, compression was provided by the application of the off-loading device, which aided in maintaining his mobility and helped create a measurable diminution of his lymphedema. In this case, the

Decongestive therapies such as compression bandaging, manual lymphatic drainage, and physical exercise are used to improve dermal lymphatic plexus lymph flow.



Figure 4: Initial presentation



Figure 5: Week 5 from initial DAMA application



Figure 6: Complete closure at Week 9

ed the benefits of compression in improving lymphedema and wound healing.^{17,18} The TCC was changed twice each week during FB's treatment to accommodate the changing girth of the leg. Over the course of treatment, his leg circumference was reduced by 20%, from 70 cm down to 56 cm. Additionally, his improved mobility increased his performance of activities of daily living and improved his socialization, enhancing his mood and overall quality of life, and resulting in the loss of 50 pounds over the treatment period.

DAMA was re-applied about every two weeks during the changes of the TCC. Five weeks after the initial DAMA application, the wound had been reduced by 53%, and measured 1.6x1.7x0.2cm (Figure 5). Nine weeks after the initial DAMA application, the wound was completely re-epithelialized (Figure 6).

Discussion

Diabetes generally causes damage to the arteries and capillaries, and lymphedema may result. Although massive localized lymphedema is usually considered a rare condition, it is closely linked to morbid obesity, the incidence of which is increasing.¹⁹ Together, these diseases damage both the arterial and lymphatic systems, as well as the subcutaneous tissue, connective tissue, and skin. The result is swelling, decreased levels of oxygen in the skin and connective tissue and increased susceptibility to infection. Most commonly, some type of decongestive physiotherapy is recommended to facilitate venous return

TCC cast was changed twice a week during treatment to ensure that a snug fit was maintained. Despite his shrinking calf girth, there was no piston-like movement of the leg inside the cast. This ultimately led to preventing areas of shear and pressure, thus avoiding the development of additional wounds.

Inadequate off-loading of the ulcer has been reported to be a significant reason for delays in ulcer healing, even in an adequately perfused limb²¹ and repeatedly, studies have demonstrated the greater efficacy of total contact casts over removable off-loading modalities.^{16,22} Despite this, TCC is often under-utilized in daily practice.²³ Less than half of wound care centers consider TCC as the gold standard for treating a non-infected diabetic foot ulcer.²⁴

Although it is understood that pressure reduction is a key element in successfully closing an ulcer, up to 41% of routines use less successful and often ineffective shoe modifications instead of more robust off-loading techniques.²⁵ Wu, et al.(24) found that the lack of support for non-removable off-loading devices was attributed to multiple reasons, but the most common included patient tolerance (55.3%), application time (54.3%), cost of material (31.6%), reimbursement issues (27.5%), and familiarity with application method (25%). Cases such as the one presented demonstrate the success that can be obtained with TCC, although innovative approaches to the implementation of basic off-loading and

wound care principles may need to be employed.

During treatment, the newly returned mobilization improved the lymphedema, reduced calf girth, and with lifted spirits, the patient could again undertake activities of daily living and lost weight. With creative casting techniques, we were able to provide adequate off-loading despite significant lymphedema, which coupled with the application of DAMA, was able to support the closure of this chronic wound in just nine weeks. Expeditious wound closure was accomplished in this challenging

Continued on page 82



Lymphedema (from page 80)

case with diligent application of the principles of good wound care and a creative approach to off-loading. **PM**

Expeditious wound closure was accomplished in this challenging case with diligent application of the principles of good wound care and a creative approach to off-loading.

Acknowledgements: Cheri Klinghard RN, CWON, DWC and Alicia Belanger, RN, BSN for helping to care for this patient for the duration of his treatment.

We would also like to thank Randi Rutan for her tireless efforts, assistance and editing of this manuscript.

Disclosure: Drs. Jensen and Tickner are both consultants for DermaSciences but received no compensation or honoraria for the article.

* DAMA refers to AMNIOEXCEL, DermaSciences Inc, Princeton NJ

** XTRASORB, Derma Sciences Inc, Princeton NJ

*** MedEKast, Derma Sciences Inc, Princeton NJ

References

- ¹ Margolis DJ, Malay DS, Hoffstad OJ, Leonard CE, MaCurdy T, Lopez de Nava K, Tan Y, Molina T, Siegel KL. Prevalence of diabetes, diabetic footulcer, and lower extremity amputation among Medicare beneficiaries, 2006 to 2008. Data Points Publication Series (Internet); Rockville MD; Agency for Healthcare Research and Quality (US); 2011.
- ² Lauterbach S, Kostev K, Kohlmann T. Prevalence of diabetic foot syndrome and its risk factors in the UK. *J Wound Care* 2010; 19:333-337.
- ³ Lavery LA, Armstrong DG, Wunderlich RP, Mohler MJ, Wendel CS, Lipsky BA. Risk factors for foot infections in individuals with diabetes. *Diabetes Care* 2006; 29(6):1288-93.
- ⁴ Moxey PW, Gogalniceanu P, Hinchliffe RJ, Loftus IM, Jones KJ, Thompson MM, Holt PJ. Lower extremity amputations—a review of global variability in incidence. *Diabet Med* 2011; 28(10):1144-53.
- ⁵ Apelqvist J, Larsson J. What is the most effective way to reduce incidence of amputation in the diabetic foot? *Diabetes Metab Res Rev* 2000; 16:S75-83.
- ⁶ Pecoraro RE, Reiber GE, Burgess EM. Pathways to diabetic limb amputation—

Basic for prevention. *Diabetes Care* 1990; 13(5):513-21.

⁷ Barshes NR, Sigireddi M, Wrobel JS, Armstrong DG. The system of care for the diabetic foot: Objectives, outcomes and opportunities. *Diabet Foot Ankle*. 2013;

10(4); doi: 10.3402/dfa.v4i0.21847.

⁸ Skrepnek GH, Mills JL Sr, Armstrong DG. A diabetic emergency one million feet long: disparities and burdens of illness among diabetic foot ulcer cases within emergency departments in the United States, 2006-2010. *PLoS One* 2015; 10(8):e0134914. doi: 10.1371/journal.pone.0134914. eCollection 2015.

⁹ Apelqvist J, Larsson J, Agardh CD. The importance of peripheral pulses, peripheral edema and local pain for the outcome of diabetic foot ulcers. *Diabet Med* 1990; 7(7):590-4.

¹⁰ Apelqvist J, Larsson J, Agardh CD. Medical risk factors in diabetic patients with foot ulcers and severe peripheral vascular disease and their influence on outcome. *J Diabetes Complications* 1992; 6 (3): 167-74.

¹¹ Snyder RJ, Kirsner RS, Warriner RA, Lavery LA, Hanft JR, Sheehan P. Consensus recommendations on advancing the standard of care for treating neuropathic foot ulcers in patients with diabetes. *Ostomy Wound Management* 2010; 56 (Suppl 4): S1-24.

¹² Fife C. Massive localized lymphedema, a disease unique to the morbidly obese: a case study. *Ostomy Wound Manage* 2014; 60(1):30-5.

¹³ Margolis D, Kantor J, Berlin J. Healing of neuropathic ulcers receiving standard treatment: a meta-analysis. *Diabetes Care* 1999; 22(5):692-5.

¹⁴ Game FL, Hinchliffe RJ, Apelqvist J, Armstrong DG, Bakker K, Hartemann A, Löndahl M, Price PE, Jeffcoate WJ. A systematic review of interventions to enhance the healing of chronic ulcers of the foot in diabetes. *Diabetes Metab Res Rev* 2012; 28(Suppl 1): 119-41.

¹⁵ Hinchliffe RJ, Valk GD, Apelqvist J, Armstrong DG, Bakker K, Game FL, Hartemann-Heurtier A, Löndahl M, Price PE, van Houtum WH, Jeffcoate WJ. A systematic review of the effectiveness of interventions to enhance the healing of chronic ulcers of the foot in diabetes. *Diabetes Metab Res Rev* 2008; 24(Suppl 1): S119-22.

¹⁶ Snyder RJ, Frykberg RG, Rogers LC, Applewhite AJ, Bell D, Bohn G, Fife CE, Jen-

sen J, Wilcox J. The Management of Diabetic foot ulcers through optimal off-loading. *J Am Podiatr Med Assoc* 2014; 104 (6):555-67.

¹⁷ Mars M, Desai Y, Gregory MA. Compressed air massage hastens healing of the diabetic foot. *Diabetes Technol Ther* 2008; 10(1):39-45.

¹⁸ Armstrong DG, Nguyen HC. Improvement in healing with aggressive edema reduction after debridement of foot infection in persons with diabetes. *Arch Surg* 2000; 135(12):1405-9.

¹⁹ Fryar CD, Carroll MD, Ogden CL. Prevalence of overweight, obesity and extreme obesity among adults: United States trends 1960—1962 through 2011—2012. National Center for Health Statistics, Centers for Disease Control and Prevention. http://www.cdc.gov/nchs/data/hestat/obesity_adult_11_12/obesity_adult_11_12.htm

²⁰ Nelson EA, Hillman A, Thomas K. Intermittent pneumatic compression for treating venous leg ulcers. *Cochrane Database Syst Rev* 2014; 12(5):CD001899. Doi: 10.1002/14651858.CD001899.pub4

²¹ Lebrun E, Tomic-Canic M, Kirsner RS. The role of surgical debridement in healing of diabetic foot ulcers. *Wound Repair Regen* 2010; 18:433-8.

²² Burns J, Begg L. Optimizing the off-loading properties of the total contact cast for plantar foot ulceration. *Diabet Med* 2011 28(2):179-85.

²³ Fife CE, Carter MUJ, Walker D. Why is it so hard to do the right thing in wound care? *Wound Repair Regen* 2010; 18(2):154-8.

²⁴ Wu SC, Jensen JL, Weber AK, Robinson DE, Armstrong DG. Use of pressure off-loading devices in diabetic foot ulcers: do we practice what we preach? *Diabetes Care* 2008 31(11):2118-9.

²⁵ McGuire J, Greene T. What is the “essential” TCC? *Podiatry Management* 2014; podiatrym.com/pdf/2014/11/PodM-McGuire814webR2.pdf



Dr. Tickner is on staff at the Saint Vincent Hospital/RestorixHealth Wound Healing Center in Worcester, MA.



Dr. Jensen is Professor and Director of Research at the Paul & Margaret Brand Research Center of the Barry University School of Podiatric Medicine, Miami Shores, FL.