

Physiatrist's Management of Diabetic Foot Ulcer

V. Ramamoorthy

Professor and Head, Department of Physical Medicine and Rehabilitation, PSG IMS&R Hospitals, Coimbatore, Tamilnadu.

ABSTRACT

Diabetes is a metabolic disease that affects multiple systems. Even within the nervous system the manifestations of this disease can be wide and varied. Foot disorders are a main source of morbidity and a leading cause of hospitalization for person with diabetes mellitus. Ulceration, infection, gangrene and amputation are significant complications of diabetes. Although not all foot complications can be prevented, dramatic reductions in their frequency have been obtained through the implementation of multidisciplinary team approach to patient management. The objectives of diagnosis and treatment of diabetic foot sequelae center around maintaining the patient as an ambulatory, productive member of society or returning the patient to that state as quickly and safely as possible. This may at any time require the expertise of a number of different specialists on the diabetic foot care team and a Physiatrist is one among them. The physiatrist by virtue of his or her training is uniquely suited to serve as a primary member of a multidisciplinary team for the management of diabetic foot disorders and able to recognize impending diabetic foot complications. Total Contact Cast is considered the Gold standard to assist healing for active diabetic ulcerations by providing weight (pressure) redistribution and friction/shear control. Multiple randomized controlled clinical studies have been conducted which illustrate that the majority of diabetic foot ulcers heal with the use of TCC in a mean time of 35-52 days for 85-95% of patients.

Keywords: Diabetes mellitus, Diabetic Ulcer, Total contact cast

INTRODUCTION

Patients with diabetes are prone to multiple complications such as diabetic foot ulcer. Diabetic foot ulcer is a common complication of diabetes that has shown an increasing trend over previous decades. In total, it is estimated that 15% of patients with diabetes will suffer from diabetic foot ulcer during their lifetime. [1] Although accurate figures are difficult to obtain for the prevalence of diabetic foot ulcer, the prevalence of this complication ranges from 4%-27%. [2-4]

To date, diabetic foot ulcer is considered as a major source of morbidity and a leading cause of hospitalization in patients with diabetes. It is estimated that approximately 20% of hospital admissions among patients with diabetes are the result of diabetic foot ulcer. [5] Indeed, diabetic foot ulcer can lead to infection, gangrene, amputation, and even death if necessary

care is not provided. [6] On the other hand, once diabetic foot ulcer has developed, there is an increased risk of ulcer progression that may ultimately lead to amputation. Overall, the rate of lower limb amputation in patients with DM is 15 times higher than patients without diabetes. It is estimated that approximately 50% - 70% of all lower limb amputations are due to diabetic foot ulcer. [1] In addition, it is reported that every 30 second one leg is amputated due to diabetic foot ulcer in worldwide. [2]

Foot ulceration is the most common single precursor to lower extremity amputations among persons with diabetes. As a result of neuropathy, the foot can become deformed. This happens through two routes of reasons. The first is that the neuropathy causes paralysis of small muscles of foot, which result in clawing of the toes. Clawing of the toes causes prominence of the metatarsal heads in the

bottom of the foot as well as the knuckles on the dorsum of top of the foot. The neuropathy also causes diminished sensation. As the prominent metatarsal heads on the plantar aspect of the foot are subjected to increased pressure because of diminished sensation, the skin will begin to hypertrophy and become callused. The callused skin can be subjected to shear forces. The forces will cause a separation between the layers of the skin, which will fill with fluid, which can then become contaminated and infected. The pressure can also cause primary breakdown of the skin in these areas and the result is a foot ulcer. Once the initial breakdown and contamination occurs, the foot then can go on to significant problems of infection. Thus increased biomechanical stress is one of the most important pathways leading to ulceration in patients with neuropathic and neuroischemic foot ulcers.

Traditionally, diabetic foot ulcers are treated with regular dressings with frequent debridement with minimal weight bearing on the affected foot. The key element of any treatment program designed to heal these wounds is effective reduction in pressure (offloading). Offloading of the wound is one of the key elements in treating diabetic foot ulcers. Several offloading devices are available, such as walkers, half shoes, orthoses, felted foam and the total contact casting (TCC). Though offloading can be achieved by several orthotics, most of these are removable and strict compliance is not achieved thus reducing their effectiveness.

TOTAL CONTACT CASTING:

TCC is a casting technique that is used to heal diabetic foot ulcers. The cast is used to heal diabetic foot ulcers by distributing weight along the entire plantar aspect of the foot. It is applied in such a way as to intimately contact the exact contour of the foot. Hence the designation "Total Contact Cast". By relieving the bony prominent areas of pressure, the ulcers are permitted to heal if the cast is applied in such a way that the patient can remain

ambulatory during the treatment of the ulcer.

Pressure is expressed in terms of force or pounds over the area per square inch. Therefore, if the weight-bearing area is enlarged the pressure per unit of weight bearing area diminished. In this way the pressure area is enlarged and the pressure per unit of the weight bearing area is diminished. So the pressure which has been concentrated on the bony prominences is distributed over the entire plantar aspect of the foot, allowing reversal of the mechanism that caused the ulcer to occur. Total Contact Cast minimizes ground reactive pressure and shear (friction), eliminates the propulsive phase of gait, shortens stride length, allows for healing while ambulating and forces patient compliance.

Total contact cast has the advantage that it cannot be easily removed by the patient and limits activity which promotes rapid healing of ulcers. When correctly applied, it has proven not only to interrupt the chain of events in the pathogenic pathway that produces ulceration but it also changes the histology of the ulcer shifting it from a chronic inflammatory state to a more evolving condition. [7] Healing of ulcers using TCC takes approximately 6-8 weeks, during which the cast is replaced on a weekly basis. The cast is removed when complete healing is achieved, after which is recommended that the diabetic patient wear specially designed shoes that will relieve pressure over the ulcer healed area.

CAST APPLICATION:

Application of the cast should be as quick and smooth as possible to avoid lamination and thus weakening of the cast. The patient is kept in prone position. Placing the patient prone is the easiest way to apply the cast. Also the patient is more comfortable as he/she will not get cramps in the thigh or hip. The prone position allows the assistant to hold the appropriate position of the foot to the leg, usually ninety degrees to the leg. This position also allows the gastro-soleus complex to shift proximally

on the leg thereby removing their bulk allowing for the cast to fit more snugly. The cast should end at the widest point of the calf and should not end the cast at the knee level as this could impinge the common peroneal nerve.

Table 1: Materials required for Total Contact Casting (TCC)

Materials required	
3" or 4" stockinette	1 walking heel
1- 1 " tape	Silicone (clear-site)
Adhesive felt- 4" wide x 20-30" long	protectors
3" or 4" webril	Foam toe protectors
1-3" roll plaster casting tape	Precut plywood foot plate
2-4" rolls plaster casting tape	
1-2" roll synthetic casting tape	
1-3" roll synthetic casting tape	
2-4" rolls synthetic casting tape	

PROCEDURE:

Total contact casting is a precise procedure that requires skillful application. The ulcer is debrided in standard fashion and if a dressing has to be applied, it is held in position with one inch paper tape. Circumferential dressings are not recommended. The patient is placed in the prone position. Bony prominences, the posterior heel and achilles tendon are padded. One fourth inch adhesive felt is applied to the leg and foot starting anteriorly on the tibial tuberosity crossing the ankle, ending on the dorsum of the foot. Stockinet is placed from the toes to just below the knee. One to two inches are left past the toes, folded dorsally and held in position with one-inch tape. Folds are created at the ankle and the excess material is cut away and the ends of the stockinet are taped with one inch tape. One fourth inch foam is placed over the toes and past the metatarsophalangeal joints dorsally and plantarly to protect the toes and limit MPJ tendonous motion. The assistant stands lateral to the extremity and holds the foot 90 degrees to the leg while the knee is flexed 90 degrees. One thin roll of webril is snugly placed over the foot and leg with minimal overlap. One or two rolls of plaster rolls are placed from the distal aspect of the toes ending just below the fibular head. The toes should be fully covered with the plaster so that they do not move once the cast dries. A

5" x 30" splint double folded at the distal 1/3 is now applied plantarly from the toes ending posteriorly on the leg. The precut plywood is placed on the plantar aspect of the foot. It should at least meet the entire plantar aspect of the foot. Multiple precut 3" to 4" pieces of plaster material are used to fill voids in areas where the foot does not meet the wood so that absolutely no rocking of the wood on the foot is noted. Four-inch synthetic rolls are used to cover the foot and leg. The walking heel is centered in the middle of the foot in a line just distal to the long axis of the tibia. The foot and leg are held in this position for a minimum of 5 minutes to allow the cast to dry. The patient may now be placed in the supine position and sits for another 20 minutes while the cast dries. It is preferred to maintain non weight bearing for 24 hours until the cast sets up well. The cast is changed as often as necessary but at least weekly to check for healing and other ulcer formation. [8]

INDICATIONS FOR TCC:

The patient must be non-infected, have an adequate blood supply to heal (ABI >0.7) and the ulcer must be Wagner Grade I or II.

CONTRA INDICATIONS FOR TCC:

Acute infection, severe ischemia, claustrophobia, Wagner Grade III or IV ulcers and wounds that are probe to bone, tendon or capsule.

DISADVANTAGES:

Although a TCC seems a highly attractive offloading modality, several disadvantages have been reported: new ulcers may occur, daily wound care is not possible, mobility is impaired, costs may be relatively high, and specialized staff seems necessary. [9] The TCC technique is not very effective in reducing elevated plantar pressures at the heel region. In some cases the ulcer may not heal during cast treatment (cast failure). In case of prolonged casting, joint rigidity and muscular atrophy have been documented. [10]

CONCLUSION

Diabetic foot ulcer healing may be delayed if the ulcer is subjected to constant pressure while walking. Total contact casting provides optimal wound healing conditions by ensuring that the ulcer is not further traumatized and also prevents the development of new ulcers in the bony prominences of the foot. Hence TCC is an excellent procedure for healing diabetic foot ulcers. The Physiatrist plays an integral role in the management of new or impending diabetic foot lesions.

REFERENCES

1. Leone S, Pascale R, Vitale M, Esposito S. Epidemiology of diabetic foot Infez Med. 2012;20 Suppl 1:8-13.
2. Richard JL, Schuldiner S. Epidemiology of diabetic foot problems. La Revue de medecine interne. 2008 Sep;29:S222-30.
3. Nather A, Bee CS, Huak CY, Chew JL, Lin CB, Neo S, Sim EY. Epidemiology of diabetic foot problems and predictive factors for limb loss. Journal of Diabetes and its Complications. 2008 Mar 1;22(2): 77-82.
4. Bakri FG, Allan AH, Khader YS, Younes NA, Ajlouni KM. Prevalence of diabetic foot ulcer and its associated risk factors among diabetic patients in Jordan. Jordan Medical Journal. 2012 Apr;171(785):1-6.
5. Fard AS, Esmaelzadeh M, Larijani B. Assessment and treatment of diabetic foot ulcer. International journal of clinical practice. 2007 Nov;61(11):1931-8.
6. Snyder RJ, Hanft JR. Diabetic foot ulcers-effects on quality of life, costs, and mortality and the role of standard wound care and advanced-care therapies in healing: a review. Ostomy/wound management. 2009 Nov 1;55(11):28.
7. Piaggese A, Macchiarini S, Rizzo L, Palumbo F, Tedeschi A, Nobili LA, Leporati E, Scire V, Teobaldi I, Del Prato S. An off-the-shelf instant contact casting device for the management of diabetic foot ulcers: a randomized prospective trial versus traditional fiberglass cast. Diabetes care. 2007 Mar 1;30(3):586-90.
8. Jimenez A. Total Contact Casting. Update. 2003:282.
9. Armstrong DG, Lavery LA. Evidence-based options for off-loading diabetic wounds. Clinics in podiatric medicine and surgery. 1998 Jan;15(1):95-104.
10. Caravaggi C, Faglia E, De Giglio R, Mantero M, Quarantiello A, Sommariva E, Gino M, Pritelli C, Morabito A. Effectiveness and safety of a nonremovable fiberglass off-bearing cast versus a therapeutic shoe in the treatment of neuropathic foot ulcers: a randomized study. Diabetes care. 2000 Dec 1;23(12):1746-51.

How to cite this article: Ramamoorthy V. Physiatrist's management of diabetic foot ulcer. Int J Health Sci Res. 2020; 10(1):24-27.
