

The Custom Total Contact Cast—A Method for Treating Wounds with Underlying Biomechanical Deformities, A Case Report

Mohammad Junayed Khan, D.P.M., Anna Stoupine, D.P.M., Kamal Farha, D.P.M., Ji Hee Kim, D.P.M., Poovasit Klinoubol, D.P.M., AACFAS

Montefiore Mount Vernon Hospital, Mount Vernon, NY

Montefiore

DOING MORE™

BACKGROUND

- Offloading is a key element in the treatment of diabetic foot ulcerations (DFU), and the total contact cast (TCC) has been considered the “gold standard” for offloading pressure related DFUs
- The TCC maintains contact with the entire plantar foot and lower leg: this immobilizes surrounding joints and soft tissue while allowing the patient to remain ambulatory.¹ A TCC offloads pressure on the prominent areas of the plantar foot that are prone to skin breakdown and ulceration, and there are multiple studies demonstrating high healing rates of pressure-related DFUs with a TCC.^{2,3}
- The TCC was first described in a case series by Dr. Milroy Paul and Dr. Joseph Khan for treating non-healing ulcers secondary to Hansen’s Disease in Ceylon, India.⁶ Then, Dr. Paul Brand adopted the TCC for the treatment of diabetic foot ulcerations and brought the technique to the United States in the 1960s.⁷
- There have been many modifications of the total contact casts to treat DFUs since Dr. Brand first introduced it, but none directly address flexible, frontal plane biomechanical deformities.

OBJECTIVES

To introduce a novel approach to the standard total contact cast (TCC) technique that addresses biomechanical deformities. A step-by-step guide is detailed with a case-report of the custom TCC’s (C-TCC) utilization.

MATERIALS & METHODS

- The C-TCC was utilized on a 54-year-old diabetic female with a flexible cavovarus foot with a recurring plantar 5th metatarsal base wound.
- Weekly debridements, one-week dressings, and cast applications were performed under the supervision of a single physician.
- The C-TCC involves strategic padding, two forms of plaster of Paris with contouring, fiberglass, and a medial to lateral positioning of the foot during the application process.
- The progression of the wound and timeline of healing was documented and analyzed graphically through i-Heal.

DESCRIPTION OF TECHNIQUE

1. After application of appropriate 7-day dressing, apply a sterile, non-adhesive 4x4 foam and secure to foot.
2. With patient seated, stockinette is pulled over the lower extremity and extended proximal to the level of the knee and distally beyond the digits.
3. A pre-made, adhesive felt padding strip is applied to the bony prominences: medial/lateral malleoli and along the dorsum of the metatarsals to the anterior crest of the tibia.
4. Protective adhesive foam padding is secured with one-finger’s width between the digits and foam.
5. ABD pads are layered along the dorsum of the foot and anterior tibia. A heel pad is created by creating two slits on either side of an ABD pad and applied to the plantar and posterior heel.



Figure 1: Methods of dressing the wound and padding with foam, stockinette, felt pads, black foam and ABD pads. (Steps 1-5)

6. 4” roll of Webril is laid on circumferentially from the distal to proximal foot, locking the ankle. The next roll starts two finger’s width from the fibular head (or just inferior to the tibial tuberosity) and extends distally to meet the ankle. A final roll is applied to the foot, ensuring the distal forefoot is protected medially and laterally. The proximal stockinette is folded down over the Webril layers to create a protective edge.
7. The patient is repositioned to prone position with 90-degree flexion at the knee. The foot is placed in a neutral position with the ankle placed at neutral or slightly plantarflexed, depending on ulcer location and etiology.
8. A posterior splint spanning the length of the foot to the proximal aspect of the padded leg is made with 1 roll of 4” plaster of Paris. The posterior splint is wetted, applied, and molded closely to the posterior leg and foot.
9. Additional strips of plaster are applied and molded to fill the arch and correct any structural deformities of the foot.
10. A roll of 4” elastic-plaster is applied circumferentially to the foot and up the leg: if any flexible frontal plane deformities exists, pull cast medial to lateral or lateral to medial to bring the foot’s plantar surface to neutral.
11. A standard 4” plaster roll is applied similarly and a final third layer of plaster is conformed to the foot and leg.
12. A similar technique is used to lay on the fiberglass layers. First, a 4” fiberglass roll is applied from the distal foot to the ankle. A second roll is applied from proximal to distal leg. The final roll is applied to the foot to secure all layers and ensure a flat, plantigrade surface. A minimum of three fiberglass rolls are recommended depending on size.
13. After a period of drying, a stockinette can be used to cover the entire cast to prevent irritation to the other lower extremity and a surgical shoe is applied for better ambulation.



Figure 2: Application of Webril padding, posterior splint, arch filler, plaster of Paris, and while the patient is prone and the foot is in corrected position. (Steps 6-11)



Figure 3: Application of fiberglass while the patient is prone and the foot is in corrected position, completed with fitting of surgical shoe. (Steps 12 & 13)

CASE REPORT

HPI: 54-year-old uncontrolled diabetic female presented with left foot plantar ulcer at the level of the 5th metatarsal base. Patient had history of ulceration at the affected site.

- Past Surgical History: previous multiple digital amputations and an open plantar exostectomy of the left foot by another treating physician 1 week prior to her initial presentation at our wound care clinic.
- After the procedure, patient was instructed to weight bear as tolerated in a CAM walker, but she ambulated outside the boot leading to dehiscence and subsequent referral to the wound care center.

Physical Exam and Results:

- Ulcer to the plantar aspect of the proximal fifth metatarsal base measured 4.0 x 3.0 x 1.5 cm with a fibronecrotic wound base, hyperkeratotic and macerated borders. Positive probe to bone. No tunneling, undermining, or acute signs of infection. Palpable pedal pulses and loss of protective sensation to the left foot.
- Weight-bearing exam revealed a varus rearfoot almost exclusively to the lateral aspect of the calcaneus and midfoot. Non-weight bearing exam showed an internally rotated forefoot and rearfoot with a prominent 5th metatarsal styloid process. Varus deformity was noted to be flexible. The patient also had a cavus foot type. Subtalar joint range of motion was limited in eversion. Peroneal muscle strength was 0/5 to the LLE.
- Left lower extremity ankle-brachial index was 0.99.
- Deep wound culture was positive for multi-drug resistant *Enterobacter cloacae*. Cefpodoxime 200 mg QID was prescribed for 10 days.
- Radiographs obtained were negative for osteomyelitis and new exostosis formation.

Treatment: Ulcer was sharply debrided to healthy and bleeding wound margins. A silver absorptive dressing was applied to the wound. The patient had the custom total contact cast applied to the LLE in the technique described. Arch fill was used to offload the lateral aspect of the midfoot and distribute ground reactive force evenly throughout the cast and patient’s foot. The flexible cavovarus deformity was corrected by pulling the elastic plaster of Paris in a medial to lateral direction.

- Serial debridement, silver absorptive dressing and C-TCC were applied every week. Within 9 weeks of treatment, the ulcer epithelialized completely.
- At one-month follow-up, the ulcer remained epithelialized. Patient continued weight bearing in a surgical shoe with felt offloading pad. Patient awaits a CROW boot.

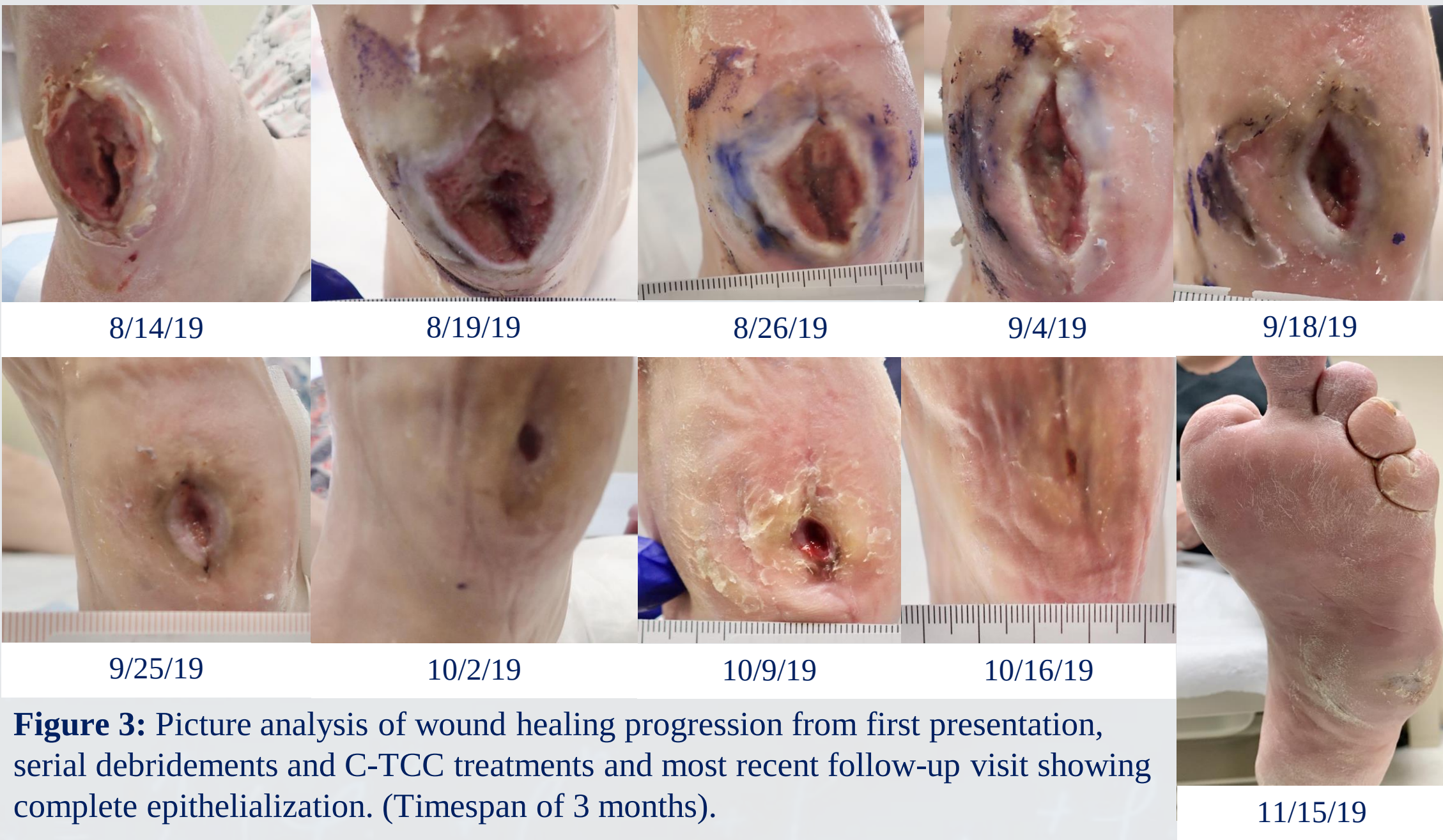
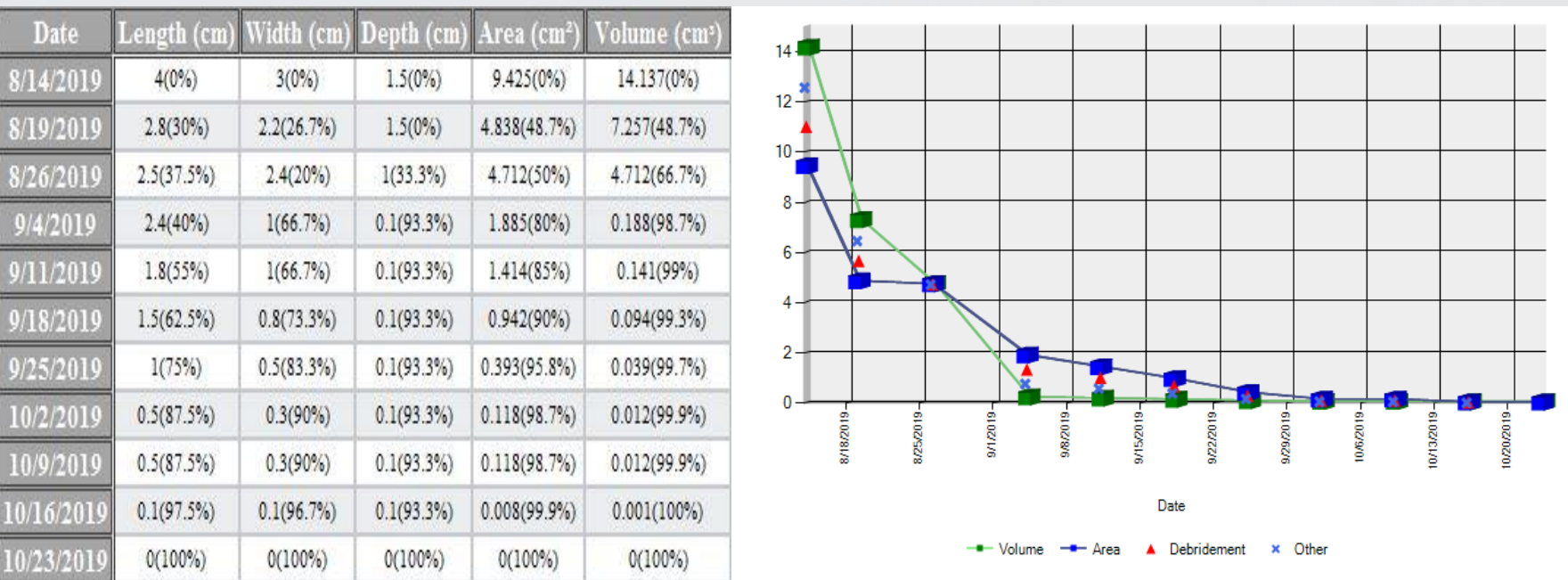


Figure 3: Picture analysis of wound healing progression from first presentation, serial debridements and C-TCC treatments and most recent follow-up visit showing complete epithelialization. (Timespan of 3 months).

RESULTS

- 48.7% ulcer volume reduction in 1 week of C-TCC offloading, 98.7% volume reduction by 4th week.
- Complete epithelialization occurred by the 9th week of serial C-TCC applications.



CONCLUSIONS

- The C-TCC is the first of its kind to address flexible, frontal plane deformities.
- The C-TCC standardizes strategic padding at bony prominences to reduce friction and increase compliance. Contouring of casting materials allows customized casting of the biomechanical deformity. Strengthening the construct with fiberglass brings the plantar surface to a neutral position.
- C-TCC is indicated in wounds of Wagner Grade 3 or less and in the absence of severe peripheral arterial disease. Wounds with mild-to-moderate levels of exudation can safely be treated with the addition of one-week, superabsorbent dressings.
- While outcomes of this case-report are promising, further studies are required to evaluate the efficacy and safety of the C-TCC technique.

REFERENCES

1. Armstrong DG, Nguyen HC, Lavery LA, van Schie CH, Boulton AJ, Harkless LB. Off-loading the diabetic foot wound: a randomized clinical trial. *Diabetes Care*. 2001;24(6):1019-1022.
2. Fife CE, Carter MJ, Walker D, Thomson B, Eckert KA. Diabetic foot ulcer off-loading: The gap between evidence and practice. Data from the US Wound Registry. *Adv Skin Wound Care*. 2014;27(7):310-316.
3. Elraiyah T, Prutsky G, Domecq JP, et al. A systematic review and meta-analysis of off-loading methods for diabetic foot ulcers. *J Vasc Surg*. 2016;63(2 Suppl):59S-68S e51-52.
4. Lewis J, Lipp A. Pressure-relieving interventions for treating diabetic foot ulcers. *Cochrane Database Syst Rev*. 2013(1):CD002302.
5. Sahu B, Prusty A, Tudu B. Total contact casting versus traditional dressing in diabetic foot ulcers. *J Orthop Surg (Hong Kong)*. 2018;26(3):2309499018802486.
6. Khan J. Treatment of Leprous Trophic Ulcers. *Lepr India*. 1939;11:19-25.
7. Coleman WC, Brand PW, Birke JA. The total contact cast. A therapy for plantar ulceration on insensitive feet. *J Am Podiatry Assoc*. 1984;74(11):548-552.
8. Jensen JL, Gillin BD, Inventors; Medeficiency, Inc., assignee. Apparatus and Method for Applying a Total Contact Cast. 2005.
9. Armstrong DG, Lavery LA, Kimbriel HR, Nixon BP, Boulton AJ. Activity patterns of patients with diabetic foot ulceration: patients with active ulceration may not adhere to a standard pressure off-loading regimen. *Diabetes Care*. 2003;26(9):2595-2597.
10. Alvarez OM, Markowitz L, Onumah N, Wendelken M. Swift Downregulation of Gelatinases (MMP-2, MMP-9) in Neuropathic Diabetic Foot Ulcers Treated With Total Contact Cast. *Wounds*. 2019;31(5):E39-E41.
11. Lavery LA, Higgins KR, La Fontaine J, Zamorano RG, Constantinides GP, Kim PJ. Randomised clinical trial to compare total contact casts, healing sandals and a shear-reducing removable boot to heal diabetic foot ulcers. *Int Wound J*. 2015;12(6):710-715.
12. Messenger G, Masoetsa R, Hussain I. A Narrative Review of the Benefits and Risks of Total Contact Casts in the Management of Diabetic Foot Ulcers. *J Am Coll Clin Wound Spec*. 2017;9(1-3):19-23.
13. Guyton GP. An analysis of iatrogenic complications from the total contact cast. *Foot Ankle Int*. 2005;26(11):903-907.
14. Tickner A, Klinghard C, Arnold JF, Marmolejo V. Total Contact Cast Use in Patients With Peripheral Arterial Disease: A Case Series and Systematic Review. *Wounds*. 2018;30(2):49-56.
15. Caravaggi C, Faglia E, De Giglio R, et al. 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;23(12):1746-1751.