Cost-effective analysis of using total contact casting for diabetic foot ulcer management

ABBAS SEE,[1] MANJULA MALLIKAGE,[1] JACQUELINE MILDRED,[2] ANDREA FRIEL,[2] MARY GRAY,[2] SAYYIED KIRMANI,[1] MICHAEL PIERIDES[3]

Key words: diabetic foot ulcer, total contact cast, multi-disciplinary team

Background

COVID-19 led to a national crisis. Services needed to change, prevention of contracting COVID-19 becoming paramount. Diabetes is a major problem, of increasing prevalence, faced by the NHS.[1] Diabetes is associated with increased risk of COVID-19 mortality.[2] A major complication of diabetes is diabetic foot ulceration (DFU) secondary to peripheral neuropathy and vascular insufficiency as well as mechanical factors such as reduced joint mobility or foot deformity.[3] Left untreated, these ulcers can lead to amputation.

A mainstay of treatment is offloading, to reduce pressure on the ulcer and the surrounding soft tissue and to precipitate wound healing. There are a number of different removable devices for offloading but non-removable total contact casts (TCCs) are widely regarded as the gold standard.[3-5] A TCC is a semi-rigid or rigid fibreglass cast that extends from the toes to just below the knee. Minimal padding is applied to the malleoli and the DFU: this allows total contact of the whole foot while isolating the DFU to reduce pressure and promote healing.[3] However, despite a large volume of evidence,[3,6-9] TCCs remain unpopular with most patients. TCCs can also be further modified by attaching a Bohler iron hoop to the plaster. The hoop rests below the plantar surface to allow for greater offloading.[10]

In our institution, DFU is managed by a multidisciplinary team (MDT) approach (diabetologists, antimicrobial pharmacists, orthopaedic foot and ankle surgeons, podiatrists and plaster technicians). Due to COVID-19 measures there was a significant reduction in use of plaster, which gave an opportunity to provide TCC treatment.

Aims

The aims of this study were to assess healing and cost-effectiveness of treatment with TCC.

[1] Department of Trauma and Orthopaedics, Kettering General Hospital, UK
[2] Multi-Disciplinary Diabetic Foot Team, Kettering General Hospital, UK
[3] Community Diabetes Centre, Kettering General Hospital, UK

Address for correspondence: Abbas See
Trauma and Orthopaedics Department, Kettering General Hospital, Rothwell Rd, Kettering, NN16 8UZ, UK
E-mail: abbassee@gmail.com

Br J Diabetes 2022;**22**:ONLINE ONLY
https://doi.org/10.15277/bjd.2023.404

Methods

All patients who had a TCC for DFU after January 2020 were identified. Selection criteria for TCC treatment included being ambulatory, having a chronic non-healing DFU, exhaustion of other conventional offloading treatments and an adequate vascular supply. TCCs were changed on a weekly basis to monitor wound progression, with sharp debridement and redressing. Retrospective data collection included baseline characteristics and costs of treatment.

Results

Five patients were included. The mean age of the patients was 56 years. All patients had a diagnosis of Type 2 diabetes (T2D). In all cases, the ulcers healed after TCC treatment and the average time to healing was seven weeks. The average BMI was 31 kg/m^2. There were no requirements for surgical debridement.

A summary of each patient can be found below.

During the time period of this study, none of the patients developed a new ulcer. Following successful treatment of the DFU, the patients went on to wear therapeutic footwear with bespoke total contact insoles.

Discussion

The results clearly show a positive outcome as all patients had fully healed ulcers after application of a TCC. Patients also had fewer courses of antibiotics after starting treatment, which indicates a lower infection rate. The improvements in healing rate in this cohort have been positively received within the team and further work has been undertaken in consolidating service pathways for the optimal patient journey. In particular, patient 4 is a prime example to show that the early use of TCC can facilitate rapid healing.

Cost of treatment was far greater prior to TCC administration in all five patients. The average cost of treatment was approximately 13 times higher prior to TCC. This is unsurprising given that all the patients had fewer outpatient appointments and fewer courses of antibiotics after commencing TCC. Despite the higher cost of TCC compared to other offloading devices, overall cost was reduced due to the lower demand on outpatient services. The reduced number of appointments also have the added benefit of reducing the risk of contracting COVID-19.

A potential risk of TCC is that the ulcer cannot be regularly reviewed due to the presence of the cast. To circumvent this, casts are often windowed or removed and reapplied to assess the patient for any ongoing infection. Although this incurs a greater

Table 1 A summary of treatment received and cost of treatment for the five patients, including average costs.

Patient	Treatment prior to TCC	Treatment after TCC	Total costs before TCC	Total costs after TCC
Patient 1	3 inpatient stays (52 days) 17 courses of antibiotics (11 as an outpatient and 6 as an inpatient) 9 outpatient podiatry appointments 19 MDT appointments	1 inpatient stay (16 days) 3 courses of antibiotics (1 inpatient, 1 outpatient, 1 unknown) 1 outpatient podiatry appointment 3 MDT appointments	£ 30,147.05	£ 8,618.16
Patient 2	4 courses of antibiotics (all outpatient) 16 outpatient podiatry appointments 8 MDT appointments	No antibiotic therapy No podiatry appointments No MDT appointments	£ 3,660.82	£ 537
Patient 3	1 inpatient stay (63 days) 14 courses of antibiotics for osteomyelitis (9 inpatient, 4 outpatient, 1 unknown) 24 outpatient podiatry appointments 20 MDT appointments	No inpatient stays 1 course of outpatient antibiotics 1 MDT appointment	£ 35,575.07	£ 1,686.75
Patient 4	No inpatient stays 1 course of IV antibiotics as an outpatient for soft tissue infection 2 outpatient podiatry appointments 4 MDT appointments	No inpatient stays No antibiotics No podiatry appointments No MDT appointments	£ 2,102.65	£ 676
Patient 5	7 inpatient stays (218 days) 34 courses of antibiotics for osteomyelitis (15 inpatient and 19 outpatient) 29 outpatient podiatry appointments 51 MDT appointments	No inpatient stays No antibiotics No podiatry appointments No MDT appointments	£ 95,619.02	£ 1,134
TOTAL cost for 5 patients			£167,104.61	£ 12,651.91
Average cost per patient			£ 33,420.92	£ 2,530.38

cost in materials, the overall cost is reduced as it avoids inpatient admissions.

Conclusion

In conclusion, an MDT approach was delivered successfully to a group of patients who had long-term foot ulceration. The use of TCC provided adequate offloading and in turn fewer hospital bed stays, less antibiotic therapy, fewer outpatient appointments and improved patient quality of life and patient experience. The result was substantial cost savings. The use of TCC would greatly improve our service as it both enhances patient care and reduces the financial strain on our department.

Conflict of interest MP has received payment or honoraria from Adtec, Novonordisk and Eli Lilly. The rest of the authors have no competing interests to declare.
Funding None.

Key messages

- An MDT approach to the management of diabetic foot ulcers is crucial in optimising outcomes
- Total contact casts modified with Bohler iron are a safe and effective method of offloading diabetic foot ulcers
- Total contact casts treatment can lead to significant reduction in the cost of treatment

References

1. Holman N, Forouhi NG, Goyder E, Wild SH. The Association of Public Health Observatories (APHO) Diabetes Prevalence Model: estimates of total diabetes prevalence for England, 2010-2030. *Diabet Med* 2011;**28**(5):575–82. https://doi.org/10.1111/j.146405491.2010.03216.x
2. Ruan Q, Yang K, Wang W, Jiang L, Song J. Clinical predictors of mortality due to COVID-19 based on an analysis of data of 150 patients from Wuhan, China. *Intensive Care Med* 2020;**46**(5):846–8. https://doi.org/10.1007/s00134-020-05991-x
3. 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* 2018;**9**(1–3):19–23. https://doi.org/10.1016/j.jccw.2018.05.002.ecollection 2017
4. ld RG, Ayello EA. Total contact cast for diabetic foot ulcers: an underused

"gold standard". *Adv Skin Wound Care* 2019;**32**(6):247. https://doi.org/10.1097/01.ASW.0000558272.10192.c5
5. Nabuurs-Franssen MH, Sleegers R, Huijberts MS, *et al*. Total contact casting of the diabetic foot in daily practice: a prospective follow-up study. *Diabetes Care* 2005;**28**(2):243–7. https://doi.org/10.2337/diacare.28.2.243
6. Rai S, Gupta AK, Kumar D, Sharma VP, Agarwal AK. Prospective analytical study of assessment of off loading by total contact cast in treatment of non healing plantar ulcers in anaesthetic foot. *Lepr Rev* 2016;**87**(1):71–7.
7. Chakraborty PP, Ray S, Biswas D, *et al.* A comparative study between total contact cast and pressure-relieving ankle foot orthosis in diabetic neuropathic foot ulcers. *J Diabetes Sci Technol* 2015;**9**(2):302–08. https://doi.org/10.1177/193229681460788
8. Ganguly S, Chakraborty K, Mandal PK, *et al*. A comparative study between total contact casting and conventional dressings in the non-surgical management of diabetic plantar foot ulcers. *J Indian Med Assoc* 2008; **106**(4):237–9, 244. PMID:18828342
9. Ali R, Qureshi A, Yaqoob MY, Shakil M. Total contact cast for neuropathic diabetic foot ulcers. *J Coll Physicians Surg Pak* 2008;**18**(11):695–8. PMID:18983793
10. Venkatakrishnan S, Zachariah K, Chinnappan P, Rawat N. A description of a modified Bohler iron walking cast in the management of plantar ulcers. *Journal of Foot and Ankle Surgery (Asia Pacific)* 2019;**6**(1):10–12. https://doi.org/10.5005/jp-journals-10040-1101