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Efficacy of total contact cast application versus conventional dressings in the management of plantar diabetic ulcers

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Abstract

Diabetic foot ulceration, a serious health problem, with main causative factors being neuropathy, foot deformity and ischemia, individually incurring a third of the total treatment costs involved in diabetic care. Most neuropathic ulcers occur on the plantar surface of the foot due to the mechanical pressure of ambulation. By relieving this pressure by offloading, we attempt to speed up the healing process, while the patient remains ambulatory. This study compares the efficacy of total contact casting against conventional dressing in the management of plantar neuropathic diabetic foot ulcers in terms of speed of healing in a sample of 2 groups of 20 patients. At the end of the study, it was noted that ulcers treated with total contact casting healed in half the time. In conclusion, total contact casting provides an effective treatment at reduced overall costs for diabetic foot ulcer treatment; hence improving the overall outcome in its management.

Keywords: total contact casting, diabetic foot, diabetic neuropathy, off-loading dressing

Introduction

Diabetes mellitus is a serious, long-term condition with major morbidity and lifestyle impact. Reduced secretion of insulin, decreased use of glucose in blood and increased production of glucose to counter the apparent lack of blood glucose are the major factors that contribute to hyperglycemia. This dysregulation of blood glucose causes secondary multiorgan changes resulting in major health burden due to associated health complications.

Of these, diabetic foot ulceration is a major problem ^[1], which occurs predominantly on the plantar side of the foot due to repetitive mechanical pressure on walking, with patients of diabetes mellitus having a lifetime risk of 19 - 34% of developing a foot ulcer as complication ^[2], the major causes of which are neuropathy (60 - 70%), foot deformity and ischemia (15 - 20%) ^[3]. Non-healing diabetic ulcers have increased morbidity and mortality for the patient, being the major causative factor of lower limb amputations.

The treatment costs of these ulcers are grossly high, prolonged hospitalization, requiring regular follow-up visits and dressings while also affecting the patient's quality of life by decreasing mobility and hindering with their ambulation. Attempting to relieve the mechanical pressure on the foot by offloading, best being non-removable form of offloading provides a good chance at healing.

Materials and Methods

This study was done as a prospective randomized control trial, done in the setting of a tertiary care hospital in Mysuru, Karnataka, over study duration of 18 months, involving a total of 40 adult diabetic patients presenting with a plantar ulcer of duration of 2 weeks or more, associated with peripheral neuropathy. They were divided into 2 groups dedicated to each dressing modality were studied and followed up. If the patients had vascular compromise, osteomyelitis, deep infections other systemic complications of diabetes or local malignancy at presentation, they were excluded from the study. After a thorough general exam and local exam, assessment of the diabetic status, pus swab from the ulcer was taken, to start antibiotics and the patients were alternatively divided into either group.

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The total contact casting group of patients underwent initial debridement followed by application of a plaster of Paris cast, in total contact with the plantar skin, leaving the ulcer “hanging” within the cast, with no plaster in contact with it; these were changed once a week, when the ulcer was assessed. In the other group, the patients, after initial debridement underwent conventional dressing with povidone-iodine, which was done every alternate day; but the ulcers were assessed weekly for the study. As far as possible, the ulcers were matched to similarity of size in both groups and all ulcers were less than 8 cm in either dimension at the initial assessment. Both groups of patients received appropriate parenteral or oral antibiotics based on the wound pus culture and sensitivity. Outcomes were measured in terms of epithelialization, granulation and recovery. At the end of the follow-up, cost effectiveness of each group was assessed as well.

Results

The total 40 patients chosen based on the inclusion and exclusion criteria, ranged between the ages of 37 and 65 years, with a mean age of 56.22 years, of which 33 were males and the remaining females. 28 of the patients had uncontrolled diabetes mellitus at the time of presentation with a HbA1C of more than 7. The most common organism to be isolated from the pus

cultures of these patients was *Escherichia coli*, followed by an equal number of patients showing growth of *Streptococcal* species and *Pseudomonas* species.

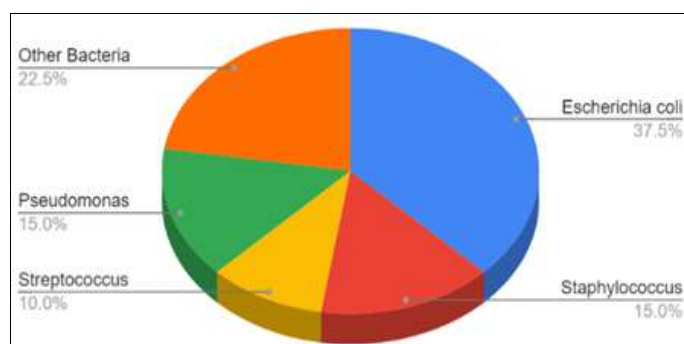


Fig 1: Organism isolate from wound culture swab

Progression of the Ulcer

Ulcers treated with total contact casting showed development of granulation tissue as early as the 1st follow up week, with nearly 50% of the ulcers showing complete epithelialization by the end of week 4. Slough and discharge took a longer time to disappear in ulcers treated with conventional dressing.

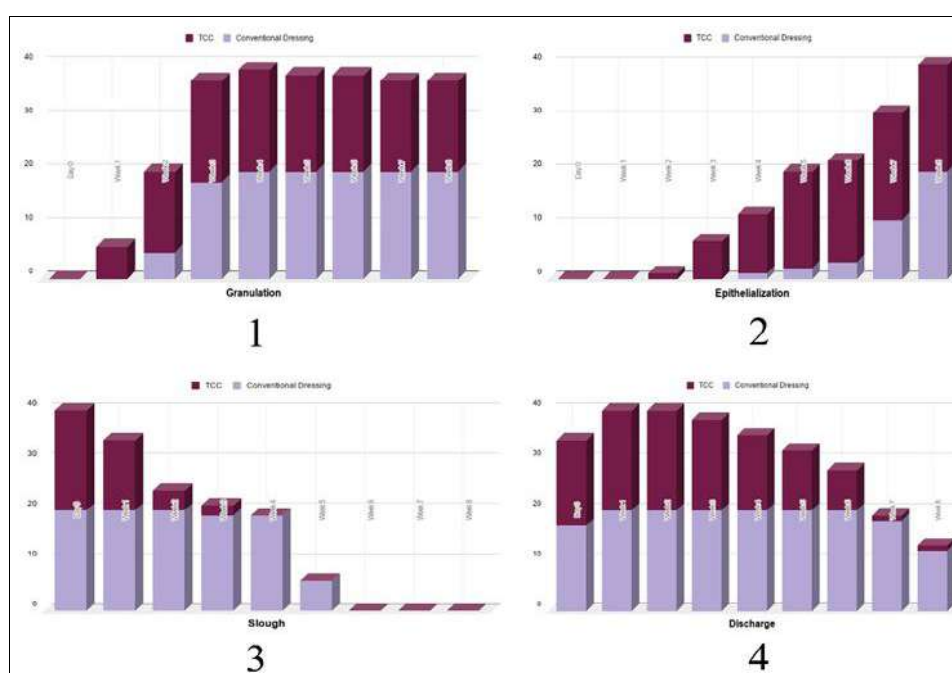


Fig 2: Graphs showing ulcer progression: 1. Appearance of granulation tissue, 2. Rate of epithelialization of the ulcer, 3. Disappearance of slough from the ulcer, 4. Disappearance of discharge from the ulcer

Average Percentage of reduction of wound area in each group

At the end of the study, the average percentage of reduction in area of the ulcers, from the time of initial presentation in the total contact casting group was nearly 98% with a statistically significant p value ($p < 0.00001$).

Table 1: Average Percentage of area reduction of the ulcer

Dressing	Percentage Reduction
Conventional Dressing	75.88395833
TCC	98.33175

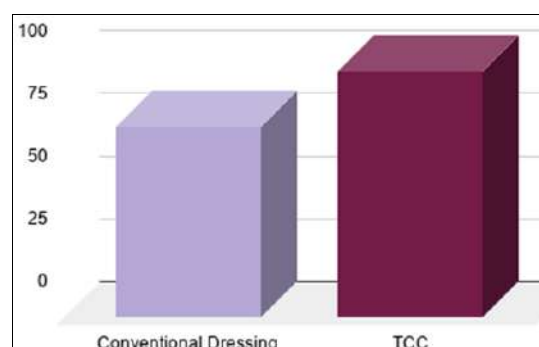


Fig 3: Average Percentage of area reduction of the ulcer

Trend in ulcer area reduction

It was observed that ulcers treated with total contact casting showed a faster reduction of ulcer surface area with time.

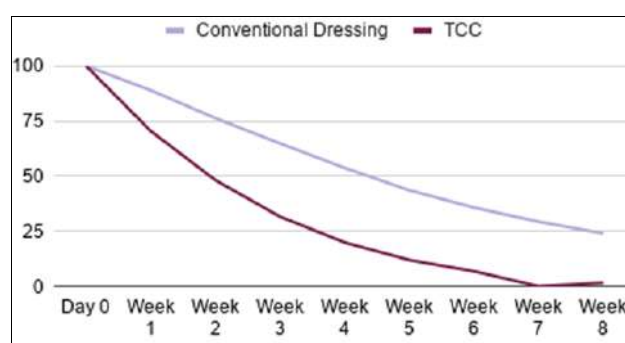


Fig 4: Trend in reduction of ulcer area over time

Cost Effectiveness

Average costs incurred in each dressing group was calculated and it was found that the expenditure in the conventional dressing was four times more than the total contact casting group.

Table 2: Average cost incurred in each dressing group

Dressing Method	Average Cost
Conventional Dressing	13603
TCC	4657.5

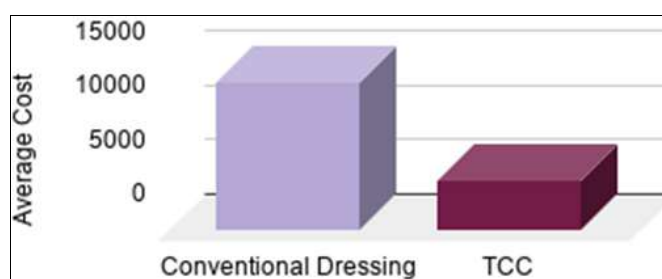


Fig 5: Average cost incurred in each dressing group

One of the main factors for increased costs was the increased number of dressings in conventional dressing group and the longer period of time taken by the ulcers to heal.

Table 3: Average number of dressings in each group

Dressing Method	Average number of dressings
Conventional Dressing	52
TCC	7

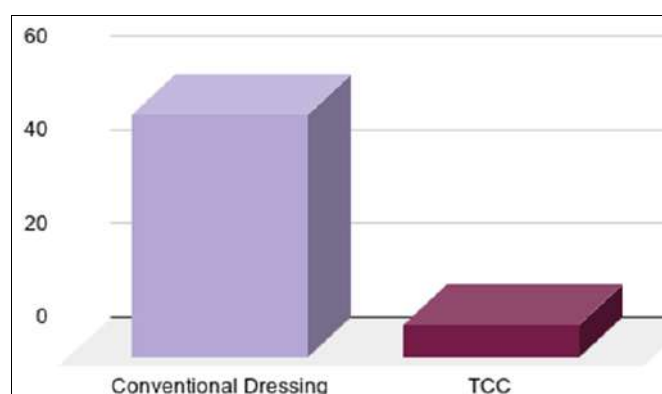


Fig 6: Average number of dressings in each group

Discussion

Neuropathic ulcers develop due to repeated mechanical stress to the plantar surface of the foot; repeated application of which prevents healing. Total contact casting minimizes the pressure at the ulcer site by equalizing plantar surface pressures [4]. Total contact casting creates a hollow under the ulcer, hence off-loading it. It also helps transfer weight directly from the leg to the cast walls [5]. Total contact casting also has shown to cause lesser secondary infection of the ulcer and reduces the inflammatory and reactive process in the ulcer [6] due to a closed environment around the ulcer, hence speeding up the healing process of the ulcer. Though total contact casting can cause few reversible minor complications like new areas of ulceration and irritation, with regular monitoring and proper application techniques, these can be prevented and reversed [7].

Conclusion

At the end of the study, we conclude that of total contact cast application to treat plantar neuropathic diabetic foot ulcers shows significantly faster appearance of granulation tissue, earlier epithelialization and faster wound healing. Ulcers treated with total contact cast healed in an average of 6.9 weeks while ulcers treated with conventional dressings required an average of 14.65 weeks to heal. As total contact casting requires only once weekly application, the average number of dressings and the total cost was much lesser, making it more cost effective, easier to manage and comply with.

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