Effectiveness of Total Contact Cast in Patients with Diabetic Neuropathic foot Ulcers

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Abstract

Introduction: To assess the effectiveness of Total Contact Cast (TCC) in treating diabetic neuropathic foot ulcers, including percentage reduction in ulcer surface area and healing time.

Methods: A quasi-experimental investigation took place in Benazir Bhutto Hospital Rawalpindi, Medical University, for six months, from August 1st, 2023 to January 31st, 2024. The study included thirty diabetes patients with non-ischemic neuropathic foot ulcers up to grade 2A, as classified by the University of Texas. The pre-intervention ulcer size was measured with metal ruler. Debridement was performed in some individuals to remove necrotic tissue, calluses, and foreign objects and Total Contact Cast (TCC) was applied. TCC was repeated every two weeks until the ulcer was healed. Post-intervention ulcer size measurements were taken. The key outcome measures were percentage reduction in ulcer surface area and time to heal in the cast.

Results: Twenty-two patients (73.3%) were males, whereas eight (26.7%) were female. The patients' average age was 59±7 years. Every patient had NIDDM. The majority of forefoot and mid-foot ulcers in the current study healed with a total contact cast. Average healing time was 39 days (three cast's duration). Patients identified as grade 1A recovered completely over the research period, but those classified as grade 2A showed a considerable reduction in ulcer size until the eighth week. Among Thirty patients with diabetic Non-ischemic neuropathic foot ulcers, the mean ulcer size (cm^2) at baseline was 4.6583±2.41090 SD. It changed to 1.3550±1.26228 SD at the end of the trial. The ulcer size at baseline and the ulcer size at the 8-week follow-up were compared using a paired sample t-test. The percentage reduction in ulcer size surface area from baseline at the eighth week was 71% with total contact cast. $P< 0.05$ was considered significant.

Conclusion: The results of the study showed that total contact cast was a successful therapy for neuropathic diabetic foot ulcers of Texas grade up to 2A that were located in the forefoot and midsole region.

Keywords: Diabetic Neuropathic foot ulcers, Total contact cast, offloading.

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1. Introduction

Diabetes is spreading at an alarming rate, causing end- organ damage from long-term hyperglycemia and imposing a large healthcare burden.1 One serious and frequently occurring complication of poorly controlled long-term diabetes is diabetic foot ulcers, or DFUs. A DFU will occur in 19% to 34% of the estimated 537 million diabetics worldwide at some point in their lives.[2] Lower limb amputations related to diabetes are primarily caused by foot ulcers.[3] Numerous studies indicate that foot ulcers cause approximately eighty-five percent of all amputations in diabetics. Individuals with diabetes in developed nations have a minimum of ten times greater risk of lower limb amputation than those without the disease.

In terms of individual disability, subsequent hospital stays, and health care costs which are anticipated to exceed $1 billion annually the diabetic foot has a substantial societal impact.[4] High peak plantar pressure is a major biomechanical factor that predisposes affected individuals to develop diabetic foot ulcers.[5] In diabetic individuals with peripheral neuropathy, the yearly incidence of foot ulcers varies from 5 to 7.5%, although it is slightly more than 2% in all diabetic patients. Peripheral neuropathy is defined by an absence of protective pain perception, autonomic dysfunction, sympathetic denervation, edema, toe clawing, abnormalities of the foot due to Charcoat joints, and callus formation at pressure points.[3]

Multidisciplinary care programs that include surgeons can minimize the number and severity of lower extremity amputations. The prevalence of diabetic foot problems is predicted to rise as the United States' population ages and obesity becomes more common.4 Therapies known as "offloading" release pressure from the area around the wound and re-distribute it to healthy tissues.[6] Pressure offloading is considered the gold standard for the fast and efficient cure of neuropathic plantar diabetic foot ulcers (DFUs).[7] A variety of offloading techniques are available, including two-shell unloading casts, felt cushioning , half-shoes, post- operative shoes, and walkers.

In order to reduce plantar pressure caused by an ulcer, total contact castings (TCCs) appear to be the gold standard procedure in the United States and other western countries.[8] Total contact casting is a rigid cast that fits the shape of the foot and leg to immobilize the affected joints and soft tissue while permitting safe mobility. It runs from just below the tibial tuberosity to the toes.[9] TCC is research-based offloading approach since it promotes compliance while limiting patient activity due to the cast's thickness and weight. By relieving pressure on the wound and spreading

pressure across the whole foot, this encourages quicker healing process.[6] Shear stresses and cast movement are lessened or eliminated using TCC.[10] Although it has been effective in treating plantar ulcerations, to reduce problems, it must be applied carefully, closely monitored, and patients must keep their regular appointments.

Redistributing walking pressures, avoiding direct stress to the wound, lowering edema, and immobilizing soft tissue and joints are all achieved via total contact casts.[11] Although there are benefits mentioned the talent and hard work needed to successfully implement it have made it a lost art and outdated technique in the treatment of neuropathic foot ulcers in modern times.[9] Infected or ischemic wounds are contraindications for total contact casts.[12] Unfortunately the orthopedic surgeon's role in treating foot ulcers nowadays is limited to treating secondary problems like osteomyelitis or pyoarthrosis. Despite the contact casting method's advantage in producing promising results, its use has declined as a result of reliance on alternative, simpler modalities.[9] The purpose of this study was to investigate the efficacy of Total Contact Cast (TCC) in neuropathic diabetic foot ulcers in terms of percentage decrease in ulcer surface area, and healing time. The purpose of this study was to redefine orthopedic doctors' role in preventing amputations by early intervention. Highlighting the effectiveness of this treatment can have a major effect on patient care and clinical practice. Sharing research-based findings may alter ulcer treatment and provide better results.

2. Materials & Methods

The ulcers were classified using the Texas categorization method, and any abnormalities on the feet were noted. The vascular assessment procedure included the use of Doppler ultrasound, pedal pulses, capillary filling time, and ankle brachial index. To rule out osteomyelitis and Charcot disease, foot X-rays were taken, and cultures of aerobic and anaerobic bacteria were taken from ulcers that were infected.

In certain cases, debridement was necessary to remove foreign objects, calluses, and necrotic tissue. Following a surgical debridement, pyodine-soaked gauze pads were used to cover and treat the ulcers. Antibiotics were prescribed for ulcers that were infected based on the results of the culture. During the first visit, each participant's ulcer was evaluated and graded using the University of Texas grading system. The location was identified as either the forefoot, midfoot, or hindfoot.

Interdigital padding, or cast padding, was divided into tiny pieces and placed between the toes to keep them in place. In order to provide at least 50% overlap between each turn, the cast padding was firmly twisted around the leg in two layers, starting from the tips of the toes and ending at the level of the fibular head or tibial tuberosity. Extrapadding was applied over any preexisting abnormalities as well as pressure areas, including the first and fifth metatarsal heads, anterior shin, malleoli, medial portion of the navicular, and heel. Less padding is needed in the other places because, as the reduced edema compresses the padding, too much padding will cause additional motion.

To recreate the contours of the foot and leg, total contact casts (TCC), which are composed of many layers of plaster of paris cast (POP), were utilized. Patients were advised to decrease their activities. Patients were recommended to maintain total nonweight bearing for the first two casts and protected weight bearing for the remaining castings. Up to the eighth week, there were follow-up appointments every two weeks for TCC renewal and complication monitoring.

To avoid recurrence, patients were recommended to utilize custom-made shoes to offload the pressure regions after the cast therapy was completed. All patients had their results evaluated at 2, 4, 6, and 8 weeks after baseline data collection. The main result was a percentage decrease in ulcer surface area after 8 weeks. The data was entered and analyzed using SPSS version 25.0. For qualitative characteristics including gender, ulcer healing, and the existence or lack of complications, frequency and percentages were estimated. Age and ulcer size were among the quantitative variables for which mean and standard deviation were computed. The ulcer size at baseline and the ulcer size at the 8-week follow-up were compared using a paired sample t-test. P-values <0.05 were considered statistically significant.

3. Results

The study consist of thirty patients. Twenty- two (73.3%) patients were male, whereas eight (26.7%) were female. The mean age of all those who presented was 59±7 years. All patients had non- insulin-dependent diabetes (NIDDM). The study found that the majority of patients (73.3%) had diabetic foot ulcers in the forefoot anatomical region, whereas 26.7% had them in the midfoot. In this study, no individuals were treated for heel and hallux ulcers. Based on the University of Texas wound grading method, 46.7% of patients were classified as Grade 1A patients and 53.3% as Grade 2A patients. Approximately 36.7% of the patients had prior

ulcers. 40% of patients had diabetic neuropathic foot ulcers on the left side and 60% on the right. [Table 1].

Table 1: Participants demographic and physical characteristics during Baseline Visit.

Variable	Baseline Characteristics
Age mean(SD)	59±6.97
Gender	
Male [n (%)]	22(73.3%)
Female [n (%)]	8(26.7%)
Diabetes Mellitus	
Type 2[n (%)]	30(100%)
Previous Ulceration%	
YES	11(36.7%)
NO	19(63.3%)
Ulcer Location	
Forefoot [n (%)]	22(73.3%)
Midfoot [n (%)]	8(26.7%)
Involved side	
Right [n (%)]	18(60%)
Left [n (%)]	12(40%)
Ulcer Grade	
Grade A1 [n (%)]	14(46.7%)
Grade A2 [n (%)]	16(53.3%)
Ulcer size mean(SD)	4.6583±2.41090

The majority of forefoot and midfoot ulcers recovered with a total contact cast. The average ulcer healing period was 39 days. Individuals categorized as grade 1A underwent full recovery throughout the research duration, whereas those classified as grade 2A demonstrated a significant decrease in ulcer size until the eighth week. The average ulcer size (measured in cm2) across 30 patients with diabetic neuropathic foot ulcers[1] was 4.6583±2.41090 SD at baseline. After the study was over, the value was 1.3550±1.26228 SD. With a total contact cast, the ulcer size decreased by 71% at the eighth week compared to the baseline. Nevertheless, we were unable to track total recovery in grade 2A patients because of the short research period. There were no significant complications associated with total contact casting in this study. Patients that show non-compliance with total contact cast treatment require assurance and counselling. There was no wound or post-treatment infection among the participants in this study.

Figure 1: Healing sequence with a total contact cast. (a) The baseline ulcer prior to the initial casting. (b) The first cast was applied in the outpatient department. (c) ulcer after two weeks; (d) ulcer size after four weeks (e) ulcer size after six weeks; and (f) ulcer size after eighth weeks.

Table 2: Outcomes of Total contact cast treatment

Healing Outcome	**After 8th weeks**
Ulcer Size(cm²)	1.3550±1.26228
Time to heal (average)	39days
Non-compliance [n (%)]	13(43.3%)
Complete Study [n (%)]	30(100%)

4. Discussion

Pressure reduction is an important element of controlling diabetic foot ulcers. Due to its capacity to alleviate pressure and encourage patient compliance with the unloading treatment, the total-contact cast has shown to be the most effective therapy.[13] Although a number of orthotics can lessen off-loading, their efficacy is compromised by the fact. Total-contact casting is the use of a molded and lightly cushioned cast which makes contact with the whole sole area of the foot and lower leg. Total-contact casting has been widely established to be helpful in managing non-infected, nonischemic plantar diabetic foot ulcers, with recovery rates varies from 72 to 100% in timeframes ranging from one month to multiple weeks.[14] The current study aimed to investigate the efficacy of Total Contact Cast in treating diabetic neuropathic foot ulcers. Most of the ulcers in this study healed quite quickly when total contact casting was used. A total of thirty individuals were recruited. Male patient percentages in the current study were 73.3%, which is lower than the 87.17% reported by

Rajab Ali et al. (2008). The study's mean age was 59±7years, which is younger than the 62 years and 60 years reported by Rajab Ali et al. (2008) and Sahu et al respectively.

Within the current study, diabetic ulcers were categorized into three "grades" (0 for a totally epithelized lesion that occurs before or after ulceration, I for a superficial wound that does not involve a tendon, capsule, or bone, II for a wound that penetrates to tendon or capsule, and III for involvement of a bone or joint) and three stages (A is not both infected and ischemic; B is infected; C is ischemia; and D is both infected and ischemic). Prior to placing the total contact cast, the baseline ulcer size was measured in each of the thirty patients. Antibiotics were administered to patients with infected foot ulcers until the infection cleared up. Thirty patients had total contact casts applied for two weeks up to the eighth week. Up until the eighth week, follow-up appointments were scheduled every two weeks to monitor complications and renew TCC. Measurements of the post-treatment ulcer size were made after two, four, six, and eight weeks. According to post-test data, there was a statistically significant variation in ulcer size between the baseline and eighth week. According to national and international research, healing rates can range from 72% to 100% over the course of a month or several weeks. The results presented in the current study are roughly in accord with these findings. In this research, there were no significant complications related to total contact casting. Patients who refuse to be compliant with the total cast treatment require assurance and counseling. There was no wound or post-treatment infection among the participants in this study. While infection was formerly considered a contraindication for TCC, recent studies suggests that it can be used for neuropathic ulcers that are even mildly infected but do not have peripheral artery dysfunction. Close patient observation, frequent dressing changes and debridement, and appropriate antibiotic coverage are necessary.[15] Only professionals who are familiar with the mechanics of total contact casting should apply it. TCC can be used once the infection has settled.[3]

A study consisting of 39 individuals with diabetic neuropathic foot ulcers was conducted to determine the effectiveness of Total Contact Cast (TCC) treatment for these conditions. 90% of forefoot and midsole ulcers were successfully treated with TCC ($p < 0.001$). Total contact casts have been shown to be effective in treating early-grade neuropathic non-ischemic foot ulcers. This validates the findings of our investigation, which showed that total contact casting significantly improved ulcer healing and reduced ulcer size in diabetic neuropathic ulcers of the feet.[3] A research was conducted to evaluate TCC's efficacy in treating diabetic neuropathic foot ulcers and its impact on gait outcomes relative to pressure-relieving ankle foot orthoses (PRAFO). Thirty diabetic individuals with neuropathic plantar ulcers were examined at the foot clinic and randomly assigned to receive one of two unloading procedures (Total contact cast or PRAFO), regardless of their gender, age, type of diabetes, or duration of diabetes.

The ulcer surface area decreased significantly ($P < .001$) four weeks from the baseline. TCC showed a reduction of 75.75±9.25, while PRAFO showed a reduction of 34.72±13.07. This supports the findings of the current study, which showed that diabetic people having neuropathic non- ischemic foot ulcers had a considerable percentage decrease in ulcer surface area.[5]

A study was done to compare total contact casts with traditional dressings for wound healing in diabetic foot ulcers. The purpose of the research was to compare the security and effectiveness of Total Contact Cast therapy to traditional dressing for the management of neuropathic plantar ulcers. 100 individuals with plantar ulcers caused by diabetes took part in the research. Participants who fulfilled the eligibility requirements while giving their permission for each treatment were randomized to one of two groups. It was observed that there was a male majority in the present research, with 31 men accounting for 68% of all participants. The research findings showed that 39 patients had achieved 76–100% tissue granulation at the six-week follow-up. Patients with TCC dressings experienced granulation at a faster rate, averaging forty-two days, compared with the control group (eighty-four days). For neuropathic, non-ischemic, early-stage diabetic foot ulcers, TCC is an effective treatment. This study confirms the findings of our investigation, which found that diabetic individuals with neuropathic non-ischemic foot ulcers showed a significant reduction in ulcer size after being treated with total contact cast.[16]

5. Conclusion

In our study, ulcers caused by diabetes in the feet were treated using total contact casting (TCC).A significant percentage of the ulcers healed with TCC in

a relatively short period of time. Most people with forefoot and midfoot ulcers experienced healing. The treatment reduced ulcer size significantly over time. Noncompliance with TCC treatment was observed despite its success, highlighting the significance of patient counseling and reassurance. Based on these findings, TCC may be recommended as the standard treatment for diabetic neuropathic plantar foot ulcers. Future study comparisons are required to determine the treatment outcomes of diabetic neuropathic foot ulcers either with or without a total contact cast. Professionals who treat diabetic foot ulcers should use it.

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