# Outcome of the Neuropathic Diabetic Foot Ulcers, Wagner's Grade 1 & 2, Treated by Total Contact Cast

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## ABSTRACT

**Objective:** To assess the outcome of the neuropathic diabetic foot ulcer, Wagner's grade 1 & 2, treated with total contact cast.

**Methods:** This study was conducted between 02 years from January 2013 to December 2015. Number of patients with grade 1 and 2 of the Wagner's classification were 34. After debridement of ulcers and sterile dressing, total contact cast was applied. The cast was changed after every 02 weeks till ulcer's healing. Cast failure labeled when there was no decrease in ulcer size in between 04 consecutive weeks in cast or the ulcer size or depth increased to higher grade or wound infection or gangrene.

**Results:** A total 34 patients (28 males and 6 females) with 40 ulcers were selected until the cutoff date, i.e., December 2015. Average mean of patients' age was 69 years old. Number of patients healed in 02-cast duration on average 30 days was 32 (i.e., 80%), whereas cast failure was 08 (i.e., 20%). Within 40 ulcers, 14 (35%) were superficial ulcer representing Wagner's grade 1 and 26 (65%) were deep ulcer representing Wagner's grade 2. Wagner's grade 1, all ulcers (i.e., 14) were healed, whereas none of the Wagner's grade 2 ulcers (i.e., 08) were healed. Based upon anatomical location number of the non-healed ulcer was only 1 (i.e 2.5%) on heel, and were 03 (i.e., 7.5%) under first metatarsal head in patients with diabetes of more than 10-years duration.

**Conclusion:** The TCC was effective in treating the Wagner's grade 1 & 2 neuropathic diabetic foot ulcers of recent onset.

**Key words:** Diabetes mellitus, neuropathic diabetic foot ulcer, total contact cast.

## INTRODUCTION

Foot ulcers are major complication in-patient with diabetes[1]. The data on the lifetime risk developing a foot ulcer in diabetic patient are scares, but most studies suggesting that, the ulcer risk is as high as 25% (Twenty Five) or more[2]. The diabetic foot ulcer, infection and gangrene are major reasons for hospitalization[1,2]. This is also a major complication of diabetes contributing to morbidity and mortality[2,3]. The foot ulcer is big burden on patient and their families[4,5,6]. The estimated cost of treating the diabetic foot complication is raised approximately to 11-billion USD in USA[1,7,8].

Regardless of the type of the diabetes, as the age of the diabetic patient increase or the duration of the disease increase, the risk of the ulcer, and amputation also increase by 2 to 4 fold[1,8]. The diabetic foot ulcer accounts for 2/3 of all non-traumatic limb amputation[7,8]. One of the serious complications of diabetes is peripheral neuropathy[1,2,9]. Mixed neuropathy occurs in diabetes[1,10]. Thus in peripheral neuropathy, the incidence of the foot ulcer is 5 to 7.5 %[1,2]. The neuropathic ulcers of the foot are mainly treated by the reduction of the pressure on the ulcer for adequate time to heal the ulcer[10,11,12]. Total contact cast considered as the standard treatment for neuropathic foot ulcer by many experts in this field[13,14].

In most local clinics, simple dressing with pyodine solution treats the neuropathic diabetic foot ulcers. We have used total contact cast to treat Wagner's grade 1 and 2 ulcer. The aim was to find out the effectiveness of the TCC in term of percentage of the ulcer healing and the time in days.

## METHODS

We conducted a prospective study in between (02) Years from January 2013 to December 2015. Neuropathic diabetic foot ulcer of Wagner's grade 1 and 2 of both male

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and female were included. The Wagner's grade 0, 3, 4, 5 ulcers, pure ischemic ulcer, infected ulcer, traumatic ulcer, post burn ulcer, malignant ulcer, and ulcer in non diabetic patient were excluded from the study. Most patients were admitted through the outpatient department. All patients gave their written consent on Performa before participating in the study.

After admission, history was taken. The type of ulcer, the duration of ulcer, the anatomical site of the ulcer was noted and traced on paper. The type of treatment for the ulcer was also recorded. The co morbid associated with the ulcer, were noted. The diabetic foot ulcer was graded in 6 grades of severity according to Wagner's classification[1,8.]

Grade 0: No ulcer. Skin is intact. The foot is at risk
Grade 1: Superficial ulcer
Grade 2: Deep ulcer, but no abscess or bone infection
Grade 3: Deep ulcer, tendon, capsule and bone involved. Plus abscess and bone infection
Grade 4: Gangrene of the toe or forefoot
Grade 5: Gangrene of the entire foot.

The assessment of perfusion was evaluated by checking the pedal pulses, the dorsalispedis and posterior tibial pulses, the capillary refill time to the digits, the ankle- brachial index using hand held Doppler device, and Doppler ultrasound studies. The ischemic ulcer was excluded.

The peripheral neuropathy assessed by measuring tactile sensation (cotton wisp on dorsum of foot), blunt and sharp discrimination (dorsum of the foot) and vibration sensation (128-Hz Tuning Fork on dorsum of hallux). The peripheral neuropathy was diagnosed if two or more of these tests were abnormal. The neuropathic ulcers were included in our study. All ulcers were treated in the orthopedic operation theatre under all aseptic measures by consultant level of doctor of our department. After draping, the ulcers were surgically debrided of all the necrotic tissue, hard calluses, and infected materials down to the viable bleeding tissues. Then it was dressed with pyodine soaked sterilized gauze. The infected ulcers were first converted to non-infected ulcer by repeated debridement of the infected wound and appropriate antibiotic cover. A thin layer of cotton padding was applied from tip of toes up to 02 cm below the fibular head to protect the common perennial nerve from pressure. Then 08 layers of Gypsona cast applied over the cotton padding. The cast was molded to the exact contour of the leg, malleoli and foot to provide maximum contact. Thin layer, light weight, soft rubber cast shoes were given to walk on and to protect the cast from wetting and softening.

All patients were followed at 2 weekly intervals in the OPD, till the ulcers were healed. At each visit, the cast was removed, the ulcer was inspected, and its size was measured. Any pressure sore cause by cast was noted. Then new cast was applied after aseptic dressing. The cast treatment was stopped when there was no reduction in size during two casts application. When the grade of the ulcer was worsening from grade 2 Wagner's to grade 3 or above or when the patient had some problem with the cast. These cases were then defined as cast failure. While those cases, which were healed in the TCC, were labeled as success. The duration of the healing was recorded from time of application of the first cast, recorded as day one to the final healing of the ulcer in the cast, in days. The final outcome of the ulcer treated by TCC was measured as percentage of the ulcer healed and time taken in days to heal the ulcer in cast.

## RESULTS

In the present study, total 34 patients (28 male and 6 female) with 40 diabetic foot ulcers were included. Within 34 patients, 28 has single ulcer, while 6 patients had two ulcers. The age of the patient ranged from 54 to 84 years, and average mean of age was 69 years. The duration of the ulcer at presentation was from 0 weeks to 12 weeks, and average mean was 5.9 weeks. Out of 40 ulcers, 14 were on the plantar surface of the first Meta tarsal head and 4 on the heel. The size of the ulcer ranged from 1.5 cm to 5.7 cm, and average was mean 3.25 cm. Within 40 ulcers, 14 (35%) were superficial ulcer representing Wagner's grade 1 and 26 (65%) were deep ulcer representing Wagner's grade 2. All 14 (100 %) Wagner's grade 1 ulcer healed in TCC. Out of 26 Wagner's grade 2 ulcer, 18 (69.230 %) were healed, while 8 (30.769%) were failed. Furthermore, 2 (7.692%) deep ulcers progressed to grade 3 and above, later required below the knee amputation. The remaining 6 (23.076 %) deep ulcer required minor amputations. Specifically looking at the table 1, it is revealed that all 14 ulcers of type grade 1 healed and are labelled as success (100 %); the 18 ulcers of type grade 2 out of 26 were also healed and are labelled as success (69.23%). On the contrary, 8 ulcers of type grade 2 out of 26 were not healed and labelled as failed (30.76 %) [table- 2]. All ulcers were healed in two consecutive cast duration (one cast duration was for 2 week)] with average mean time of 30 days. Out of 8 (30.76%) failure cases, it was noted that, the anatomical location of the ulcer was not deciding factor. The grade of the ulcer and vascularity of the limb were important deciding factor.

**Table-1:** Wagner's grade of neuropathic diabetic foot ulcer- Results

| Wagner's grade of ulcer | Total no. of ulcer | Healed | Non Healed | Minor Amputation (Digits or Ray | Major Amputation (Above the Ankle Lever) |
|---|---|---|---|---|---|
| Grade-1; superficial ulcer | 14 (35%) | 14 (100%) | 0 | 0 | 0 |
| Grade-2; deep ulcer (no bone infection or abscess) | 26 (65%) | 18 (69.230%) | 8 (30.769%) | 6 (23.076%) | 2 (7.692%) |
| Total no-of ulcer | 40 (100%) | 32 (80%) | 8 (20%) | 6 (15%) | 2 (5%) |

**Table-2:** Anatomical location of neuropathic diabetic foot ulcer-Results

| S.No | Site of ulcer | Total no. of ulcer | Healed | Non Healed | Minor Amputation (Digits or Ray) | Major Amputation (Above the ankle level) |
|---|---|---|---|---|---|---|
| 1 | First meta-tarsal head (plantar) | 14 (35%) | 12 (30%) | 2 (5%) | 2 (5%) | 0 |
| 2 | Big toe (plantar) | 6 (15%) | 5 (12.5%) | 1 (2.5%) | 1 (2.5%) | 0 |
| ` 3 | Little toe (plantar) | 4 (10%) | 3 (7.5%) | 1 (2.5%) | 1 (2.5%) | 0 |
| 4 | Ray 2nd, 3rd, 4th (plantar) | 3 (7.5%) | 2 (5%) | 1 (2.5%) | 1 (2.5%) | 0 |
| 5 | Ray 5th (plantar) | 3 (7.5%) | 2 (5%) | 1 (2.5%) | 1 (2.5%) | 0 |
| 6 | Midsole | 6 (15%) | 5 (12.5%) | 1 (2.5%) | 0 | 1 (2.5%) |
| 7 | Heel | 4 (10%) | 3 (7.5%) | 1 (2.5%) | 0 | 1 (2.5%) |
| 8 | Total no. of ulcer n=40 | 40 (100%) | 32 (80%) | 8 (20%) | 6 (15%) | 2 (5%) |

## DISCUSSION

Neuropathic diabetic foot ulcer is common complication of diabetes mellitus[1,2]. The off-loading is the main factor in treating such ulcer of foot. The off - loading can be achieved by several means, such as walker use, wheel chair, bed rest, half shoes, light weight orthotic shoes[11,14]. However, the total contact cast is believed to be standard. It reduces pressure on the ulcer area[14]. The TCC, remain there all the time, so its effectiveness to reduce pressure on the ulcer is increased[10,14]. It results in rapid healing of the ulcer[14]. Using the TCC, the majority of the ulcer i.e., (80 %) in our study healed in two consecutive casts. These results are in line with the results of the studies conducted by Ali Ret al 2008, Chakraboty PP et al 2015. In the study of Ali R, authors found the healing within 39 patients with 52 ulcers i.e., (78.84 %). Similarly, Chakraboty PP et al 2015, received 75.75 % success in 30 patients with TCC. These healing rate 72-100% in time duration range from 4 weeks to several weeks[10,14]. However we achieved [80 %] success. The grade of the ulcer was more predictive factor in ulcer healing. In our study, out of 40 ulcers in 34 patients, all 14 Wagner's grade 1 ulcers (100 %) were healed, while only 18 ulcer (69.230 %), out of the 26 Wagner's grade 2 were healed. Failure rate in grade 2 ulcers was (30 .769 %). The Anatomical location of the ulcer did not affect the healing rate in our study. Out of 4 ulcers 3 (7.5 %) were healed. While Ali R 2008 have achieved results (only 2 healed out of 9 ulcer with 77.77% failure) in heel ulcer[14]. As the cause of the failure was not the anatomical location of the ulcer, the uncontrolled glycemia, prolonged duration of the diabetes, the duration of the ulcer, smoking and vascularity of the foot, all affect the

healing of the ulcer.

The different neuropathic foot deformities like clawing of the toes, cavus, valgus and varus did not altered the healing of ulcer in our study. The ulcer size and depth, however has direct relation with healing. The deep ulcer took more than 5 weeks time to heal. The small and shallow ulcer took less than 3 weeks to heal. The same was noted by others studies[15,16,17]. The vascularity of the foot also has predictive role. The ulcer with red viable margins and good blood supply healed rapidly, while the ischemic ulcers were reluctant to heal. The same findings were noted by Chakraboty PP, Ray S, Biswas D et al[10] and others[15,17]. The ulcer of recent onset healed more rapidly than the ulcer of the longer duration. The presence of infection also delayed the ulcer healing. We faced 7 (17.500%) infected ulcers in our study. These were initially treated by repeated debridement and dressing and intravenous Antibiotic after culture and sensitivity. Once the ulcer was infection free, then these were treated by TCC as routine. The infected ulcer had taken 2 to 3 weeks more time to heal than non-infected ulcer. We faced poor patient compliance when treating ulcer with TCC. The poor compliance was also note by others[14,15].

In our study, 8 (20.00 % of ulcer) or (23.529%) of patient underwent amputations, 2 (5 .00 %) were major amputations above the ankle level and 6 (15 %) were minor amputations below the malleoli. All 8 (23.529%) amputated patients had prolonged history of diabetes more than 15 years. Their age was more than 70 years and had poor glycemia control. Those patients, who had multiple co-morbid, also had poor ulcer healing.

In our study, the TCC itself was safe. It was easy to apply. It does not needs analgesia or sedation. No complications were noted with TCC. We do not recommend its application in ischemic limb and infected ulcer.

There were certain limitations of our study. The number of the patients was small. There was lack of similarity of the patients, in respect to age of the patient, ranged from 54 to 84 years, the duration of the diabetes, [ranged from 5 year to 20 year], the associated co-morbid the patient had, the Wagner's grade 1 and 2, the anatomical location of the ulcer on plantar surface of the foot, the duration of the ulcer at presentation, the glycemia control and the vascularity status of the limb. These all variable in one way or other had adverse effect on the ulcer-healing rate. Further studies are required to evaluate the outcome of the neuropathic diabetic foot ulcer treatment with TCC.

## CONCLUSION

The diabetic neuropathic foot ulcer is very common complication of the diabetes mellitus. It is big burdon on the patient and his family. The duration of the ulcer has a negative effect on the time to heal it. The patients with the ulcer need to be treated as whole. The TCC is an effective treatment modality indicated for neuropathic ulcer of Wagner's grade 1 and grade 2 on the plantar surface of the foot.

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