Prospective analytical study of assessment of off loading by Total Contact Cast in treatment of non healing plantar ulcers in anaesthetic foot

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Summary

Background: Chronic planter ulcer, also known as trophic ulcer, shows no tendency towards healing. It is usually seen in sensory deficient foot. The clinical result of a sensory, motor or autonomic loss of a nerve function is frequently the same – ulceration, although the exact cause may vary. The treatment principle involves dressing and avoiding pressure on the ulcerated site called ‘offloading’ and patient education for prevention.

Aim of the study: To determine the outcome of non-healing planter ulcers in an anaesthetic foot treated with offloading, total contact casting (TCC), in terms of rate and duration of healing and percentage of ulcers healed based on improvement of Wagner’s grading with respect to the clinical profile of the patient.

Method: Detailed examination of the patients was done, and neuropathic foot confirmed. Surgical debridement of the ulcer was done to take off all the necrotic tissues, periwound callus, and infected material down to viable tissues. Once the ulcer became clean, a total contact cast was applied with a walking iron for ambulation. TCC was renewed every 2 weeks and rate of healing was assessed.

Result: 80% of the cases healed within 8 weeks, healing defined by complete re-epithelisation of wound. Average duration of healing of an ulcer was 6·73 ± 1·92 weeks.

Limitations of the study: Small sample size and the lack of control subjects for comparison.

Conclusion: Offloading with total contact casts is believed to be the gold standard method with better and faster healing rates.

Keywords: Planter ulcer, Neuropathic foot, Total Contact Cast (TCC), Walking iron

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Introduction

Chronic plantar ulcer, also known trophic ulcer is usually seen in a sensory deficient foot. The clinical result of a sensory, motor or autonomic loss of a nerve function is frequently the same – ulceration – although the exact cause may vary.

With sensory loss acute or chronic skin trauma may go unrecognised. In patients with peripheral sensory deficits, the protective pain perception being absent, they do not relieve pressures and hence the repetitive trauma leads to skin breakdown and ulceration.¹

Autonomic nerve loss contributes to skin breakdown by producing dry, inelastic skin due to loss of oil and sweat glands. In addition to the sensory component, modification of gait may also happen due to a motor weakness and muscle mass decrease seen in most patients of peripheral neuropathy.² There may be a sharp increase of pressure under the forefoot with very high pressures localised to under the metatarsal heads and the heel.³ The treatment principle involves avoiding pressure on the ulcerated site called ‘offloading’. Offloading can be done by complete bed rest, axillary crutches, walker, walking stick, half shoes, healing sandals, depth in lay shoes, scotch cast shoes, total contact casts, total contact casts with walking iron.⁴ In the present study plaster casting and walking iron for weight bearing will be applied to the patient with chronic plantar ulcer.

Material and Methods

TYPE OF STUDY: PROSPECTIVE ANALYTICAL STUDY

Subjects

All the patients with anesthetic foot and having trophic ulcers up to Grade II of Wagner’s classification system (ulcers extending into soft tissues but not abscesses or osteomyelitis), attending the Outpatient department (OPD) of the department.

Sample size

30 patients with anesthetic foot with trophic ulcer who fulfilled the inclusion criteria, (initially there were 28 patients, two patients had relapse and were treated as fresh cases, therefore total cases were 30)

Inclusion criteria

1. Non healing plantar ulcers due to any cause in anaesthetic/hypoaesthetic foot up to Grade II of Wagner’s classification.
2. Foot should be plantigrade and flexible.
3. Age group 2yrs- 65 years both males and females.
4. Willing to participate in the study and giving informed consent.

Exclusion criteria

1. Active or acute deep infection, sepsis or gangrene, osteitis, abscess or osteomyelitis.
2. Patients unable to comply with follow up visits.
3. Deformed foot.
5. Lepra reactions and those on steroids.
6. Charcot joint.
7. Contralateral foot ulcers and limb amputation.
9. Mental illness.
10. Previous or current deep venous thrombosis of the leg.
11. Those having fungal infections in the ulcer.

Procedures

All patients were informed about the procedure to dispel fear and misconception. Written informed consent was taken from each patient or from guardian/parent if the patient was a minor, who participated in the study. A detailed clinical history and ulcer examination was done. Ulcers were graded according to Wagner’s system. Sensation of the involved foot was tested using a 10-G monofilament. Neuropathy was defined as the patient’s inability to sense the 10-G monofilament. Routine investigations as Hb, TLC, DLC, and ESR were done. Blood sugar both fasting and post prandial was checked. Aerobic and anaerobic cultures were taken from ulcers. Skiagram (AP and lateral view) of the foot was obtained to exclude the presence of osteomyelitis and Charcot disease.

Ulcers were surgically debrided to take off all the necrotic tissues, periwound callus, foreign and infected material down to viable tissues, wound was then irrigated with saline and properly dressed. For infected ulcers, appropriate antibiotics were given according to culture and sensitivity. Repeated debridement of infected wounds were done till the elimination of clinical signs of infection. Once the ulcer became clean, a total contact cast was applied. It was a 5–6 layers plaster of Paris cast applied over cast padding, starting from 1 inch distal to fibular head and extending up to the tip of the toes, which were left open dorsally, moulded to the exact contour of the leg and foot to provide maximum contact. Ulcers were closed in total contact cast. Strict attention was paid to avoid harm to the insensitive foot from the cast itself. A walking iron was attached to the heel to walk on. Shoe raise was given on the opposite side to adjust raised height. The subjects were told to return to the hospital if any discomfort was felt under the cast or if the cast felt loose. Patients were followed fortnightly till the ulcer healed.

TCC was renewed every 2 weeks. On each visit the ulcer size was measured and any complications noted. Main outcome measures included the rate and duration of healing and the percentage of the ulcers healed. Data was collected and analysed on SPSS Version 16·0.

Results

1. Twenty eight patients were enrolled in the study.
2. Two relapse cases were treated as fresh cases and so total ulcer cases studied were thirty.
3. 24 cases (80%) healed within 8 weeks only 6 cases (20%) did not heal completely within time frame of 8 weeks (but were in the process of healing) (Figure 1).
4. Average duration of healing of an ulcer was 6·73 ± 1·92 weeks.
Discussion

Loss of protective sensation is the primary factor in causing trophic ulcers. Mechanical stresses resulting from joint deformity, hypomobility and poor foot care/footwear are important in the causal pathway of neuropathic foot ulcers. Infection is a major factor in ulcer complications and is aggravated by repeated mechanical stresses. Total contact cast technique was originally described in the 1930s by Dr. Joseph Khan in patients with Hansen’s disease.\(^8\) The aim of TCC is to reduce plantar pressures by increasing the weight-bearing surface of the foot (Sinacore \textit{et al.} 1987).\(^9\) Dr. Paul Brand expanded the application of total contact casting to neuropathic ulceration in diabetes mellitus.\(^10\)

Many lesions in the diabetic foot are preventable or treatable with patient education, properly designed and fitted orthosis/footwear, and careful periodic monitoring.

Twenty eight patients were enrolled in the present study. Two patients had relapse, which developed ulcers on the same site as before. These cases were treated as fresh cases so total ulcer cases were thirty. Seventeen patients (56·67\%) were male and 13 patients (43·33\%) were female (Table 1).

The mean age was 36·60 years ± 18·80 years (Table 2).

<table>
<thead>
<tr>
<th>Sex</th>
<th>Number of cases</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>17</td>
<td>56.70%</td>
</tr>
<tr>
<td>Female</td>
<td>13</td>
<td>43.30%</td>
</tr>
<tr>
<td>Total</td>
<td>30</td>
<td>100%</td>
</tr>
</tbody>
</table>

Figure 1. Progressive healing of a plantar ulcer in neuropathic foot.
The majority of patients were married (63.3%). Patients were evaluated to their occupation and we noted that the majority were unskilled workers (43.3%). Half of the patients had a monthly income below Rs 5000. In the educational status we found that 30% of patients were educated up to the primary level and 20% were illiterate.

In the present study various causes of neuropathic foot were analysed, the maximum cases, 17, (56.7%) were due to Hansen’s disease, followed by seven patients (23.3%) due to diabetes and all of them were non-insulin dependent diabetes mellitus, six patients (20%) were having anesthetic foot because of lumbosacral meningomyelocele (Table 3).

The mean duration of ulcer was 14.60 ± 16.66 months.

We have taken Wagner’s Grade I and II ulcers only, there were 23 patients (76.7%) with ulcers of Grade I and seven patients (23.3%) with Grade II ulcers.

The mean hemoglobin level was 10.54 ± 0.85 gm/dl. Average blood sugar fasting was 100.23 ± 18.06 mg and post prandial was 142.53 ± 54.45 mg/dl. For diabetics mean blood sugar fasting was 124 ± 20.25 mg/dl, and postprandial was 221.86 ± 5.64 mg/dl.

Twenty four cases (80%) healed within 8 weeks, the other six cases (20%) did not heal completely within the timeframe of 8 weeks (but were in the process of healing); healing defined by complete re-epithelisation of wound. Average duration of healing of an ulcer was 6.73 ± 1.92 weeks (Table 4).

Addressing pressure reduction is a critical component of therapy in the management of diabetic foot wounds. The total contact cast has proved to be the standard treatment because of its ability to reduce pressure on the ulcer area and facilitate patient’s adherence to the off-loading regimen.

Though offloading can be achieved by several orthotics, most of these are removable and strict compliance is not achieved thus reducing their effectiveness. TCC has the advantage that it cannot easily be removed by the patient and limits the activity of patients, which helps in the rapid healing of ulcers. When correctly applied, it has proved not only to interrupt the chain of pathogenesis that produces the ulceration but also to induce modifications in the

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**Table 2. Age distribution of the cases**

<table>
<thead>
<tr>
<th>Age group (years)</th>
<th>Number of cases</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–10</td>
<td>4</td>
<td>13.33%</td>
</tr>
<tr>
<td>11–20</td>
<td>2</td>
<td>6.67%</td>
</tr>
<tr>
<td>21–30</td>
<td>7</td>
<td>23.33%</td>
</tr>
<tr>
<td>31–40</td>
<td>4</td>
<td>13.37%</td>
</tr>
<tr>
<td>41–50</td>
<td>9</td>
<td>30%</td>
</tr>
<tr>
<td>&gt;50</td>
<td>4</td>
<td>13.30%</td>
</tr>
<tr>
<td>Total</td>
<td>30</td>
<td>100%</td>
</tr>
</tbody>
</table>

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**Table 3. Clinical profile of the patients**

<table>
<thead>
<tr>
<th>Etiology of ulcer</th>
<th>Number of cases</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meningomelocele</td>
<td>6</td>
<td>200</td>
</tr>
<tr>
<td>Hansen’s Disease</td>
<td>17</td>
<td>56.7</td>
</tr>
<tr>
<td>Diabetes</td>
<td>7</td>
<td>23.3</td>
</tr>
</tbody>
</table>
histology of the ulcer, shifting it from a chronic inflammatory state to a much more evolutive condition.\textsuperscript{11}

The use of serial TCC in the treatment of neuropathic ulcers of the feet is safe, effective, quick and an inexpensive treatment modality. Our patients were mainly men and of working age, so that the major advantages of cast therapy were the ability of the patient to continue his occupation and the reduction of the need for inpatient treatment. Also the female cases could continue with their household activities in total contact casts. It is unfortunate that plaster casts, especially if they are not well padded are associated with production rather than cure of ulcers. Though infection was once thought a contraindication for TCC, recent studies recommend it for even superficially infected neuropathic ulcers without peripheral arterial disease.\textsuperscript{12} Pre-requisites are close monitoring of the patient, repeated debridement and dressings and proper antibiotic cover. Once infection settles, TCC can be applied. In infected cases, a removable cast is rather a better option because it allows for changing the dressing daily.

In the study casts were well tolerated: most patients walked well and remained at work. In two patients, recurrent ulcers developed on their foot during the study period, which healed again in TCC. Repeated casting is as effective in recurrent ulcers as in primary ones. Poor patient compliance has been a problem with TCC and requires repeated counseling and reassurance. Educating the patient is most important; without this the foot will always break down again, so the importance of foot care and proper footwear was impressed upon the patients.

**Limitation of the study**

Small sample size and the lack of control subjects for comparison.

**Conclusion**

Offloading with TCC is believed to be the gold standard method with better and faster healing rates, and its superiority to other treatment modalities is related to excellent compliance. The treatment of choice for an established trophic ulcer is the application of serial, light skin tight plaster casts with relief from weight bearing. Educating the patient about the care of neuropathic feet and use of proper footwear cannot be ignored.

**References**


### Table 4. Duration of healing in weeks

<table>
<thead>
<tr>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Healing in weeks</td>
<td>30</td>
<td>2.00</td>
<td>8.00</td>
</tr>
</tbody>
</table>


