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## The effectiveness of removable cast walker in the healing of diabetic neuropathic ulcer in Basra

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### ABSTRACT

Diabetic foot ulcers are one of the most common causes of lower limb amputation in diabetic patients, the ulcer occurs commonly in the plantar aspect of the foot (weight bearing area). To evaluate the effectiveness of the use of a removable cast walker (RCW) in the healing of the diabetic neuropathic plantar foot ulcerations. This study was done at Al-Fayha general hospital, Basra, Iraq. A prospective study between August 2016 and September 2018 on 29 adult patients, 22 males and 7 females with a neuropathic plantar foot ulcer. The minimum age of patients was thirty-nine years and the maximum was seventy years; with a mean age of (55.79 +/-7.7) years. This study also showed the relationship between the healing rate and the site of neuropathic ulcers and it had been observed that the number of healed ulcers in the forefoot were eighteen patients (78.3%) of all patients with forefoot ulcers. Removable cast walker is an effective method in the treatment of diabetic neuropathic non-ischemic foot ulceration.



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However, TCC has limited use in clinical practice, as they are technically difficult, time-consuming to apply, expensive and have low patients tolerance (Laing *et al.*, 1992). To overcome these difficulties (Laing *et al.*, 1987).

### INTRODUCTION

Diabetic foot ulcers (DFUs) are one of the most common precursors to lower limb amputation in diabetic patients, effective management of these wounds have an important rule in amputation prevention. Diabetic foot ulcers frequently occur in weight-bearing areas of the foot. Patients are insensate due to diabetic neuropathy lacking the sensory feedback (Lavery *et al.*, 1998). Relieving pressure facilitate healing by external mechanism or devices 4 (David *et al.*, 1998)

Dr.Paul Brand was the first to use a total contact casting (TCC) in 1960 to offload the foot in Hansen's disease. TCC was the golden standard of treatment to offload diabetic foot ulcer (Sinacore *et*

of TCC, and alternative offloading method such as removable cast walker (RCW), it's a cast-like or readymade devices that are removable to allow self-inspection of the wound and application of dressings that require frequent administration (Armstrong *et al.*, 2004).

The aim of this study is to evaluate the effectiveness of the use a removable cast walker (RCW) in the healing of the diabetic neuropathic plantar footulceration.

A diabetic foot ulcer is defined as non-healing or poorly healing full-thickness wound, through the dermis below the ankle in an individual with diabetes for more than three months (Mendes and Neves,2012). Diabetic foot ulcers are of three types: neuropathic ulcer, ischemic ulcer or both (neuroischemic ulcer) (Ndip *et al.*, 2012).

The effect of forces on the plantar aspect of the neuropathic foot plays an important role in the development of diabetic foot ulcer. These forces are:

1. Vertical stress: defined as mechanical stress that occurs at the right angle and

tends to damage healthy tissue through repetitive compressive forces.

2. Shear: stress that is imparted parallel to the plantar aspect of the foot (Armstrong *et al.*, 1998).

### Testing for loss of sensation

Two simple and effective tests for peripheral neuropathy are being used:

1. Ten-gram (Semmes-Weinstein) monofilament.
2. Standard 128Hz tuning fork (Boulton *et al.*, 2008).

### Testing for vascular status

Assessment pedal pulses in both feet with measurement ankle-brachial index, toe pressure assessment with transcutaneous oxygen measurement (LoGerfo and Coffman, 1984).

### Classification of diabetic foot ulcer

A various wound classification system that is used attempt to cover different characteristics of an ulcer. The University of Texas classification system which combine grade and stage shows a greater association with increased risk of amputation and prediction of ulcer healing (Lavery *et al.*, 2010; Samson *et al.*, 2001).

### Patients and method

This study was done in Alfalfa diabetic foot clinic in Basra, Iraq. It's a prospective study from August 2016 until September 2018. Twenty-nine patients were included in this study. The mean age of the participants was (55.79 +/- 7.7) years, with a mean duration of the disease of (11.52 +/- 4.0) years. The study had twenty-two (75.9%) males and seven

(24.1%) females. Study inclusion criteria were the presence of a neuropathic plantar foot ulcer with an area graded up to 2A according to the University of Texas Classification of the Diabetic ulcer. The diagnoses of Peripheral neuropathy was based on clinical signs and symptoms in addition to the insensitivity of the foot to a 10-g Semmes-Weinstein monofilament and by a loss of vibration perception which is tested by using 128 Hz tuning fork on the medial malleolus and dorsal aspect of the big toe.

All patients were admitted to the hospital, full history systemic and local examination were performed, lab investigation was requested (complete blood count, blood sugar, blood urea, serum creatinine, HbA1c, the radiological study of both feet. Doppler U/S of lower extremities were done. Surgical debridement to remove nonviable tissue for all patients and debridement was done under regional anaesthesia (ankle block), we instructed the participants a removable cast walker (RCW) in the second-day post-operation, and the patient should use removable cast walker (RCW) during walking indoor and outdoor. Follow up were performed weekly for up to twelve weeks and the outcome was assessed by complete wound healing.

### RESULTS

The different demographic parameters for the patients were summarized in table 1 and as follows:

Twenty-nine patients were included. Twenty-Two male (75.9%) and seven female (24.1%). The minimum age of patients was thirty-nine years and the maximum was seventy years; with a mean age of (55.79 +/- 7.7) years. The minimum duration of diabetes was four years and the maximum duration was twenty-one years, with a mean duration of (11.52 +/- 4.0) years.

**Table 1: The demographic parameters**

Sex	Male 22 (75.9%)		Female 7 (24.1%)	SD
	Minimum	Maximum	Mean	
Age (years)	39	70	55.79	7.7
Duration of D.M (years)	4	21	11.52	4.0
Ulcer duration (months)	3	24	7.1	4.3
HbA1c	6.9%	11%	9.4%	
Ulcer UT-classification	1A		2A	
	13 (44.8%)		16 (55.2%)	
Ulcer Location	Forefoot	Midfoot	Heel	Total
	23 (79.3%)	1 (3.4%)	5 (17.3%)	29 (100%)

**Table 2 : Age distribution**

(Age (years	Patients No.	Percent %
31-40	1	3.4 %
41-50	7	24.0 %
51-60	12	41.4%
61-70	9	31.0%
Total	29	100.0%

**Table3 : Healing of the ulcer**

HEALING	(AGE [years				Total
	31-40	41-50	51-60	61-70	
Healed	1	5	9	6	20
	0.0 %	71.9 %	75.0 %	66.7%	69.0 %
Not Healed	1	2	3	3	9
	100.0 %	24.1%	25.0 %	33.3 %	31.0 %
Total	1	7	12	9	29
	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %

(P value = 0.16 (not significant)

**Table 4: Healing of the ulcer according to the ulcer site**

HEALING	SITE OF ULCER			Total
	Forefoot	midfoot	Heel	
Healed	18	0	2	20
	78.3%	0.0%	40.0%	69.0%
Not healed	5	1	3	9
	21.7%	100.0%	60.0%	31.0%
Total	1	1	5	29
	100.0%	100.0%	100.0%	100.0%

(P value = 0.034 (significant)

The minimum duration of the ulcers was three months and the maximum was twenty-four months, with a mean duration of (7.1 +/-4.3) months. The minimum HbA1c was (6.9%) whereas the maximum level was (11%) with a mean level of (9.4%). According to UT-Classification, there were thirteen patients (44.8%) with 1A and sixteen (55.2%) with 2A. The neuropathic foot ulcers were most commonly located in the forefoot which was twenty-three (79.3%) ulcers while there were five (17.3%) ulcers in the heel and the least number of the ulcers located in the midfoot which was one ulcer.

Table 2 shows the relationship between the planter foot ulcers and the age groups of patients. This study found that the number of patients with diabetic neuropathic foot ulcers in the first age group (31-40) years was one (3.4%), in the second age group (41-50) years was seven (24.0%), the third age group (51-60) years was twelve (41.4%) and in the fourth age group (61-70) years was nine (31.0%). However, we found that the foot ulcers have most commonly occurred between (51-70) years which represented (72.4%) of all ulcers.

For statistical purposes we divided the age of the patients into four groups and we observed that in the first group (31-40 years) there was one patient with non-healed ulcer; in the second age group (41-50 years) there were five (71.9%) patients with healed ulcers and two (24.1%) patients were not healed; in the third age group (51-60 years) there were nine (75.0%) patients with healed ulcers and three (25.0%) patient were not healed and in the fourth age group (61-70 years) there were six (66.7%) patients with healed ulcers and

three (33.3%) patients were not healed. However, p-value = 0.16 (not significant), shows table 3.

This study also showed the relationship between the healing rate of the ulcer and the site of neuropathic ulcers and it had been observed that the number of healed ulcers in the forefoot was eighteen patients (78.3%) of all patients with forefoot ulcers and there were only five patients (21.7%) with non-healed ulcers whereas in the heel area the healed ulcers were two patients (40%) and there were three patients (60%) with non-healed ulcers while the only patient with midfoot ulcer did not show any evidence of healing. (P-value = 0.034) (Significant). Shows table 4.

The total number of planter neuropathic ulcers with 1A according to University of Texas (UT-Classification) were thirteen (44.8%), the healed ulcers were ten (76.9%) whereas the non-healed ulcers were three (23.1%), and the total number of ulcers with 2A was sixteen (55.2%), the healed were ten (62.5%) and six (37.5%) not healed. P value = 0.229 (not significant). Shows table 5.

In this study we found that no healing of ulcer was obtained before five weeks of treatment whereas there were twelve patients (41.4 %) healed between (5-8wks.) and eight patients (27.6%) healed between (9-12 wks.) and nine patients (31.0%) not healed, as shown in table 6.

The study found that the minimum time taken for the ulcers to heal was 6 weeks, whereas the maximum time was 12 weeks and the mean duration of off-loading time was (8.45 +/- 2.2) weeks.



## DISCUSSION

There are many types of off-loading strategies used for the treatment of diabetic neuropathic foot ulceration to decrease the incidence of lower limb amputations but, which of these strategies are more suitable?

In this study, I evaluated the efficacy of using the removable cast walker (RCW) in the treatment of diabetic neuropathic foot ulcers. Twenty-nine patients have completed the study. The mean age of patients was (55.7 +/- 7) years, (75.9%) were males, with a mean duration of diabetes mellitus of (11.52 +/- 4) years.

A study done by Piaggese in 2007 showed that the mean age of patients was (59.8 +/- 8.2) years, with a mean duration of diabetes mellitus of (14.7 +/- 11.1) years, however, this study designed to compare between removable and irremovable cast walkers (Piaggese *et al.*, 2007)

In this study we observed that the healing percentage of the first age group (31-40 years) was (0.0%), in the second age group (41-50 years) was (71.9%), in the third age group (51-60 years) was (75.0%) and in the fourth age group (61-70 years) was (66.7%). We think that the low percent of healing in a younger age group because they are more active than older age groups. However, the relationship between the age of patients and the healing of ulcers was not significant (p-value = 0.16).

The planter foot ulcers in this study most commonly located in the forefoot (79.3%), the heel ulcers represent (17.3%) and the least number of the ulcers were located in the midfoot (3.4%). The healing rate of the forefoot ulcers was (78.3%). These results were in disagreement with the study done by Gutekunst *et al.* in (2011) in which they compared between the effectiveness of (TTC) and (RCW) and they observed that " the removable cast walker (RCW) provides greater reduction in the key loading variables of peak pressure, pressure-time integral, maximum force, and force-time integral in the forefoot region of the foot, a frequent site of diabetic foot ulceration. However, this finding of lower healing proportions (41.6%) in the RCW despite greater load reductions reinforces the importance of compliance in ulcer healing in the person with diabetes, neuropathic foot (Gutekunst *et al.*, 2011).

The percentage of planter neuropathic ulcers with 1A class according to (UT-Classification) was (44.8%) with a healing rate of (76.9%) whereas the percentage of ulcers with 2A class was (55.2%), with a healing rate of (62.5%), however we found that the total percentage of healing of the ulcers with (1A,2A) classes were (69.0%) with a mean duration of (8.45 +/- 2.2) weeks. The results of this

study seems to be comparable to the result of Faglia *et al.* in 2005 whom they observed that the healing percentage of the ulcers was (72.7%) with a mean duration of (5.6 +/- 0.6) weeks of using (RCW) (Faglia *et al.*, 2010).

## CONCLUSION

Removable cast walker is an effective method in the treatment of diabetic neuropathic non-ischemic foot ulceration. The healing rate of the ulceration by this method of offloading is mainly depending on the site of ulceration in the plantar aspect of the foot in which the forefoot ulcers have a higher rate of healing. Patients' education and compliance is a cornerstone for the successfulness of this type of offloading strategy.

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