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Tibial Nerve Decompression in The Tarsal Tunnel versus Conservative Measures in The Treatment of Painful Diabetic Polyneuropathy

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ABSTRACT

Background: The response of diabetic polyneuropathy (DPN) to conservative treatment is usually unsatisfactory. As the manifestations of DPN usually mimic nerve compression, we evaluated the outcomes of tibial nerve decompression at the tarsal tunnel compared to the conservative measures in patients presenting with painful lower limb diabetic neuropathy. **Patients and methods:** This randomized controlled clinical trial included 42 patients who were randomly assigned into two groups; *Group 1* included 21 patients who were surgically managed by tibial nerve decompression at the tarsal tunnel level, and *Group 2* included the remaining cases who received the standard conservative management. Follow-up was done after six months via clinical, nerve conduction, and ultrasound assessment.

Results: All pre-intervention patient and disease criteria showed no significant difference between the study groups. Nevertheless, a significant improvement in neuropathic pain and ischemic manifestations was noticed in *Group 1*. The same group also expressed better improvement of nerve conduction studies at follow-up compared to its baseline values and *Group 2*. Posterior tibial artery indices and cross-sectional area of the posterior tibial nerve (PTN) were significantly improved in *Group 1* compared to *Group 2*. Consequently, there was a great improvement in patient satisfaction with the surgical intervention. **Conclusion:** The surgical decompression of the PTN is associated with better short-term outcomes regarding pain improvement, nerve conduction findings, and ultrasonographic arterial and nerve parameters compared to the conservative treatment.

Keywords: Diabetic neuropathy, Tibial nerve, Decompression, Conservative treatment.

INTRODUCTION

Diabetic polyneuropathy (DPN) is a clinical entity that describes the manifestations of peripheral nerve dysfunction in diabetic personnel after other causes have been excluded. Its diagnosis is established based on the clinical findings as well as objective quantitative testing, which may reveal the condition despite the absence of related symptoms [1]. It is one of the most common consequences of diabetes mellitus (DM), as it affects about 66% and 59% of diabetic patients with types I and II, respectively [2]. Not only does DPN constitute a major healthcare and economic problem, but also it is associated with an increased risk of morbidity and mortality in such patients [3].

According to a recent community-based review, about one-third of diabetic individuals have neuropathic pain, which is the most distressing complaint and the main motive for these individuals to seek medical advice [4]. The management of neuropathic pain in such cases is still challenging for many physicians due to its different distribution, wide severity spectrum, and numerous clinical presentations [5].

Based on previous clinical observation, one could notice that the manifestations of DPN could be more or less similar to chronic nerve compression. This suggests that chronic nerve entrapment could play a crucial role in the pathogenesis of pain in patients with DPN. Therefore, surgical intervention aiming at nerve decompression may be a hopeful solution for these distressing symptoms rather than the traditional management protocol, including lifestyle modification, strict glycemic control, and pharmacological therapy[6].

The entrapment of the tibial nerve at the tarsal tunnel level was initially described in 1962. After that, multiple reports have been published describing its clinical manifestations, diagnostic criteria, and management protocols which are mainly surgical. Later in 1980, a higher incidence of tarsal tunnel syndrome (TTS) was described in patients with DM, as diabetes is associated with a higher risk for peripheral nerve compression [7].

In the current study, we evaluated the outcomes of tibial nerve decompression at the tarsal tunnel and compared it to the conservative measures in patients presenting with painful lower limb diabetic neuropathy.

PATIENTS AND METHODS

This randomized controlled clinical trial entailed 42 patients who presented with painful lower extremity DPN, confirmed to have tibial nerve entrapment at the tarsal tunnel by nerve conduction velocity (NCV) studies, and attended at Mansoura University Hospitals during the period between January 2018 and June 2021.

Our sample size was estimated via the "sample size and power analysis software" based on the average pain improvement rates reported after surgical and conservative management of these cases, which are 80% and 38%, respectively. We needed to enroll 21 patients in each group to achieve an 80% power and 0.05 significance level. Based on the previous

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estimation, we needed a total of 42 patients to be enrolled in our clinical trial.

We enrolled patients manifested with painful lower limb diabetic neuropathy affecting the distribution of the posterior tibial nerve (PTN) medial and lateral plantar surfaces, having positive Tinel sign at the entrapment site (tarsal tunnel), and confirmed by NCV and electromyographic (EMG) studies.

We excluded patients with neuropathy due to other causes other than DM. Patients with alcoholism, chronic kidney disease, absent distal foot pulsations, radiculopathy, lumbar spondylosis, pedal edema, or major psychiatric illness were also excluded.

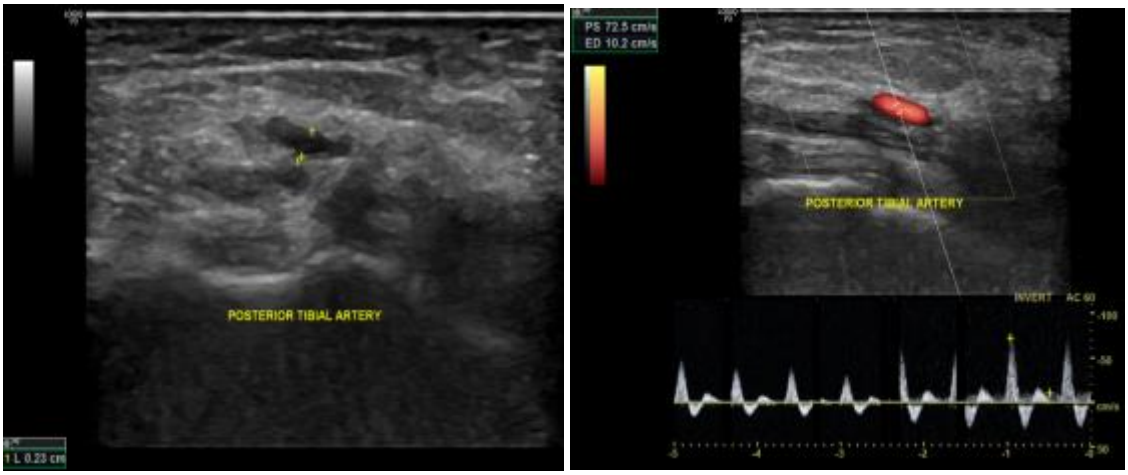
All participants were subjected to history taking which included analysis of pain, and its duration, the presence of tingling or numbness, together with the duration of diabetes and its type. Patients were additionally inquired about their functional status, normal activities, ability to work, walking distance, family history of diabetes, and the use of medications. The reported neuropathic pain was expressed via the visual analog scale (VAS), which is an eleven-point scale, with 0 for no pain and 10 for the worst pain ever [8]. Patients were also subjected to neurosensory assessment, including percussion over the distribution of the affected peripheral nerve (Tinel sign) and two-point discrimination (2-PD). Laboratory workup included routine preoperative investigations along with fasting, postprandial blood glucose, and glycosylated hemoglobin (HbA1c). Beside NCV and EMG, a high-resolution ultrasound using linear probe (5-12 MHz) was performed to assess nerve echogenicity and continuity. The cross-sectional area (CSA) of the PTN was measured 1.5 cm inferior to tip of medial malleolus (distal to the tarsal tunnel). The posterior tibial artery (PTA) was also assessed regarding its diameter, peak systolic velocity (PSV), and resistive index (RI) (**Figure 1**).

After proper assessment, the patients were randomly enrolled into two groups via the sealed envelope method; *Group 1* included 21 patients who were surgically managed by tibial nerve decompression at the tarsal tunnel level, and *Group 2* included the remaining cases who received the standard conservative management.

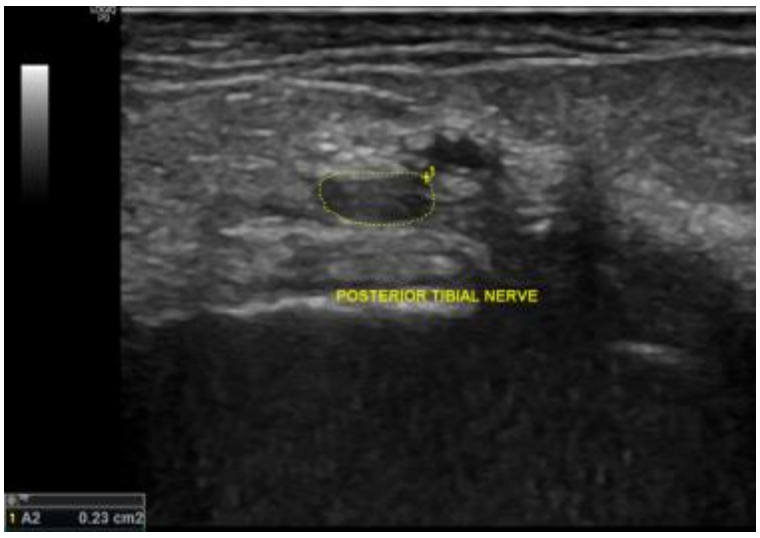
In *Group 1*, the surgical procedure was done under local anesthesia. A six-cm curved incision was performed along the medial malleolus (**Figure 2**), followed by division of the superficial and deep fasciae. The tarsal tunnel release was done by dividing the flexor retinaculum. After its division, the PTN and vessels were identified and decompressed. Dissection and release of PTN branches (medial plantar, lateral plantar, and calcaneal) was done (**Figure 3**). If there was evidence of epineurium thickening, epineurium decompression was done. Finally, the skin incision was closed. The patient was also instructed to keep strict monitoring of his blood glucose level. In *Group 2*, management was done through lifestyle modification, strict glycemic control, neurotonic and neurotrophic medications, vasodilators, and pain killers.

The follow-up was conducted mainly on an outpatient basis, with the assessment of the following parameters: VAS, 2-PD, NCV, and high-resolution ultrasound for the assessment of the CSA after six months (**Figure 4**). The "patient satisfaction questionnaire" form (PSQ-18) was used to assess patient satisfaction. This tool entails 18 items for the assessment of seven dimensions, including general satisfaction, technical quality, interpersonal manner, communication, financial aspects, time spent with the physician, and accessibility and convenience [9,10].

Our primary outcome was pain improvement, whereas secondary outcomes were the healing of diabetic foot ulcers, improvement of vascularity, and physical activities.



(A) **(B)**



(C)

Figure (1): (A&B) Pre-operative ultrasound & Doppler images of posterior tibial artery at level of medial malleolus revealed reduced diameter (2.3 mm) as well as increased flow velocity (peak systolic velocity = 72.5 cm/s). (C) Pre-operative ultrasound of posterior tibial nerve 1.5 cm inferior to tip of medial malleolus revealed increased cross-sectional area (23 mm^2).

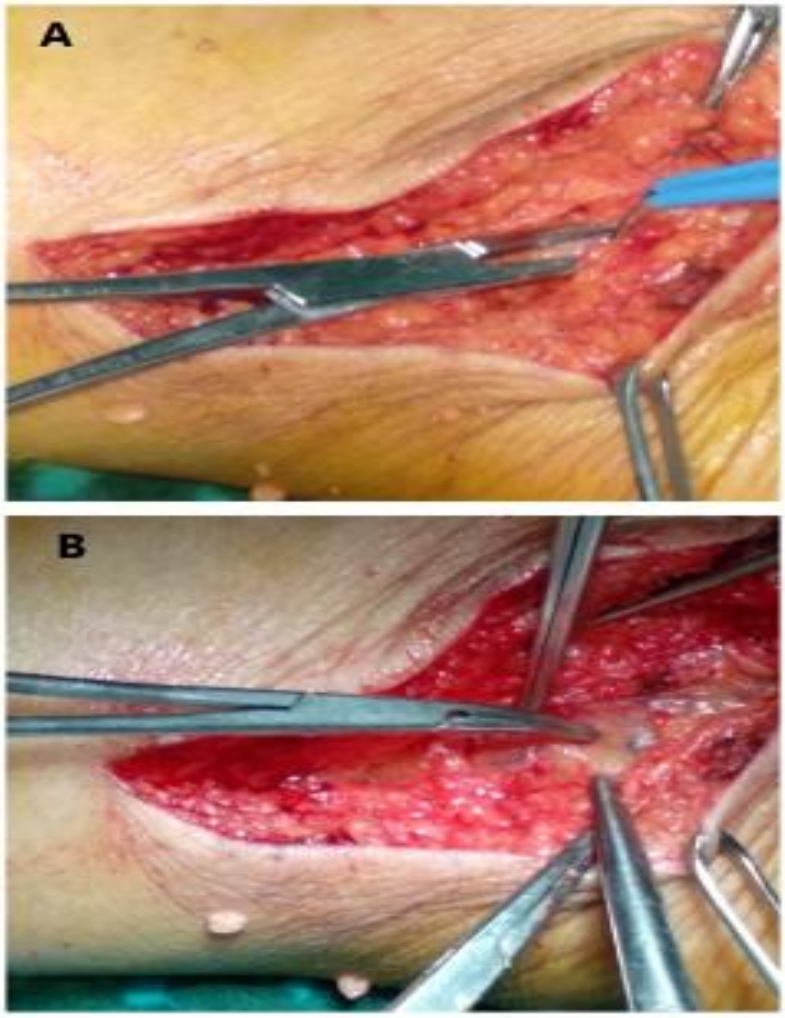


Figure (2): (A) tarsal tunnel release was done by division of the flexor retinaculum, (B) exposure of the posterior tibial structures after division of the flexor retinaculum.

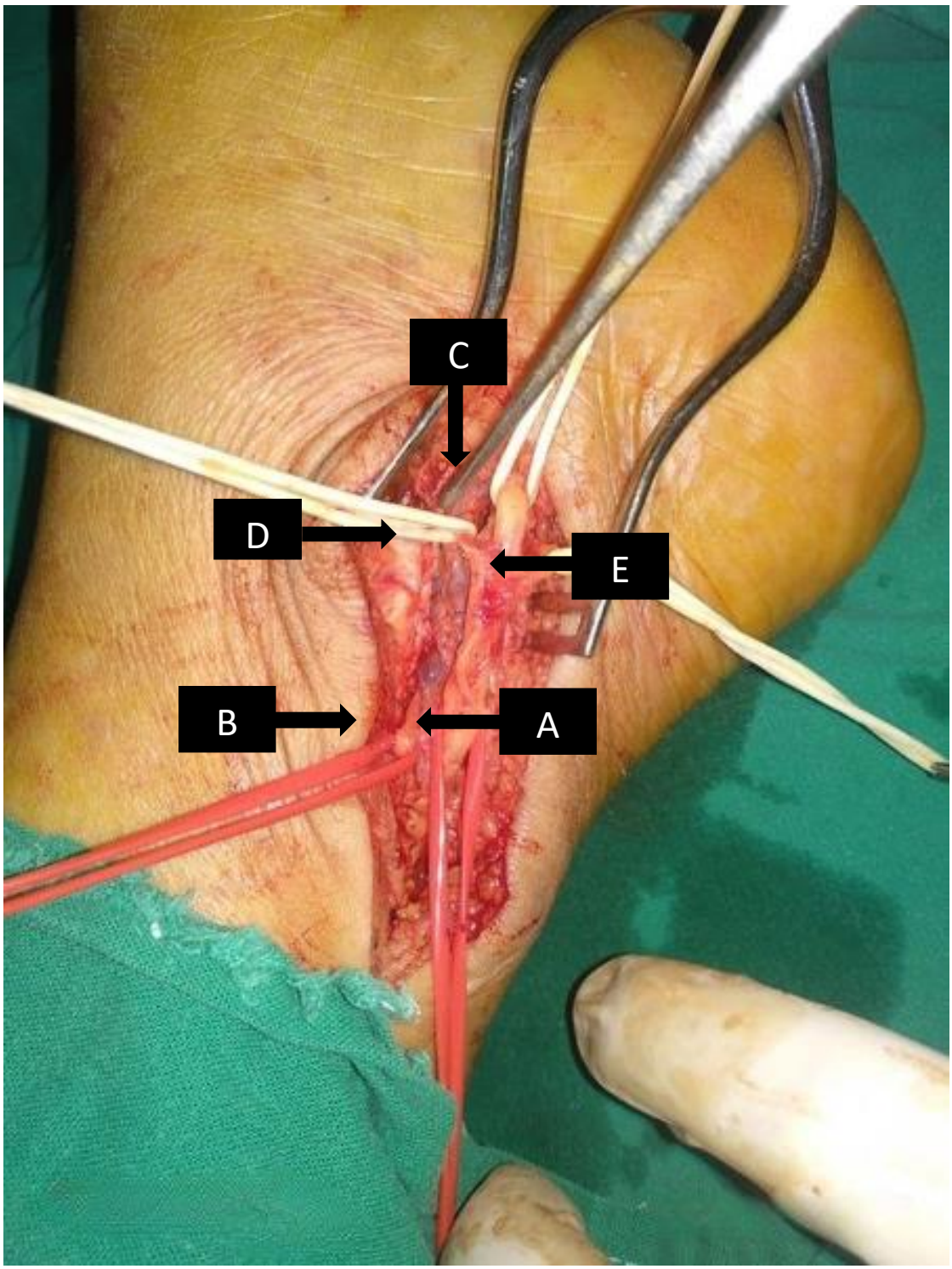
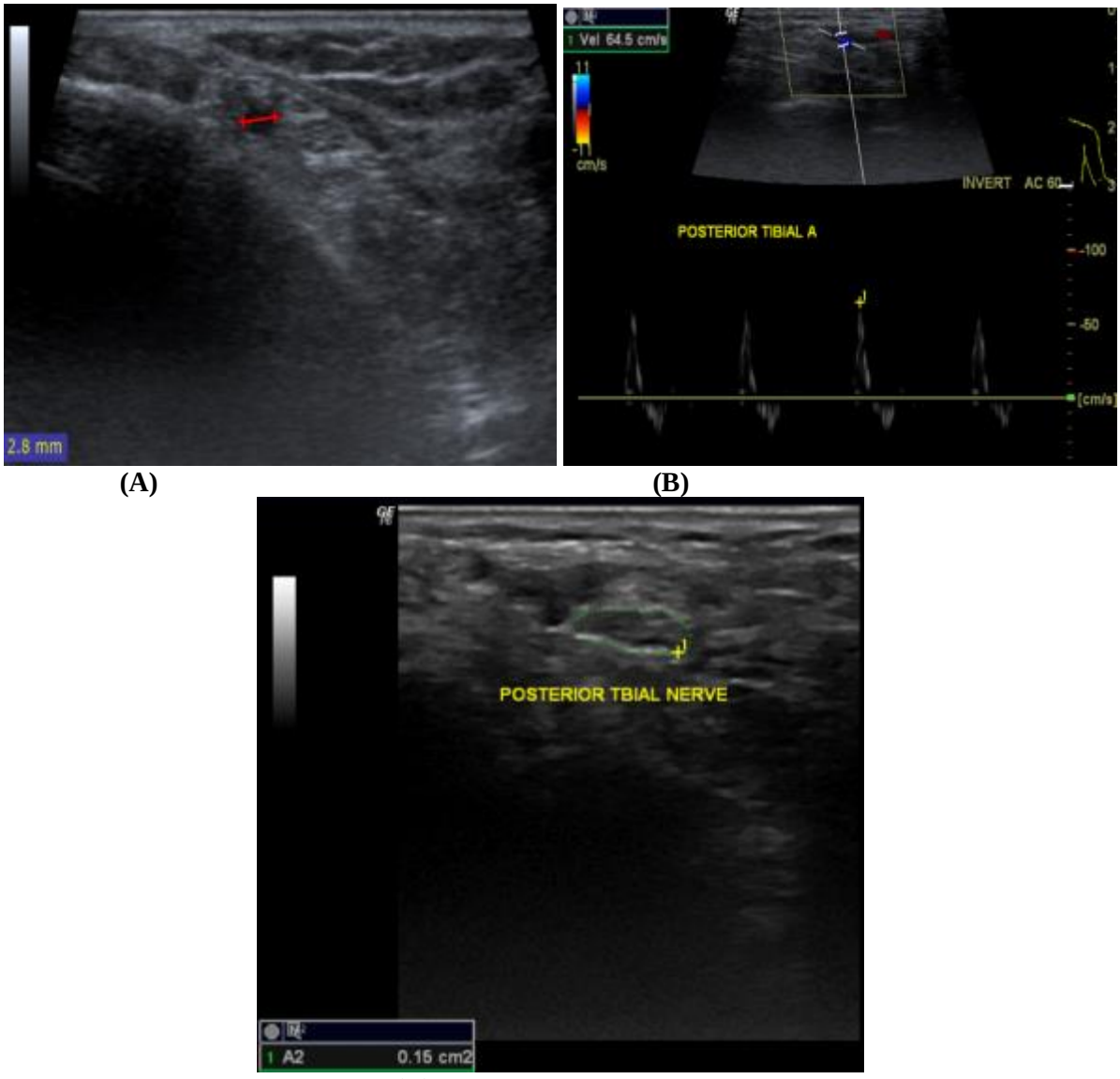


Figure (3): Identification, decompression and neurolysis of the tibial nerve and its branches; (A) main trunk of posterior tibial nerve, (B) posterior tibial artery and vein, (C) medial planter nerve, (D) lateral planter nerve, (E) calcaneal nerve.



(A) **(B)**

(C)

Figure (4): (A&B) Post-operative ultrasound & Doppler images of posterior tibial artery at level of medial malleolus revealed mild increased diameter (2.8 mm) with average flow velocity (peak systolic velocity = 64.5 cm/s). (C) Post-operative ultrasound of posterior tibial nerve 1.5 cm inferior to tip of medial malleolus revealed average cross-sectional area (15 mm^2).

Ethical consent:

We started to enroll patients in the study after gaining approval from the Institutional Review Board (IRB) of Mansoura University (IRB code: R.16.06.65). All patients signed informed consent before enrollment in the study. This work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Statistical analysis

The previous parameters were collected and analyzed via the SPSS (Statistical Package for the Social Sciences) software, version 24 for Windows. Categorical data were expressed as numbers and percentages, then compared between the two groups using the Chi-Square (X2), Fischer Exact (FET), or Monte Carlo (MC) tests based on the number of categories. Quantitative variables were expressed as mean (with standard deviation) or median (with range) according to data normality. For the former, the Student's t-test (t) was used to compare the two groups, whereas the paired-t-test was used to compare time periods within the same group. For the latter, the Mann-Whitney test (U) was applied when comparing the two groups, while the Wilcoxon signed rank test was applied when comparing different time points within the same group. For all tests performed, a p-value equals or less than 0.05 was considered significant.

RESULTS

Table 1 summarizes the sociodemographic characteristics of the 2 studied groups. No statistical significant differences were observed regarding age, gender, smoking habit, type of diabetes, or duration of diabetes in years.

Table (1): Comparison of sociodemographic characteristics of the studied groups.

Variable	Group1 N=21	Group2 N=21	test of significance
Age/years Mean ± SD	55.29 ± 11.76	55.14 ± 11.77	t=0.039 p=0.969
Sex N (%) Male Female	7 (33.3) 14 (66.7)	5 (23.8) 16 (76.2)	χ^2=0.467 p=0.495
Smoking N (%) -ve +ve	16 (76.2) 5 (23.8)	17 (81.0) 4 (19.0)	χ^2=0.141 p=0.707
Type of diabetes N (%) I II	3 (14.3) 18 (85.7)	3 (14.3) 18 (85.7)	P=1.0
Disease duration/years median (range)	7 (2 - 25)	8 (3 - 23)	Z=0.101 P=0.920

Table 1 summarizes and compares the clinical characteristics of the 2 studied groups.

Table (2): Comparison of laterality, duration, VAS, and symptoms between the studied groups.

Variable	Group 1 N=21	Group 2 N=21	test of significance
Affected side N (%) Right Left Bilateral	3 (14.3) 2 (9.5) 16 (76.2)	3 (14.3) 1 (4.8) 17 (81)	χ^{2MC}=0.364 p=0.834
Duration of symptoms of neuropathy/year Median (range)	5 (1 - 14)	3 (1 - 10)	z=1.41 p=0.158
VAS Mean ± SD	7.0 ± 1.92	7.43 ± 1.59	t=0.785 p=0.437
Stock hypothesia N (%) -ve +ve	12 (57.1) 9 (42.9)	13 (61.9) 8 (38.1)	χ^2=0.099 p=0.753
Symptoms of Chronic ischemia N (%) -ve +ve	14 (66.7) 7 (33.3)	13 (61.9) 8 (38.1)	χ^2=0.104 p=0.747
Diabetic foot ulcer N (%) -ve +ve	15 (71.4) 6 (28.6)	16 (76.2) 5 (23.8)	χ^2=0.123 p=0.726

In follow-up of the response among both groups, we found that neuropathic pain was improved in 17 (81%) cases of the surgical group in comparison to only eight (38.1%) cases in the medical group, and this was statistically significant (p = 0.005). Out of nine patients with pre-interventional hypothesia, it improved in seven cases (77.8%) in *Group 1*. Meanwhile, two cases (25%) improved in *Group 2*. Ischemic manifestations improved after tarsal tunnel release in five out of seven cases (71.4%) in *Group 1*, compared to only one out of eight cases (12.5%) after drug therapy in Group 2, and this result was statistically significant (p = 0.02). Improvements in patients after surgical release and medications are listed in **Table 3.**

Table (3): Comparison of neuropathic pain, stock hypothesia, ischemic manifestations, and ulcer improvement between studied groups.

Variable	Group 1 N=21	Group 2 N=21	test of significance
Improvement of neuropathic pain (VAS) Not improved Improved	4 (19) 17 (81)	13 (61.9) 8 (38.1)	χ^2=8.01 p=0.005*
Improvement of stock hypothesia Not improved Improved	N=9 2 (22.2) 7 (77.8)	N=8 6 (75) 2 (25)	χ^{2FET}=4.74 p=0.057
improvement of ischemic manifestations Not improved Improved	N=7 2 (28.6) 5 (71.4)	N=8 7 (87.5) 1 (12.5)	χ^2=3.54 p=0.02*
Improvement of diabetic foot ulcers Not improved Improved	N=6 2 (33.3) 4 (66.7)	N=5 3 (60) 2 (40)	χ^{2FET}=0.782 p=0.376

On comparing results of NCV among both groups before therapy and on follow-up after six months, the results were statistically significant. Tibial nerve latency improved in the surgical group from a mean of 6.67 ± 0.097 m.sec preoperatively to 6.38 ± 0.177 m.sec on the six-month postoperative follow-up (p < 0.001), which was highly significant. When compared to the results of tibial nerve latency in cases of the medical group at presentation and on the six-month follow-up, better improvement was detected in cases of the surgical group (p < 0.001). Results of NCV among both groups at presentation and on 6-month interval follow-up are demonstrated in **Table 4.**

Table (4): Comparison of NCV between studied groups before and after treatment.

Nerve conduction velocity		Group 1 N=21	Group 2 N=21	test of significance
Tibial nerve amplitude (N. =/> 3 milli volt)	Pre	2.95 ± 0.18	2.84 ± 0.23	t=1.75 p=0.09
	Follow up 6 months	3.08 ± 0.17	2.89 ± 0.18	t=3.70 p=0.001*
	P-value	< 0.001*	0.168	
Tibial nerve conduction velocity (N. =/> 40 milli/second)	Pre	38.095 ± 1.33	37.86 ± 2.04	t=0.448 p=0.657
	Follow up 6 months	40.76 ± 1.77	39.09 ± 1.81	t=3.09 p=0.004*
	P-value	< 0.001*	0.012*	-------
Tibial nerve latency (N. =/< 6.5 milli second)	Pre	6.67 ± 0.097	6.69 ± 0.13	t=0.469 p=0.642
	Follow up 6 months	6.38 ± 0.177	6.61 ± 0.15	t=4.53 p<0.001*
	P-value	<0.001*	0.025*	-------

Regarding ultrasound findings, the compared results at the presentation and after the six-month follow-up between both groups were statistically significant. Details of ultrasonographic findings are described in **Table 5.**

Table (5): Comparison of Duplex ultrasound findings between studied groups.

Duplex ultrasound		Group 1 N=21	Group 2 N=21	test of significance
PTA diameter (N. = 3.8 mm)	Pre	2.42 ± 0.30	2.48 ± 0.41	t=0.311 p=0.757
	Follow up months	2.86 ± 0.48	2.51 ± 0.43	t=1.98 p=0.06
	P-value	< 0.001*	0.480	-----
PTA (PSV) (N. = 55 – 65 cm /second)	Pre	67.93 ± 3.04	68.21 ± 3.27	t=0.291 p=0.773
	Follow up months	63.83 ± 3.17	68.24 ± 3.36	t=4.37 p<0.001*
	P-value	< 0.001*	0.936	-----
PTA (RI) (N. = 0.7 - 0.72)	Pre	0.775 ± 0.051	0.776 ± 0.048	t=0.093 p=0.926
	Follow up 6 months	0.738 ± 0.04	0.781 ± 0.046	t=3.28 p=0.002*
	P-value	0.001*	0.314	-----
PTN (CSA) (N. = 12.7mm² +/- 4.5 mm²)	Pre	23.86 ± 2.92	24.36 ± 2.83	t=0.563 p=0.576
	Follow up 6 months	16.33 ± 1.79	22.79 ± 3.24	t=7.98 p<0.001*
	P-value	< 0.001*	0.042*	-----

Patients' satisfaction was assessed among cases of both groups using the short-form instrument, the PSQ-18. Patient satisfaction scores among cases of both groups were demonstrated in **Table 6.**

Table (6): Comparison of patient satisfaction between studied groups.

Variable	Group 1 N=21	Group 2 N=21	Test of significance
General satisfaction 3,17	6.76 ± 1.67	7.38 ± 1.59	t=1.23 p=0.227
Technical quality 2,4,6,14	12.14 ± 2.35	12.09 ± 2.53	t=0.026 p=0.979
Interpersonal manner 10,11	7.86 ± 1.6	7.05 ± 1.42	t=1.33 p=0.191
Communication 1,13	8.19 ± 1.44	5.67 ± 1.77	t=5.07 p<0.001*
Financial aspects5,7	6.95 ± 1.16	6.38 ± 1.88	t=1.18 p=0.244
Time spent with the doctor 12,15	6.43 ± 1.08	5.90 ± 1.13	t=1.53 p=0.133
Accessibility & convenience 8,9,16,18	13.90 ± 3.63	11.38 ± 2. 16	t=2.07 p=0.045*
Total satisfaction	62.24 ± 8.24	55.86 ± 8.66	t=2.45 p=0.019*

DISCUSSION

This clinical trial compared the outcomes of surgical decompression therapy to conservative treatment in the management of patients with painful DPN affecting the lower extremity. Generally, our findings highlighted the superiority of the surgical intervention against the conservative measures in managing such cases.

First of all, the reader could notice no significant differences regarding all preoperative patient and clinical criteria between the two groups. This denoted our proper randomization. Besides, this should negate any bias skewing our findings towards one group rather than the other.

Our findings showed a significant improvement in pain sensation and stock hypothesia in the surgical group compared to the conservative one. Nonetheless, the marked improvement noticed in the latter symptom did not reach a statistical significance.

The success of surgical decompression in improving the DPN-associated symptoms could be elucidated when one becomes aware of peripheral nerve changes occurring in DM. This theory has been described as the double-crush theory, in which the nerve is subjected to chronic compression by two means, the first via the increased endoneurial water content and the second via compression at the regions of anatomical tunnels like the tarsal tunnels [11]. Vasculopathy associated with diabetes also hinders sufficient blood

supply to the affected nerves leading to distressing pain sensation [12].

Yang *et al.* [13] demonstrated the efficacy of tibial nerve decompression on pain sensation measured by the 100-mm VAS. It decreased from 84.5 (SD 4.7) before the operation down to 41.8 (SD 16) and 26.8 (SD 20.3) after three and six months, respectively.

Dellon *et al.* [14] reported findings similar to ours, as pain improvement was evident after decompression of the tibial nerve. Pain scores decrease from 8.5 before intervention down to 2 at the six-month follow-up visit. Moreover, sensation improved from a loss of protective sensation to the recovery of some 2-PD during the same follow-up. These authors also reported that the presence of positive Tinel sign before intervention is a good prognostic marker for improvement after surgical decompression [14].

In another study conducted in Turkey, **Karagoz *et al.*** [11] reported that 80% of patients reported good to excellent pain relief the day after surgery, and that percentage increased up to 85% at the six-month follow-up visit. The remaining patients had fair or no improvement in their pain sensation. VAS score had mean values of 6.85 (SD 2.05) before the operation, which decreased down to 1.40 (SD 1.81) after one day, and 1.15 (SD 1.63) after six months. The same authors reported good improvement in the mean 2-PD length, which was 72.6 and 89% after one day and six months, respectively.

In the study conducted by Caffee in 2001, PTN decompression was associated with a significant improvement in pain sensation, which showed complete or nearly complete relief in 24 out of the 28 patients (86%). However, these positive outcomes were not noticed regarding improvement of paresthesia and numbness, which showed improvement in only 50% of them [15]. All of the previous studies are in line with our findings regarding the improvement of pain and hypothesia with surgical decompression.

In our study, the surgical intervention was associated with a significant improvement in ischemic manifestations ($p = 0.02$) compared to the conservative management. Improvement of diabetic foot ulcers was noted in 66.7% of patients with surgery compared with only 40% of patients with medical treatment, with statistically insignificant difference.

In 2010, Nickerson emphasized the efficacy of nerve decompression in the treatment of diabetic foot ulcers, with a marked decrease in the annual recurrence rates, which was 4.28%. The same authors also reported that the risk of having ulcers was even higher in the contralateral feet that did not undergo nerve decompression [16]. This denotes that nerve compression plays an important role in the pathogenesis of DPN-associated symptoms together with the metabolic disturbances, and relief of that compression has a great beneficial impact on disease manifestations.

In another prospective study by **Zhang and his colleagues** [17], they reported no patients (out of the included 208 with a history of foot ulcers) had ulcer recurrence or needed amputations within a 1.5-year follow-up period. Furthermore, another study evaluated the effect of unilateral nerve decompression on subsequent ulcerations in patients with DPN. Out of the included 50 cases, 12 of them had ulcers, and three required amputations within a 4.5-year follow-up period. Surprisingly, all of these complications were on the contralateral leg that did not undergo decompression [18]. All of the previous studies agree with our findings regarding the efficacy of surgical decompression in the relief of ischemic manifestations of DM.

In the current study, tarsal tunnel release was associated with a significant improvement in PTN-NCV manifested in increased nerve amplitude, increased NCV, and decreased latency period. These effects were more pronounced in association with surgery rather than conservative treatment.

Zhang *et al.* [17] also noted a significant increase in NCV after tibial nerve decompression. NCV increased from 28.2 (SD 7.20) m/sec before surgery to 36.31 (SD 3.33) m/sec 1.5 years following decompression ($p < 0.05$). The same beneficial impact was also noted in the common and superficial peroneal nerves. Nonetheless, all post-operative NCV values were significantly lower than controls. This fact should highlight the multiple agents incriminated in the pathogenesis of DPN, as correction of nerve compression resulted in a partial, not complete, improvement of NCV.

Another study reported contradictory findings, as tibial nerve decompression was associated with just small NCV changes that were statistically and clinically irrelevant. However, the same study reported significant improvement in pain. The authors reported that NCV changes are not correlated with clinical changes as NCV is mainly affected by myelinated nerve fibers rather than the small non-myelinated ones, which are better expressed by clinical manifestations [19]. The debate, whether decompression affects small or large fibers, should be assessed in the upcoming studies to elucidate this dilemma.

Our findings showed a significant decline in PTN-CSA after surgical decompression compared to medications. A previous study evaluated the morphological changes of PTN in patients with PDN. The authors noted that the CSA of this nerve was 24 mm2, which is twice the normal one. They also reported that the tarsal tunnel was the most common factor contributing to neuropathy symptoms. Ultrasound assessment of the PTN at the tarsal tunnel region revealed a characteristic hour glass deformity, as the nerve area below the tunnel was compressed, while the proximal and distal regions were swollen due to edema [20]. This coincides with our pre-intervention findings, which noted an increased PTN-CSA in both groups.

Zhang *et al.* [17] also confirmed the presence of significant nerve swelling and increased CSA in association with DPN. Although patients in the previous study underwent preoperative ultrasound for nerve assessment, the authors did not perform follow-up ultrasound for their cases to monitor changes in nerve CSA.

In a previous radiological study, **Singh and his colleagues [21]** detected a significant correlation between tibial nerve CSA and the degree of neuropathy. This is in the same context as our findings which showed a marked decrease in PTN-CSA along with the increased NCV. **Liao *et al.* [6]** mentioned that the swelling of the nerves, detected by ultrasound, was resolved after two years after decompression with the restoration of the normal nerve morphology. Tibial nerve CSAs decreased from 25.1 (SD 4.1) to 19.7 (SD 3.8) in patients with diffuse neuropathy, while it decreased from 25.3 (SD 3.5) to 16.9 (SD 3.2) in patients with focal neuropathy.

Regarding tibial arterial changes in our study, it showed a marked improvement after surgery compared to conservative management, manifested in decreased peak systolic velocity and decreased resistive index.

In a previous similar study, tarsal tunnel decompression was associated with significant changes in the PTA. The RI declined from 0.94 (SD 0.04) before surgery to 0.89 (SD 0.05) after it ($p < 0.05$) [22]. As the nerves are affected by tarsal tunnel compression, the accompanying vessels are expected to be affected as well. Subsequently, the release of this compression should positively impact both structures, as reported in our study. Another study confirmed the same perspective, as the peripheral microcirculation was significantly improved after tarsal tunnel release as manifested by pulse oximetry changes [23].

All of the previous findings showed the upper hand of surgical management compared to conservation, and that could explain the higher level of patient satisfaction reported in the surgical group.

Another study pointed to the positive impact of nerve decompression on the quality of life in patients with DPN using the short-form-36 questionnaire. Only body pain and general health domains showed improvement at the two-week follow-up. However, most of the remaining domains expressed significant improvement at the two-year follow-up [13].

Although our trial handled a unique comparison that was rarely discussed before, it has some limitations, including the small sample size and lack of long-term follow-up. Therefore, the upcoming studies should cover the previous drawbacks.

In conclusion, the surgical decompression of the PTN is associated with better short-term outcomes regarding pain improvement, nerve conduction findings, and ultrasonographic arterial and nerve parameters compared to the conservative treatment. It is also associated with better patient satisfaction without an increased risk of surgical complications. The surgical decompression technique should be considered when managing diabetic patients with PTN neuropathy with previous failure or intolerance to the medical treatment.

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Author contribution: Authors contributed equally in the study.

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