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Original Article

Effectiveness of Minimal Incision Surgical Decompression in Patients with Tarsal Tunnel Syndrome

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BACKGROUND: Tarsal tunnel syndrome may occur from different causes, including fibrosis or thickening of osteofibrous structures in the tarsal canal. Surgical treatment mainly involves open decompression and release of the tibial nerve. Recently, minimal-incision decompression has been trending due to more advanced surgical techniques and aiming to provide good patient satisfaction scores.

OBJECTIVE: To evaluate the effectiveness of minimal incision surgical decompression in patients with Tarsal tunnel syndrome and to explore different factors that affect postoperative pain scores.

PATIENTS AND METHODS: All patients with Tarsal tunnel syndrome indicated for surgery who underwent minimal incision decompression were included in the period between March 2018 till July 2022. The study was revised and approved by the Fayoum University Supreme ethical committee and conducted at the neurosurgery department, Fayoum university Hospital, Egypt. The pain was measured pre- and postoperatively by visual analog scale (VAS) from 0 to 10, where 10 is the maximum perceived pain. Complications were recorded, and correlation analyses were conducted to explore factors affecting postoperative pain.

RESULTS: A total of 18 patients were included in this retrospective cohort study. The mean VAS preoperative burning pain in the sole was 8.056 ± 1.023, while the mean postoperative VAS score was 4.11±1.31. We found a statistically significant difference between both the pre-operative and postoperative pain scores $P < 0.001$. The mean S-LANSS pain score was 18.11±2.45, while the average duration of surgery was 21.78 ±4.91 minutes. Postoperative edema was noted in 33% of participants. Correlation analysis revealed a significant reduction in pain scores in younger patients compared with older patients and that older age is associated with increased postoperative VAS pain scores ($r=0.803$, $p<0.01$). Interestingly, we found that postoperative pain score is negatively correlated with the duration of surgery ($r= -0.521$, $p=0.03$).

CONCLUSION: Minimal incision surgical decompression provides a safe, effective, and reliable option for treating patients with tarsal tunnel syndrome. Patients with younger age and no comorbidities experience better reductions in pain scores. Postoperative edema remains a complication that requires attention.

KEYWORDS: Tarsal tunnel syndrome, Sole pain, Tibial nerve decompression, Tibial neuralgia.

INTRODUCTION

Tarsal tunnel syndrome (TTS) is an uncommon condition that causes ankle pain, especially in the elderly population. The tarsal tunnel contains crucial structures such as the tendons of flexor digitorum longus (FDL), flexor hallucis longus (FHL), posterior tibialis, and posterior tibial nerve which runs between the FHL and FDL muscles.[1]

TTS may occur due to different etiologies, including trauma, non-fitting shoes, post-surgical scarring, systemic diseases such as diabetes, or space-occupying lesions in the tarsal tunnel.[2,3] Previous studies supposed that TTS may occur from fibrosis or thickening of osteofibrous structures in this important anatomical area.[4] Diabetes mellitus may induce degeneration and thickening of both the tibial nerve and its branches, decreasing the tarsal tunnel space and causing more entrapment of the tibial nerve yielding sensory and motor deficits.[5]

Patients with TTS may present with sharp shooting pain, numbness, and tingling of the foot and along the distribution of the tibial nerve.[6] Since TTS was first reported in the early 60s by Keck et al. and Lam et al.,[7,8] Many attempts have been made to treat TTS surgically when patients experience failure of conservative treatment.[9,10]

The primary aim of traditional and minimally invasive surgical treatment is to provide appropriate decompression of the posterior tibial nerve. Most patients prefer the minimally invasive method because it is less traumatic and is associated with fewer complications. We aim in this study to evaluate the effectiveness of minimal incision surgical decompression in patients with TTS and explore different factors affecting postoperative pain scores.

METHODS

This retrospective cohort study was conducted on 18

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patients with tarsal tunnel syndrome indicated for surgery. Patients who underwent minimal incision decompression in the period between March 2018 till April 2022 at the neurosurgery department at Fayoum University Hospital. This study was approved by the Fayoum University Supreme ethical committee, and consent was obtained from all patients.

All patients with tarsal tunnel syndrome (Unilateral or bilateral) who underwent surgical decompression were included in this study. Indication for surgery was the failure of conservative trials for at least 3 months. Patients with recurrent Tibial nerve entrapment (Who underwent a previous procedure) and those with negative nerve conduction studies were excluded from this study. Patients with recent ankle trauma or recent fractures of the lower limb were also excluded from this study.

All patients matching our inclusion criteria were contacted and interviewed at the Neurosurgery clinic. Data obtained included metabolic conditions which might predispose nerve entrapment syndromes like Diabetes Mellitus, Acromegaly, Hyperuricemia, Hypothyroidism, and Rheumatoid arthritis. We also addressed the history of old trauma to the ankle region, especially with positive findings or previous orthopedic maneuvers.

The skin coloration over the foot and the presence or absence of edema was observed. All patients underwent an assessment of sensations over the heel, dorsum of foot, and leg and an assessment of motor power. The percussion was just posterior to the medial malleolus (Tinel's sign). Sustained compression on the nerve just posterior to medial malleolus with inversion and eversion of the foot may aggravate pain and is considered a positive test also.

Neuropathic pain assessment

The modified Leeds Assessment of Neuropathic Symptoms and Signs (S-LAANS) pain score questionnaire was presented for all patients preoperatively to confirm that the pain was of neuropathic origin. S-LAANS pain score is a group of questions (7 questions) with a total score of 24 points, a score of 12 or more is confirmative of neuropathic pain.

Foot neuropathic pain grade was assessed using the Visual Analogue Score (VAS), graded from zero to 10. Zero means no pain at all, 1-3 means mild pain, 4-6 for moderate pain, 7-9 means severe pain, and 10 for agonizing worst pain. A full neurological assessment of motor function: power, reflexes, tone, sensory function, coordination, and gait assessment was done.

Preoperative nerve conduction velocity and electromyogram were done for the affected side of all patients and the most common finding was delayed distal latency of medial plantar motor branch and delayed latency with reduced amplitude of medial and lateral plantar sensory branches.

Patients were informed about the underlying neurological problems, the rule of surgery, surgical technique, postoperative care, expected mortality, morbidity, and their percentages.

Operative procedure

Patients were usually admitted the day before the operation or on the same day in early morning. The antibiotic was given during the induction of anesthesia for all patients.

We operated while the patient was lying in the supine position under spinal or general anesthesia. We applied a pneumatic tourniquet around the mid-thigh of the patient, and the pressure was set to 280-300 mmHg. The procedure started with a small curved incision using blade no. 15 about 4 to 5 cm posterior and inferior to the medial malleolus.

We reached the flexor retinaculum through sharp dissection using scissors and a blade we avoided using diathermy to guard against neural injury and identified the posterior tibial nerve in its sheath just below the crural fascia. The flexor retinaculum was cut by scissors after isolating the nerve.

The proximal part of the nerve was assessed bluntly using a blunt dissector under the sheath of the nerve, and any constricture was released, then exposed distally till the branching of the nerve and any constricting tissue was released. After that, we released the tourniquet, and any bleeding was dealt with by bipolar coagulation to ensure hemostasis.

We adequately irrigated and sutured the wound in two layers without the involvement of the flexor retinaculum. Skin closure was done using a 3/0 Vicryl suture. A crepe bandage from the toes to the mid-leg point was put after sterile dressing of the wound, which was then removed 2-3 hours after recovery. **(Figs. 1,2)**

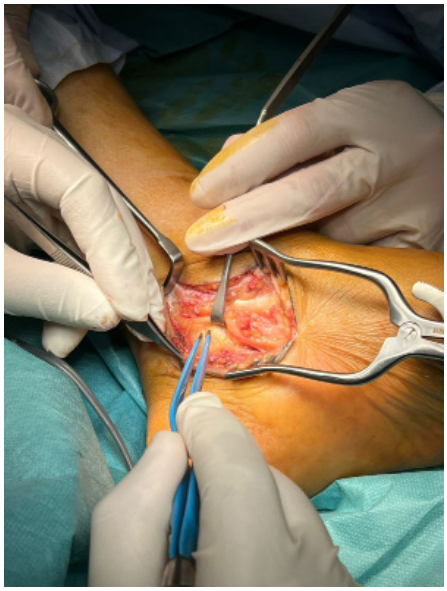

Fig 1: Shows the identification of the tibial nerve and

releasing of all constricting and fibrosis strictures.

Fig 2: Shows the posterior tibial nerve with its branches after the complete release of the nerve with adequate decompression.

Follow-up and evaluation after operation:

Any postoperative edema or skin color changes were observed and followed up. Assessment of foot pain 3 months postoperative was done by the patient using a VAS score.

RESULTS

Demographic and clinical characteristics

A total of 18 patients were included in this retrospective cohort study and the average age of the included participants was 47.50 ± 12.894 (Range: 24-71) years. We included 11 males (61.11%) and 7 females (38.89%). Eleven patients (61.11%) had diabetes mellitus, while five patients (27.78%) were hypertensive. The baseline characteristics of the included participants are shown in **(Table 1).**

Postoperative pain

The mean preoperative VAS pain in the sole was 8.056 ± 1.023, while the mean postoperative VAS score was 4.11 ± 1.31. We found a statistically significant difference between both the pre-operative and postoperative pain scores $P < 0.001$. The average duration of surgery was 21.78 ± 4.91 minutes and postoperative edema was noted in 33% of participants. Correlation analysis revealed a significant reduction in pain scores in younger patients compared with older patients and that older age is associated with increased postoperative VAS pain scores ($r=0.803$, $p<0.01$), **(Fig. 3).** Interestingly, we found that the postoperative pain score is negatively correlated with the duration of surgery ($r= -0.521$, $p=0.03$), **(Fig. 4).**

The average S-LANSS Pain Score that was measured before the operation was 18.11 ± 2.44, which was a confirmative value of neuropathic pain. Any patient with foot or sole pain with an S-LANSS score less than 12 was excluded from this study, even if his neurophysiological studies were positive for TSS. In our series, 14 patients were operated on under spinal anesthesia, and 4 patients were under general anesthesia. Those who operated under general anesthesia were upon their request because of severe anxiety and fear of the operating theatre.

The main postoperative complication we faced was significant postoperative edema at the ankle and foot. This condition was managed conservatively by anti-edematous drugs like alpha chymotrypsin and Leg elevation.

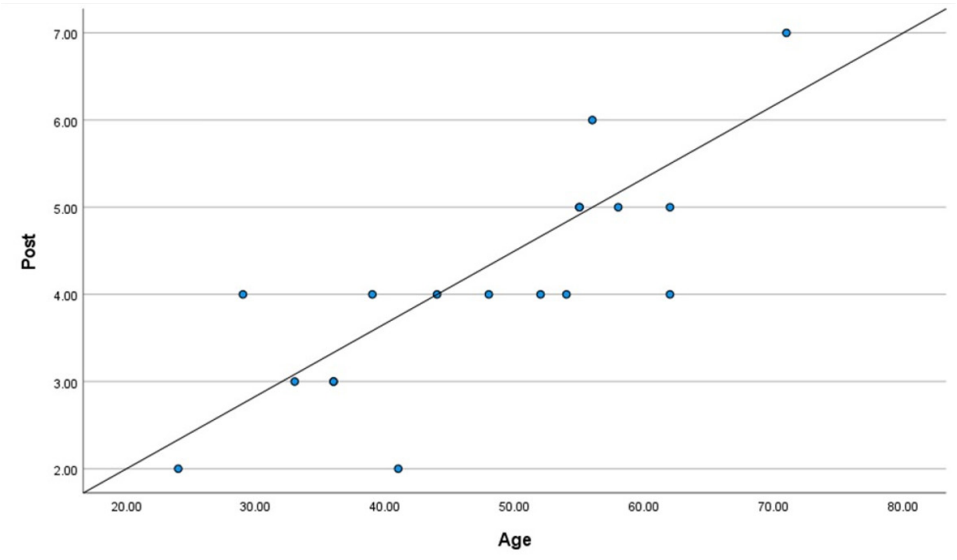

Fig 3: Shows correlation between age and postoperative pain scores.

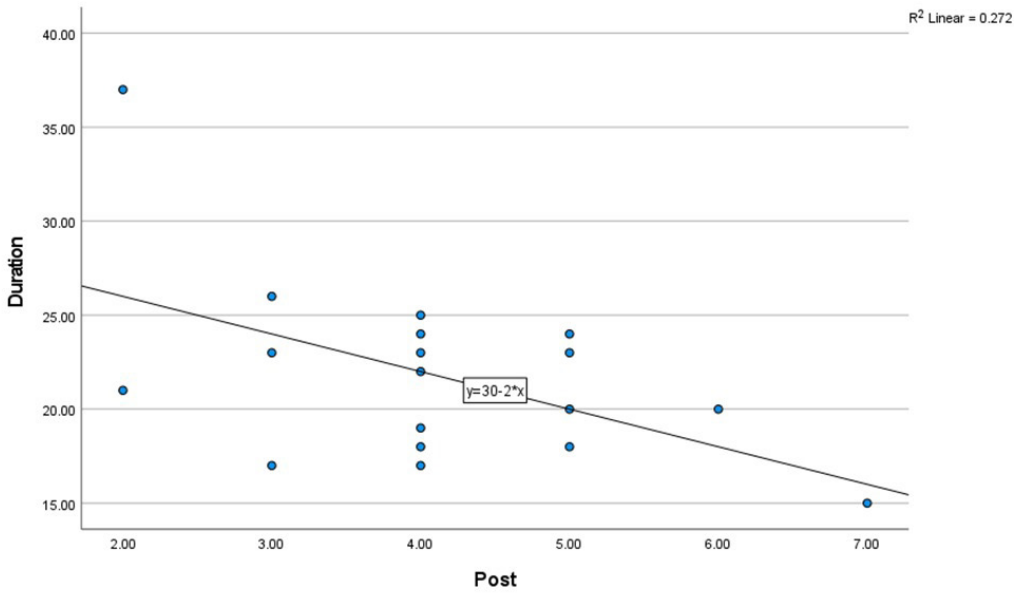

Fig 4: Shows correlation between duration of surgery and postoperative pain scores.

Table 1: Shows the baseline characteristics of the included participants

(N=18)	Number	%
Gender		
Males	11	61.11
Female	7	38.89
Side		
Right side	9	50
Left side	8	44.44
Bilateral	1	5.556
Comorbidities		
DM	11	61.11
HTN	5	27.78
CRF	1	5.556
Gout	3	16.67
RA	3	16.67
Sudek's Atrophy	1	5.556
Hypothyroidism	1	5.556
Pregnancy	2	11.11
History of Trauma	6	33.33
Type of Anesthesia		
General	4	22.22
Spinal	14	77.78
Postoperative edema	5	27.78

Table 2: Pain scores and the duration of the procedure

(N=18)	Range	Minimum	Maximum	Mean	SE	SD
Age, years	47.00	24.00	71.00	47.5000	3.03923	12.89437
S-LANSS pain score	9.00	14.00	23.00	18.1111	0.57672	2.44682
Duration of procedure, minutes	22.00	15.00	37.00	21.7778	1.15627	4.90565
VAS pain in sole Preoperative	3.00	7.00	10.00	8.0556	0.22099	0.93760

SD: Standard deviation, SE: Standard error.

Table 3: Pain scores three months postoperatively

(N=18)	Range	Minimum	Maximum	Mean	SE	SD
VAS pain in sole Postoperative	5.00	2.00	7.00	4.1111	0.30129	1.27827

SD: Standard deviation, SE: Standard error.

DISCUSSION

Our findings suggest that minimal incision tarsal tunnel decompression significantly improves burning pain in the soles. Younger patients and patients with fewer comorbidities are more likely to experience significantly better improvements in pain scores. Interestingly, increased duration of surgery is associated with significantly better postoperative pain scores. This might be explained by the fact that first of all, the duration of the surgery itself is short (Average 21 minutes), and second: better postoperative pain results are obtained with good decompression and release of the posterior tibial nerve and increased duration of surgery contribute to more decompression and better release.

Previous studies by Alshami et al. and Gessini et al.[11,12] demonstrated that conservative management options include anti-inflammatory drugs, mobilization exercises, and lifestyle modifications. Furthermore, they found a significant symptomatic improvement after reducing the pressure load on the posterior tibial nerve by using orthotic shoes and after proper immobilization by using night splints and a boot walker.

A previous literature review conducted by Ahmad et al. found that ganglia aspiration may provide temporary symptomatic relief in addition to steroid injection that can reduce intraneural edema. Patients may benefit from different physiotherapy techniques such as bracing, taping, icing, stretching, and massaging.[13,14] Comorbidities are expected to alleviate symptoms in patients with TTS as it may result from systemic diseases such as diabetes mellitus, gout, hyperlipidemia, hypothyroidism, or mucopolysaccharidosis; approximately 43% of patients have a positive history of traumatic events such as sprains or previous ankle or foot fractures.[13,15]

Surgical intervention may be considered after failure of conservative management, especially when entrapment of the nerve is proved by NCV and EMG. The reported success rate of Tarsal tunnel decompression surgery ranges from 44% to 96%. Decompression of the posterior Tibial, medial, and lateral plantar nerves as well as the first branch of the lateral plantar nerve, was shown to be associated with favorable outcomes in 96% of patients in a previous study of 51 patients with chronic heel pain who had failed conservative treatment after six months of the trial.[16] However, other studies reported low success rates, such as Pfeiffer et al.,[17] who reported successful results in only 44% of patients. Besides, Kaplan et al.[18] showed that only nine patients out of 21 patients (42.8%) who underwent decompression experienced relief of symptoms. This wide range of success rates may be attributed to the type and criteria of patients, the technique of decompression, and the time needed for surgical management.

It is thought that the gold standard indicator of successful outcomes after surgery is the presence of a positive Tinel sign. The absence of positive Tinel`s sign before the decompression surgery may indicate a marked sensory deficit and a slight possibility of recovering the nerve functions.[19] The best indication for successful surgery is the presence of a space-occupying lesion. This was proved by Nagaoka et al., that reported successful outcomes following the removal of ganglia in all 29 patients with TTS.[20]

The earlier the patient is treated the better prognosis. Late management causes more compression on the nerve, which leads to intraneural fibrosis and muscle weakness, and wasting.[21] Many advanced surgical techniques have emerged to achieve better outcomes. Endoscopic decompression had the advantage of less tissue trauma and faster recovery after surgery.[22] Research by Moroni et al. examined the ultrasound-guided minimally invasive surgical technique for releasing nerve entrapments in the distal tarsal tunnel. They came to the conclusion that this novel treatment option is a quick, safe, and effective decompression method for treating a subset of individuals with a distal tarsal tunnel syndrome.[6]

Study limitations were the relatively small number of patients and the few assessed outcomes. However, pain which is the primary outcome was assessed in our study. To conclude, Minimal incision surgical decompression provides a safe, effective, and reliable option for treating patients with TTS.

CONCLUSION

Minimal incision surgical decompression provides a safe, effective, and reliable option for treating patients with TTS. Patients with younger age and no comorbidities experience better reductions in pain scores. Investing adequate time in good decompression and release yields better postoperative pain scores. Postoperative edema remains a complication that requires attention and care.

List of Abreviatians

FDL: Flexor digitorum longus.
FHL: Flexor hallucis longus.
TTS: Tarsal tunnel syndrome.
S-LAANS: Leeds Assessment of NeuropathicSymptoms and Signs.
SE: Standard Error.
SD: Standard deviation.
VAS: Visual Analogue Score.

Disclosure

The authors report no conflict of interest in the materials or methods used in this study or the findings specified in this paper.

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