

Original

Symptom Improvement after Surgery for Tarsal Tunnel Syndrome

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Background: Tarsal tunnel syndrome (TTS) is an entrapment neuropathy of the posterior tibial nerve in the tarsal tunnel. Patients with TTS exhibit plantar symptoms, including numbness, foreign body sensation, and cold/burning sensation. We investigated postoperative improvement of symptoms and the association of preoperative symptoms with surgical outcomes in patients with idiopathic TTS.

Methods: We enrolled 17 consecutive patients (21 sides) with idiopathic TTS (mean age 68.6 years). The presence and severity of symptoms were evaluated before and 6 months after surgery and recorded on a numeric rating scale (NRS). Major preoperative symptoms noted were numbness in 14 patients, foreign body sensation in 13 patients, and cold/burning sensation in 5 patients. Some patients had multiple major symptoms. Patient satisfaction was recorded on an NRS at 6 months postoperatively.

Results: Postoperative patient satisfaction was 7.0. Improvement in foreign body sensation was weakest, although the difference as compared with other symptoms was not significant. Patients with foreign body sensation and at least one other major symptom reported significantly lower symptom improvement and treatment satisfaction. There was no significant difference in perceived improvement between those reporting numbness and cold/burning sensation as major symptoms and those who did not.

Conclusions: Patients reporting foreign body sensation as a major symptom were significantly less satisfied with the outcome of surgery than other patients. Our findings may help predict satisfaction with surgical outcomes in patients with idiopathic TTS.

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Keywords: symptoms, surgery, tarsal tunnel syndrome, nerve compression, surgical outcome

Introduction

Tarsal tunnel syndrome (TTS) is an entrapment neuropathy of the posterior tibial nerve in the tarsal tunnel. Symptomatic TTS can be caused by space-occupying lesions such as ganglions, schwannomas, or accessory muscles and is diagnosed by ultrasound or magnetic resonance imaging^{1–6}. Idiopathic TTS is thought to result from physiological changes, including posttraumatic adhesions, arterial tortuosity, venous dilation, and flexor retinaculum hypertrophy^{3,5,7,8}.

Patients with TTS exhibit plantar symptoms such as numbness/pain, foreign body sensation, and cold/burning sensation. These symptoms affect quality of life, although surgery can lead to improvement^{5–11}. Although surgical outcomes are favorable for patients with symptomatic TTS^{2,12,13}, they are less satisfactory for patients with idiopathic TTS^{5,7,8,12–14}. While several factors affect treatment outcome in idiopathic TTS, evidence is limited on postoperative improvement in patients with numbness, foreign body sensation, and cold/burning sensation. We

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Table 1 Surgical outcomes for 20 sides in patients with cold sensation and/or burning sensation

	Cold sensation	Burning sensation	p value
Number	15	5	
Surgical satisfaction (NRS)	7.1±2.4	7.4±0.5	0.800
Overall symptom improvement (NRS)	7.2±1.1 to 2.9±2.4	7.2±0.8 to 3.0±1.0	0.933
Cold/burning sensation (NRS)	5.5±1.7 to 1.3±2.1	5.2±2.2 to 0.4±0.9	0.800

NRS: numerical rating scale.

investigated postoperative improvement of symptoms and the association of preoperative symptoms with surgical outcomes in patients with idiopathic TTS.

Materials and Methods

This study was conducted in accordance with the principles of the Declaration of Helsinki and was approved by the ethics committee of Nippon Medical School Chiba Hokusoh Hospital (approval number: H-2024-177). All patients provided prior written informed consent for surgery. Written informed consent for participation in this study was waived because an opt-out choice was available on our hospital's homepage.

Twenty patients (24 affected sides) with TTS underwent surgery during the period April 2024 through March 2025. Symptom improvement was the focus when treating patients with idiopathic TTS. Three patients were excluded: 1 with symptomatic TTS due to a ganglion, 1 (1 side) with a history of tibial nerve trauma, and 1 (an 82-year-old male, 1 side) whose general condition deteriorated. Ultimately, 17 consecutive patients (21 sides) with idiopathic TTS were included in the analysis. There were 12 men and 5 women (mean age 68.6 ± 8.3 years, range 57–83 years). TTS was unilateral in 13 and bilateral in 4 patients; 13 lesions involved the right side and 8 involved the left side. The mean duration of symptoms was 48.8 ± 26.1 months (median 48 months).

Except for 1 patient with bilateral TTS, a Tinel-like sign was detected at the tarsal tunnel on all affected sides. During electrophysiological evaluation we measured sensory nerve conduction velocity at the tarsal tunnel; a positive finding was recorded when the terminal latency of the abductor hallucis muscle exceeded 5.8 ms and the difference in side-to-side amplitude was greater than 50%^{14,15}. All patients underwent preoperative MRI of the tarsal tunnel to confirm nerve compression consistent with their clinical symptoms^{1,16,17}.

First, patients were asked to describe the overall intensity of their plantar symptoms. The responses were scored on a numerical rating scale (NRS) on which the

symptom severity score ranged from 0 to 10. Then, the severity of individual plantar symptoms was recorded on the NRS. Patients with foreign body sensation commonly reported feeling as if something adhered to their soles or that they were walking on gravel. This major symptom was defined as the symptom with the highest NRS score. Coexisting symptoms with high NRS scores were considered as major symptoms. Surgical outcome was evaluated by comparing NRS scores before and 6 months after treatment. Patient satisfaction was also noted on an NRS.

IBM SPSS for Windows ver. 26.0 (IBM Corp., Armonk, NY, USA) was used for all statistical analysis. Preoperative and postoperative scores were evaluated with the Wilcoxon signed-rank test, and the Mann-Whitney *U*-test and Kruskal-Wallis test were used for intergroup comparisons. A *p* value of <0.05 was considered to indicate statistical significance. All values are expressed as mean ± SD.

Results

Symptom Severity before and 6 Months after Surgery

Surgery improved patients' symptoms. The mean NRS score was 7.0 ± 1.2 preoperatively and 2.9 ± 2.1 at 6 months postoperatively (*p* < 0.05). The mean surgical satisfaction score was 7.0 ± 2.1. All patients reported numbness preoperatively; the mean NRS score for that symptom decreased from 6.1 ± 1.7 to 2.2 ± 2.3 (*p* < 0.05). One patient with bilateral TTS had no foreign body sensation. In those that did have foreign body sensation, the NRS score improved from 6.0 ± 1.8 to 2.7 ± 2.3. One patient with unilateral TTS reported no cold/burning sensation preoperatively; in the others, the NRS score improved from 5.5 ± 1.8 to 1.1 ± 1.9. Among patients with cold/burning sensation, there was no significant difference in symptom improvement or surgical satisfaction (Table 1).

Comparison of the 3 symptoms revealed less improvement for foreign body sensation than for the other symptoms, although the difference was not significant (*p* = 0.081). Pairwise comparison showed a significant difference between foreign body sensation and cold/

Table 2 Surgical outcomes in relation to the presence of foreign body sensation as a major symptom

Foreign body sensation	Yes (n=13)	No (n=8)	p value
Surgical satisfaction (NRS)	5.8±1.4	9.1±1.0	0.000*
Pre-op NRS to post-op NRS change			
Overall symptom intensity	7.0±1.5 to 3.8±1.8	7.1±0.6 to 1.4±1.7	0.008*
Numbness	5.9±2.0 to 2.7±2.5	6.5±1.1 to 1.4±1.7	0.030*
Foreign body sensation	6.7±1.7 to 3.8±1.9	4.5±1.0 to 0.3±0.5	0.804
Cold/burning sensation	5.6±1.6 to 1.8±2.2	5.3±2.2 to 0.0±0.0	0.121

*Statistically significant. NRS: numerical rating scale.

Table 3 Surgical outcomes in relation to the presence of numbness as a major symptom

Numbness	Yes (n=14)	No (n=7)	p value
Surgical satisfaction (NRS)	6.8±2.1	7.3±2.1	0.856
Pre-op NRS to post-op NRS change			
Overall symptom intensity	6.9±1.2 to 3.2±2.1	7.4±1.1 to 2.7±2.3	0.488
Numbness	6.6±1.5 to 2.7±2.2	5.3±1.9 to 0.7±1.9	0.400
Foreign body sensation	5.9±1.7 to 2.9±2.5	6.4±2.1 to 2.7±2.3	0.375
Cold/burning sensation	5.3±1.7 to 1.2±2.2	6.0±1.9 to 0.6±1.0	0.097

NRS: numerical rating scale.

Table 4 Surgical outcomes in relation to the presence of cold/burning sensation as a major symptom

Cold/burning sensation	Yes (n=5)	No (n=16)	p value
Surgical satisfaction (NRS)	7.4±2.9	6.9±1.8	0.660
Pre-op NRS to post-op NRS change			
Overall symptom intensity	7.4±0.9 to 2.2±2.9	6.9±1.3 to 3.1±1.9	0.275
Numbness	5.2±2.4 to 1.6±3.0	6.4±1.4 to 2.4±2.1	0.660
Foreign body sensation	6.0±2.1 to 2.2±2.9	6.0±1.8 to 2.9±2.1	0.336
Cold/burning sensation	7.4±0.9 to 1.8±3.0	4.8±1.5 to 0.8±1.4	0.147

NRS: numerical rating scale.

burning sensation in the degree of postoperative improvement ($p = 0.036$). Postoperative improvement did not significantly differ between numbness and foreign body sensation ($p = 0.087$) or between numbness and cold/burning sensation ($p = 0.646$).

Impact of Major Symptoms on Surgical Outcomes

The major preoperative symptoms were numbness in 14 patients, foreign body sensation in 13 patients, and cold/burning sensation in 3 and 2 patients, respectively. Some patients had multiple major symptoms.

Patients with a major symptom of foreign body sensation reported significantly lower surgical satisfaction and less symptom improvement postoperatively than did those without foreign body sensation (Table 2). Patients with a major symptom of numbness or cold/burning sensation reported no significant difference in surgical

satisfaction or postoperative symptom improvement, as compared with patients without these major symptoms (Tables 3 and 4).

Discussion

We found that symptom improvement was greater in patients with idiopathic TTS who underwent surgery for numbness or cold/burning sensation than for those with coexisting foreign body sensation. Preoperative foreign body sensation was associated with significantly lower symptom improvement and lower patient satisfaction with surgical outcome.

We and others^{1,12,18-21} previously reported that surgical treatment of patients with idiopathic TTS improved their symptoms and quality of life, although only 44–96% of the procedures were considered successful. Factors that had a role in reported surgical outcomes included patient

selection, symptom duration, electrophysiological and MRI findings, Tinel sign positivity, surgical technique, inadequate anatomic knowledge, misdiagnosis, concomitant plantar fasciitis, severe hindfoot eversion/inversion, bone-nerve contact, and duration of postoperative follow-up^{2,7,12,17–19,22–24}.

Pfeiffer and Cracchiolo²⁵ found that only 44% of patients with TTS obtained significant benefits from surgery, whereas Bouysset et al.¹² reported that 51% of operated TTS patients would choose to undergo surgery again in similar circumstances. However, these researchers did not report the specific residual symptoms and persistent complaints experienced by the patients. We found that degree of improvement varied in relation to preoperative symptoms, and that foreign body sensation was associated with worse surgical outcomes.

Foreign body sensation is a common symptom in patients with TTS. Sensory nerves consist of large fibers and myelinated and unmyelinated small fibers (A β , A δ , and C fibers, respectively). A δ and C fibers contribute to pain and temperature sensation. A β fibers respond to touch and pressure and are involved in deep sensation. They may be associated with A β fiber dysfunction in patients with foreign body sensation. Because A β fibers are myelinated, they are resistant to injury and have a high regenerative capacity. Our patients with a major symptom of foreign body sensation had worse surgical outcomes. Therefore, when the feeling of foreign body adhesion is strong, A β fibers may be severely damaged.

Our literature search revealed no studies that focused on foreign body sensation as a predictor of surgical outcomes. It may be a condition-specific issue in TTS, because the plantar surface has a unique sensory role and is subjected to prolonged contact with the ground.

This study has some limitations. It was a retrospective, single-center study with a small sample size and short duration of follow-up. The inclusion of a larger patient population could change the results of our statistical analysis, and larger patient samples may improve understanding of the impact of individual factors on surgical outcomes.

Conclusions

In conclusion, surgery for idiopathic TTS yielded better results in patients without foreign body sensation. Patients with foreign body sensation reported significantly less symptom improvement and lower satisfaction with surgical treatment than did other patients. These findings will likely be useful in predicting postoperative outcomes

for patients undergoing surgery for idiopathic TTS.

Author Contributions: Ideguchi M and Kim K designed the study. Mihara R, Dan H, and Kim K acquired the patient data, and Yamaguchi S and Kim K analyzed the data. Ideguchi M and Kim K drafted the manuscript. Koketsu K, Isu T, and Murai Y supervised the project. All authors made substantial contributions to this work and have reviewed and approved the final manuscript.

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