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Utility of thermographic evaluation in spinal cord stimulation therapy DTM workflow for thoracolumbar compression fracture and lumbar spinal canal stenosis

Abstract

Among the orthopedic conditions that cause low back pain, many patients with thoracolumbar compression fractures and lumbar spinal canal stenosis caused by osteoporosis visit orthopedic surgeons. However, many patients do not respond to analgesics or nerve block injections, and many are at risk or unwilling to undergo surgery due to age or underlying disease. We believe that spinal cord stimulation therapy is a new treatment option for orthopedic low back and leg pain. We have performed spinal cord stimulation for chronic intractable pain in patients with thoracolumbar spine compression fractures and lumbar spinal canal stenosis who had lower limb pain and back pain. There are few reports of spinal cord stimulation therapy treatment by orthopedic surgeons.

In many cases, medical medications and nerve blocks do not improve the pain, and surgical treatment may be performed. We evaluated whether minimally invasive spinal cord stimulation therapy for orthopedic diseases improves pain by altering blood flow to the lower extremities using thermography.

Methods: Thermography and NRS of both lower extremities were measured before and after spinal cord stimulation therapy in 27 patients (15 women and 12 men) with back and leg pain due to thoracolumbar spine compression fracture and lumbar spinal canal stenosis.

Results: Thermography showed an increase in body surface temperature of approximately 6°C. NRS showed an average improvement of 6.4.

Discussion: Spinal cord stimulation therapy may improve blood flow in both lower limbs and lower back and leg pain, especially for back and leg pain caused by thoracolumbar vertebral compression fracture and lumbar spinal canal stenosis, among other orthopedic diseases. Thermography is likely to be useful as an evaluation tool.

Keywords: spinal cord stimulation, thermography, intellis platform, rehabilitation, orthopedic diseases, NRS

Volume 8 Issue 1 - 2023

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Received: March 10, 2023 | **Published:** March 27, 2023

Abbreviations: SCS, spinal cord stimulation; DTM, differential target multiplexed; CRPS, complex regional pain syndrome

Objective

Patients with low back pain and leg pain due to thoracolumbar spine compression fractures and lumbar spinal canal stenosis frequently visit orthopedic surgeons. There are many patients with low back pain and leg pain who do not improve with drug therapy or nerve blocks, and who are unable or unwilling to undergo surgery due to underlying diseases. Spinal cord stimulation therapy is actively used overseas as a conservative orthopedic treatment. There have been few reports on the evaluation of blood flow changes and pain using thermography after spinal cord stimulation therapy for orthopedic diseases. In this study, we report on the improvement of blood flow and pain in the lower extremities.

Subjects and methods

From April 2021 to March 2022, 27 patients (15 women and 12 men) with thoracolumbar spine compression fracture, low back pain due to lumbar spinal stenosis, and lower limb pain (chronic intractable pain) who had been in pain for more than 2months and had not improved with oral medication or nerve blocks were included in this study. Patients were admitted to the hospital and used Medtronic's INTELLIS PLATFORM lead (stimulating electrode) and wireless extracorporeal nerve stimulator. The electrode was implanted in the spinal cord posterior cord for 7days, and all patients were removed on the 7th day, and the stimulation was continuous until the patient felt comfortable and had a restful sleep. Stimulation settings consisted of one low-frequency stimulus (base signal: 50 Hz, 200μs pulse width, starting at 70% perceptual threshold) and three high-frequency stimuli (prime signal: 300 Hz, 170 μs pulse width, starting at 65% perceptual threshold), for a total of four simultaneous stimulations, DTM (Differential Target Multiplexed) Workflow was used. Rehabilitation was used in all patients. Under local anesthesia, a puncture was made from L2 in the supine position, and two leads (stimulation electrodes) were placed in the midline to cover the Th9-10 intervertebral space. Blood flow was evaluated by thermography in both lower extremities before and 5 days after the spinal cord stimulation therapy. A statistical t-test was performed, and $P < 0.01$ was considered a significant difference.

Results

A significant increase in surface body temperature was observed, with a mean increase of 6°C from a mean of 24.6°C before spinal cord stimulation therapy to 30.6°C. The NRS showed a significant

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improvement from a mean of 8.6 before treatment to a mean of 2.2 after treatment, with a mean of 6.4 (Figure 1).

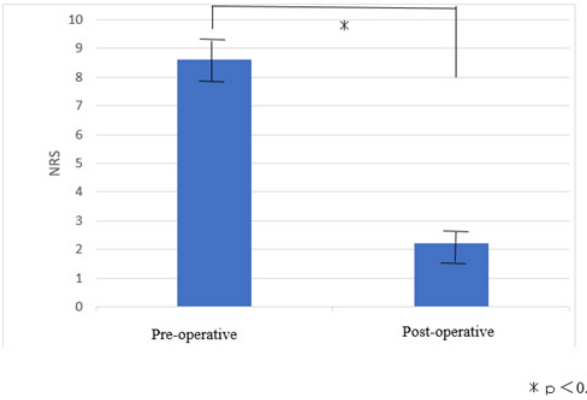

Figure 1 pre and post-operative NRS.

Case

A 73-year-old woman with lumbar spinal canal stenosis presented with back pain, leg pain, and intermittent claudication. The skin color of her toes was grossly mispresent. A spinal cord stimulation therapy puncture trial was performed with the lead tip placed at the eighth thoracic vertebra. The surface body temperature of both lower extremities increased from 24.7°C to 32.2°C using a thermographic camera. NRS improved from 9 before treatment to 3 after treatment. The gross color tone and edema of the toes also improved (Figures 2–4).

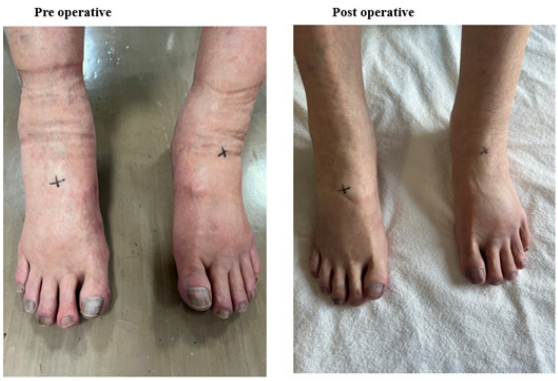

Figure 2 Change in color tone of the toes.

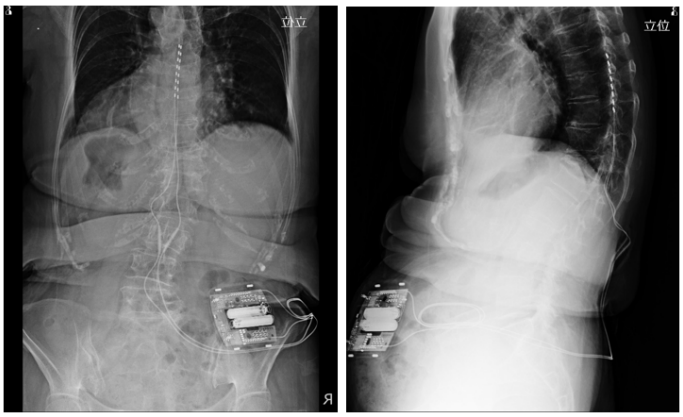

Figure 3 X-ray image after spinal cord stimulation therapy puncture trial.

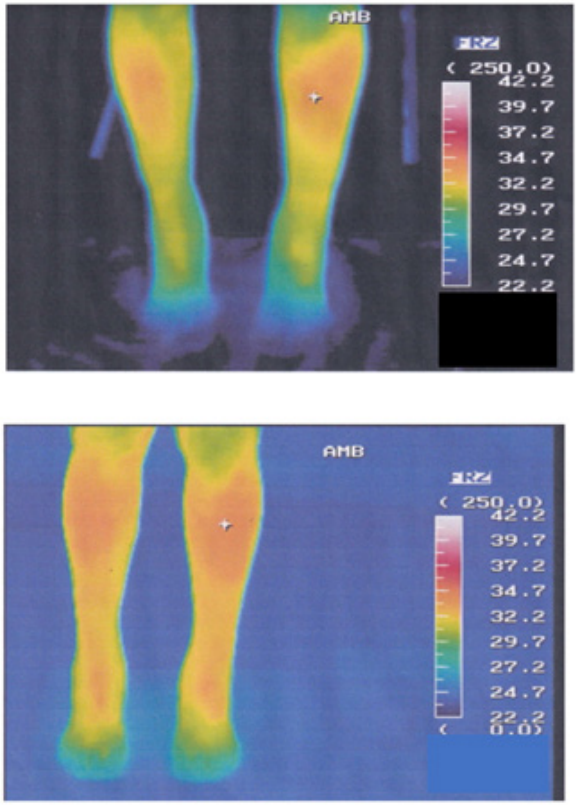

Figure 4 Pre- and post-operative thermographic images.

Discussion

Spinal Cord Stimulation Therapy (SCS) is a treatment method to reduce pain and improve blood flow by applying a weak electric current to the posterior cord of the spinal cord using spinal cord stimulation electrodes called leads in the epidural space. Spinal cord stimulation therapy requires consultation, examination, and appropriate diagnosis by an orthopedic surgeon, technique and knowledge by an anesthesiologist, and specialized evaluation and rehabilitation training by a physiatrist. Therefore, it is very important for multiple professions to work together.

In the gray matter of spinal cord segments, the number of glial cells outnumbers neurons by a ratio of 12:1, and it has been found that glial cells involved in pain are particularly abundant in the Th9 and Th10 vertebral segments.[2] In addition, the Intellis Platform by Medtronic, which analyzes gene expression and influences not only neurons but also glial cells in the spinal cord, has been used to analyze gene expression. DTM Workflow has been developed as a new spinal cord stimulation algorithm using the Intellis Platform by Medtronic, which analyzes gene expression and influences not only neurons but also glial cells in the spinal cord. The DTM workflow has been reported to provide superior pain relief in 84% of patients with low back pain compared to 51% of patients with tonic stimulation who experienced half the pain relief in 12months.

SCS has been shown to be effective in improving blood flow in critically ischemic limbs.[3] In addition, Oda et al. reported that SCS is useful in CRPS (complex regional pain syndrome) with an increase in skin temperature of 2°C or more, which can be evaluated by thermography.[4] SCS activates interneurons in layer 1-2 of the dorsal horn of the spinal cord, releases calcitonin gene-related peptide,

Citation: Maeda H. Utility of thermographic evaluation in spinal cord stimulation therapy DTM workflow for thoracolumbar compression fracture and lumbar spinal canal stenosis. *Int Phys Med Rehab J.* 2023;8(1):103–105. DOI: 10.15406/ipmrj.2023.08.00342

enhances nitric oxide production, and causes vasodilation, which is thought to improve peripheral circulatory disturbance.[5]

Improvement of pain and blood flow was observed with electrical stimulation by SCS. This is thought to be effective not only for ischemic limbs due to CRPS or lower limb blood flow disorders, but also for lower limb blood flow disorders due to thoracolumbar spine compression fractures or lumbar spinal canal stenosis caused by orthopedic diseases. Therefore, thermography is likely to be useful in the evaluation of spinal cord stimulation therapy and will increase patient satisfaction because it can be visualized.

Acknowledgements

All authors contributed to conception and design of the study, acquisition of data; analysis and interpretation of data; and drafting or reviewing the article, and all approve the final version to be published.

Conflict of interest

None

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

References

1. Thongtrangan I, Le HN, Park J, et al. Chapter 42 – Thoracic and Thoracolumbar Fractures. *Surgical Anatomy & Techniques to the Spine*. 2006:352–363.
2. Ruiz–Sauri A, Orduña–Valls JM, Blasco–Serra A, et al. Glia to neuron ratio in the posterior aspect of the human spinal cord at thoracic segments relevant to spinal cord stimulation. *J Anat*. 2019;235(5):997–1006.
3. Linderoth B, Meyerson BA. Spinal cord and brain stimulation. In: McMahon SB, Stephen B, Koltzenburg M, editors. *Textbook of pain, 6th ed*. Netherlands: Elsevier; 2013. p570–591.
4. Oda K, Morishita T, Shibata S, et al. Case report: Favorable outcomes of spinal cord stimulation in complex regional pain syndrome Type II consistent with thermography findings. *Surgical neurology international*. 2021;12;598.
5. Wu M, Linderoth B, Foreman RD. Putative mechanisms behind effects of spinal cord stimulation on vascular diseases: a review of experimental studies. *Auton Neurosci*. 2008;138(1–2):9–23.