Effect of non-surgical spinal decompression therapy on walking duration in subjects with lumbar radiculopathy: A randomized controlled trial

Article *in* International Journal of Medical Science and Public Health · January 2020

DOI: 10.5455/ijmsph.2020.08130202027082020

Megha Sandeep Sheth
SBB College of physiotherapy, ahmedabad

Effect of non-surgical spinal decompression therapy on walking duration in subjects with lumbar radiculopathy: A randomized controlled trial

Aalap Shah[1,2], Megha S Sheth[3], Disha A Shah[1]

[1]Department of Physiotherapy, Mission Health Multispecialty Physiotherapy Centre, Ahmedabad, Gujarat, India, [2]Ph.D Scholar, Gujarat University, Ahmedabad, Gujarat, India, [3]Department of Physiotherapy, S.B.B. College of Physiotherapy, Ahmedabad, Gujarat, India

Correspondence to: Aalap Shah, E-mail: missionhealth@gmail.com

Received: August 10, 2020; **Accepted:** August 27, 2020

ABSTRACT

Background: Lumbar radiculopathy is a prevalent complaint (12–40%) made by subjects with low back pain. It causes various functional limitations such as gait deviations and reduction of walking duration. Non-surgical spinal decompression therapy (DTS) is a relatively newer technology that has changed the management of lumbar radiculopathy. It has been found to relieve pain, improve neurologic symptoms, improve disk height, and reduce intervertebral pressures in various spinal pathologies. There are relatively few studies that have tried to focus on the effect of DTS on walking duration, though. **Objectives:** The objectives of the study were to evaluate the effect of non-surgical DTS on walking duration in subjects with lumbar radiculopathy. **Materials and Methods:** A randomized controlled trial using a random number generator was done with 80 subjects having lumbar radiculopathy. Forty subjects were included in each group. The experimental received 20 sessions of DTS, transcutaneous electrical nerve stimulation, hot water fomentation, core stabilization exercises, and lower extremity strengthening exercises. The control group received the same intervention except DTS. **Results:** Both groups showed improvements in the walking duration post-intervention ($P < 0.001$). However, the experimental group better improvement than the control group ($P < 0.001$). **Conclusion:** DTS is effective in improving walking duration in subjects with lumbar radiculopathy.

KEY WORDS: Non-surgical Spinal Decompression Therapy; Walking Duration; Lumbar Radiculopathy

INTRODUCTION

Lumbar radiculopathy is defined as radiating leg pain below knee level into the foot and toes with neurological deficits (sensory, reflex, or motor) in the distribution of the lumbosacral nerves. Lumbar radiculopathy is caused by the compression of nerve roots in the lumbar spine.[1] The most common cause of lumbar radiculopathy is some form of inflammatory, traumatic, or degenerative compression in the spinal canal leading to irritation of nerve roots. Lumbar radiculopathy receives prominence as about 12–40% of low back pain patients also complain of radiculopathy and low back pain is the second most common cause of leave of absence at work.[2]

Access this article online	
Website: http://www.ijmsph.com	Quick Response code
DOI: 10.5455/ijmsph.2020.08130202027082020	

Any patient with lumbar radiculopathy usually presents with pain or paresthesia that travels from the back to the buttocks and/or the legs. There is also weakness in the lower extremities due to compression of motor nerve roots. Superficial and deep tendon reflexes may also be diminished or absent. All these symptoms ultimately cause an abnormal gait pattern with reduced walking duration or difficulty in walking. The abnormal gait pattern differs based on the level affected.

A subject with lumbar radiculopathy can present with a high steppage gait due to weakness of ankle dorsiflexors, pelvic dropping due to weakness of hip abductors, a weak push off due to the weakness of ankle plantarflexors, etc. However, the one common functional impairment that is present in most of the subjects, regardless of the level involved, is the reduction of walking duration. The subject frequently complains of the inability to walk long distances or for prolonged periods.[2] Subjects presenting with neurogenic claudication have comparatively greater limitations with walking than subjects with osteoarthritis of the hip or knee.[3]

Several protocols have been used for the management of lumbar radiculopathy.[4-6] The management includes mostly surgical techniques that are based on the concept of decompression of the nerves and nerve roots. With advances in modern medicine, newer technologies have been developed that may decompress the spinal canal non-surgically. Non-surgical spinal decompression therapy (DTS) is one of the foremost of these technologies. DTS has shown great outcomes in relieving the pain and paresthesia in lumbar radiculopathy, improving the physical function and quality of life and increasing the functional independence of such subjects.[7-9]

Even though DTS has been proven as an effective treatment alternative for lumbar radiculopathy, studies related to its effect on walking duration in subjects with lumbar radiculopathy are limited. The present study was conducted to determine the effect of DTS on walking duration in subjects with lumbar radiculopathy.

MATERIALS AND METHODS

A randomized controlled trial was designed at a multi-specialty physiotherapy center in Ahmedabad, India. Ethics approval was obtained from the ethics committee. Male and female subjects having Lumbar radiculopathy were included in the study. The diagnosis was based on the presentation (pain, numbness, or paresthesia in the lower limb that followed a dermatomal pattern with or without back pain, muscle weakness, or diminished reflexes that followed a myotomal pattern), and magnetic resonance imaging (MRI) findings. Subjects having any other lower limb pathologies, for example, osteoarthritis of the hip or knee, any previous history of lower limb or back surgery, back trauma, diabetic neuropathy, vascular claudication, spinal tumors, spinal fractures, and limb length discrepancy were excluded from the study.

One hundred six subjects were screened for the study and 87 subjects were included based on the inclusion and exclusion criteria. They were then divided into two groups – experimental and control using a random number generator. The subjects were then explained about the nature and relevance of the study and an informed, written consent was obtained from them. Walking duration was measured in seconds on the first day before the intervention and the last day after the intervention. Subjects of both groups received the intervention 6 times a week (excluding Sundays) for a total of 20 sessions.

The experimental group received DTS in the supine position with the traction force equivalent to one-third to half of the subject body weight ± 5 kg.[9] The angle of decompression was calculated based on the MRI findings. The treatment duration was based on the number of levels involved (ranging from 15 to 30 min). The experimental and control groups received 20 min of conventional transcutaneous electrical nerve stimulation (TENS) from lower back up to the legs depending on the area of symptoms (post-DTS for experimental group), 10 min hot water fomentation, and 10 repetitions of core stabilization exercises for the activation of multifidus, transversus abdominis, pelvic floor, and diaphragm along with lower extremity strengthening exercises for all the major muscle groups. Figure 1 describes the methodology in detail.

RESULTS

Seven subjects (four subjects from the experimental group and three subjects from the control group) could not complete the study protocol due to personal reasons (difficulty in commutation, family, and medical issues). As these subjects could not meet the 80% compliance criteria set by the investigators, they were excluded from the study. Data analysis was done for the remaining 80 subjects. Statistical Package for Social Sciences 16.0 was used to analyze the data.

The mean age of the studied sample was 50.34 ± 12.55 years, with age ranging from 29 to 69 years in the experimental group and from 29 to 77 in the control group. Baseline comparison was done between both the groups using the Mann–Whitney U test. Both groups were found to be statistically similar at baseline ($P = 0.356$). Kolmogorov–Smirnov test was applied to analyze the distribution of the data and the data were found to be skewed ($P < 0.05$). Therefore, non-parametric tests were applied. Table 1 shows the demographic details of the sample.

Both the groups had 10 subjects who were taking medications and 30 subjects who were not taking medications. Medications included non-steroidal anti-inflammatory drugs or other analgesic agents such as paracetamol, opioids, etc., pregabalin, gabapentin, muscle relaxants, and supplements.

Wilcoxon test was applied for analyzing the difference between the pre and post-intervention walking durations. There was a statistically significant difference for both groups ($P < 0.001$). The results are shown in Table 2.

Mann–Whitney U test was applied for analyzing the difference between both the groups. A statistically significant

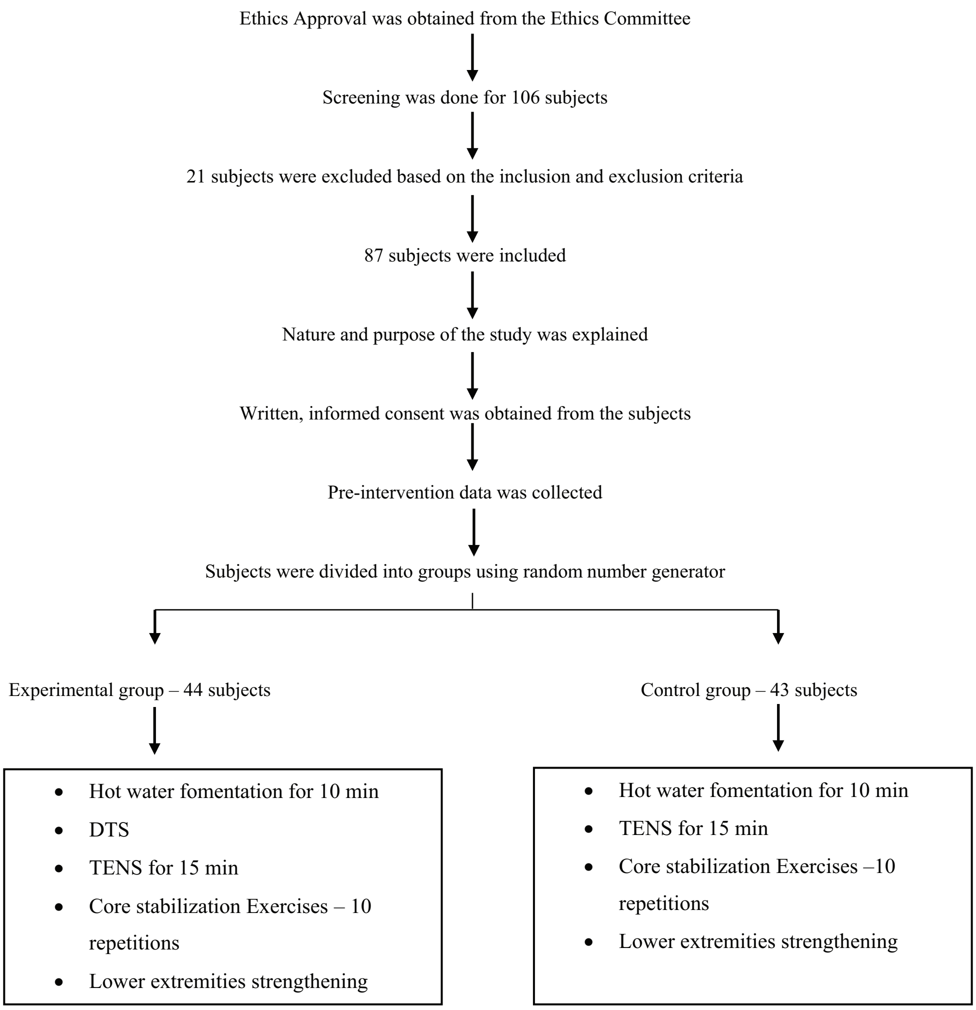

Figure 1: Flowchart explaining the procedure

Table 1: Demographic details of the subjects

Demographics	Group A	Group B
Age (years)	50.05±12.49	50.63±12.77
Gender		
Males	23	18
Females	17	22

difference was found between both the groups (*P* < 0.001) with the experimental group showing better results than the control group, as shown in Table 3.

DISCUSSION

The present study was conducted to determine the effect of non-surgical DTS on walking duration. The results show that both the experimental and control group interventions improve walking duration, but the experimental group receiving additional DTS therapy gives better outcomes than the control group.

One of the characteristic features of lumbar radiculopathy is the pain and weakness that are precipitated by walking and prolonged standing, leading to a reduced walking duration. The neurological symptoms seen in lumbar radiculopathy are commonly due to the ischemia or mechanical compression of nerves within the spinal canal. This may be secondary to spinal stenosis, disk herniation, thickening of ligamentum flavum, facet joint hypertrophy, spondylolisthesis, etc. The neurological symptoms manifest most during prolonged standing and walking as they cause a reduction in the interlaminar spaces. Standing and walking are extension activities. Extension in a lumbar radiculopathy subject causes overlapping of the laminar edges of neighboring vertebral bodies, which causes a superior and anterior movement of the superior facets along with relaxation and internal buckling of the ligamentum flavum. Walking further increases the symptoms by increasing the oxygen demands of the spinal nerve roots where blood supply has already been compromised due to the narrowing of the canal.[10]

In the present study, it was found that both – the experimental and control groups showed improvement in the walking duration post-intervention. Both the groups received TENS for 15 minutes and hot water fomentation for 10 min, along with core stabilization exercises and lower extremity strengthening

Table 2: Within group comparative analyses for experimental and control groups

Group	Pre-intervention (s)	Post-intervention (s)	Z-value	*P*-value
Experimental group	492±371.35	1448.0±389.71	−5.515	<0.001
Control group	576.25±374.64	776.5±542.22	−5.001	<0.001

Table 3: Between groups comparative analyses for experimental and control groups

Experimental group (s)	Control group (s)	Z-value	*P*-value
956.0±418.46	200.25±275.41	−6.89	<0.001

exercises. Both TENS and hot water fomentation are modalities that cause pain relief in various conditions. Hot water fomentation causes muscle relaxation through improvement in blood supply and removal of pain-causing metabolites and counter-irritation. It reduces the paraspinal muscle spasm that may be present secondary to the lumbar radiculopathy. It also relieves low back pain. A Cochrane review by French *et al*. in 2006 concluded similar results stating that there is moderate evidence for heat wrap therapy providing a reduction of pain and disability in subjects with acute and sub-acute low back pain.[11] Gautschi *et al*. also confirmed these findings by concluding that there is sufficient evidence regarding the effectiveness of heat therapy and physiotherapy for the management of acute low back pain.[12]

TENS also improves pain and other neurologic symptoms. Conventional TENS stimulates the nerves and causes pain modulation through the pain gate theory. As the subject has reduced low back pain and other neurologic symptoms by virtue of TENS and hot water fomentation, the walking duration improves. A study by Poitras and Brosseau in 2008 suggested that TENS can be used as adjunctive therapy for immediate or short-term pain relief in various pathologies.[13]

Both the groups also received core stabilization exercises and lower extremity strengthening exercises. Core stabilization exercises lead to an improvement of the strength of the core muscles. As the core muscles strengthen, they can stabilize the spine more efficiently and thereby reducing the changes in the spinal canal space occurring with walking; and effectively reducing the neurologic symptoms and improving walking duration. Lower extremity strengthening improves the strength and endurance of major muscle groups of the lower limbs. As the strength and endurance of the lower limb muscle groups improve, they are able to endure longer periods of standing and walking and leading to an improvement in the walking duration. The Cochrane review by French *et al*. also concluded that the addition of exercises to heat therapy further relieves pain and leads to improvement of function.[11] The relief in low back pain secondary to exercises can also lead to improved walking duration.

A significant difference was also observed between the groups for the walking duration. This improvement can be attributed to non-surgical decompression therapy. DTS uses motorized decompression to reduce pressure on the intervertebral disks by expanding the vertical space in the spinal canal and restoring the disk height, also causing a reduction in the pain. The decompression causes the release of pressure on the disk, which promotes regeneration of the compressed and diseased disk and increases the height of the disk, causing unloading of the facet joints.[9]

Guehring *et al*. concluded that the distraction of the disk causes rehydration and an increased extracellular matrix gene expression which is followed by an increase in the number of protein-expressing cells in a rabbit model. Distraction results in biglycan and decorin gene expression up-regulation along with collagen 1 and collagen 2, along with simultaneously causing a reduction in the fibromodulin, tissue-inhibitor of matrix metalloproteinase-1, and bone morphogenetic protein-2 expression. These alterations in the disk cause reduction in the disk bulge which is followed by a reduction in the nerve root compression.[14]

With the unloading of the facet joints and restoration of disk height, the compression of the nerve roots occurring secondary to the increased pressure in the spinal canal decreases. The blood vessels supplying the disk and the nerve roots also get decompressed and there is an improvement in the blood supply to the nerve roots. As there is decompression of nerve roots, the neurologic symptoms are reduced gradually. Due to better blood supply and as a direct effect of the decompression, the neurologic symptoms related to the compression of the nerve root decrease gradually. With this, there is an improvement in the walking duration as well. With a better canal space and lesser compression, the subject is able to walk for a longer duration as the symptoms decline.

The present study is one of the few studies done to determine the effect of DTS on walking duration. It evaluated the short-term effect of DTS on the walking duration and long-term effects were not studied. Future research can be done on determining the long-term effect of DTS on the walking duration and the effect of DTS on radiologic parameters.

CONCLUSION

The present study concluded that DTS causes an improvement in the walking duration of a subject with lumbar radiculopathy, and hence, it can be used as a part of the rehabilitation program for lumbar radiculopathy subjects to improve functional outcomes.

REFERENCES

1. Shah A, Sheth M, Shah D. Correlation of walking duration with spinal canal diameter in-subjects having lumbar radiculopathy. Int J Sci Res 2018;7:12-14.
2. Alexander CE, Varacallo M. Lumbosacral Radiculopathy. Treasure Island, FL: StatPearls Publishing; 2020.
3. Winter CC, Brandes M, Muller C, Schubert T, Ringling M, Hillmann A, *et al*. Walking ability during daily life in patients with osteoarthritis of the knee or the hip and lumbar spinal stenosis: A cross sectional study. BMC Musculoskelet Disord 2010;11:233.
4. Even J, Gasbarro G, Pantanowitz L, Kang J, Weiss K. An unusual cause of lumbar radiculopathy. Clin Orthop Relat Res 2015;473:2431-6.
5. Hahne AJ, Ford JJ, McMeeken JM. Conservative management of lumbar disc herniation with associated radiculopathy: A systematic review. In: Database of Abstracts of Reviews of Effects (DARE): Quality-Assessed Reviews. New York, UK: Centre for Reviews and Dissemination; 1995.
6. Clark R, Weber RP, Kahwati L. Surgical management of lumbar radiculopathy: A systematic review. J Gen Intern Med 2020;35:855-64.
7. Macario A, Richmond C, Auster M, Pergolizzi JV. Treatment of 94 outpatients with chronic discogenic low back pain with the DRX9000: A retrospective chart review. Pain Pract 2008;8:11-7.
8. Ramos G, Martin W. Effects of vertebral axial decompression on intradiscal pressure. J Neurosurg 1994;81:350-3.
9. Apfel CC, Cakmakkaya OS, Martin W, Richmond C, Macario A, George E, *et al*. Restoration of disk height through non-surgical spinal decompression is associated with decreased discogenic low back pain: A retrospective cohort study. BMC Musculoskelet Disord 2010;11:155.
10. Munakomi S, Foris LA, Varacallo M. Spinal Stenosis and Neurogenic Claudication. Treasure Island, FL: StatPearls Publishing; 2020.
11. French SD, Cameron M, Walker BF, Reggars JW, Esterman AJ. Superficial heat or cold for low back pain. Cochrane Database Syst Rev 2006;1:CD004750.
12. Gautschi OP, Hildebrandt G, Cadosch D. Acute low back pain--assessment and management. Praxis (Bern 1994) 2008;97:58-68.
13. Poitras S, Brosseau L. Evidence-informed management of chronic low back pain with transcutaneous electrical nerve stimulation, interferential current, electrical muscle stimulation, ultrasound, and thermotherapy. Spine J 2008;8:226-33.
14. Guehring T, Omlor GW, Lorenz H, Engelleiter K, Richter W, Carstens C, Kroeber M. Disc distraction shows evidence of regenerative potential in degenerated intervertebral discs as evaluated by protein expression, magnetic resonance imaging, and messenger ribonucleic acid expression analysis. Spine 2006;31:1658-65.

How to cite this article: Shah A, Sheth MS, Shah DA. Effect of non-surgical spinal decompression therapy on walking duration in subjects with lumbar radiculopathy: A randomized controlled trial. Int J Med Sci Public Health 2020;9(8):475-479.

Source of Support: Nil, **Conflicts of Interest:** None declared.