



Case Study

Acupuncture and Therapeutic Exercise in the management of Chronic Low-Back pain with Lumbar Spinal Stenosis: A Clinical Case-Study

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Citation: Ganiyu S, Mukadas A, Bashir B, and Bello U (2016) 'Acupuncture and Therapeutic Exercise in the management of Chronic Low-Back pain with Lumbar Spinal Stenosis: A Clinical Case-Study', ScholReps, 1(2).

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Publication Details

Received: Oct 20, 2016

Accepted: Dec 02, 2016

Published: Dec 07, 2016

Funding: None.

Subject Section: Physiotherapy

Conflict of interest: The authors have read the journal's policy and have no Competing Interest.

Abstract:

Background: Lumbar spinal stenosis is a growing concern with clinical features capable of resulting into highly disabling conditions. Most patients choose to opt for conservative care as opposed to seeking surgical solutions. However, it is unclear from the literature which of the conservative treatments when apply singly or in combination might work best.

Aims of the study: The objective of this study was to investigate the effects of acupuncture, core stability exercise, and single knee to chest stretch and treadmill walk exercises on pain severity, time of first onset of pain (TFS), functional limitation due to pain, and functional mobility in a patient with low back pain with lumbar spinal stenosis.

Methods: This is a single case report on a 70-year-old patient with clinical features and radiological diagnosis of lumbar spinal stenosis. The main findings from assessments were; lower back and right leg pain, impaired mobility and impaired ability to do functional Activity of Daily Living (ADL) in a weight bearing position due to pain. The patient underwent a treatment regimen comprising manual acupuncture needle stimulation and the therapeutic exercises twice weekly for eight weeks.

Results: At the end of 8 weeks of intervention, the patient reported complete resolution of back pain and 87.5% reduction in the leg pain. Also, the patient was able to do treadmill walk for the total period of time allowed (10minutes) based on the treadmill walk protocol without experiencing back and/or leg pain. Functional limitation due to back pain was reduced by 62.5%, functional mobility (FM) improved with FM test scores reduced to 10 seconds from 29 seconds. The patient reported 90% recovery with ADL.

Conclusion: Findings from this single case study demonstrated the efficacy of acupuncture and therapeutic exercises in the management of lower back pain with spinal stenosis.

Keywords: Spinal stenosis; Acupuncture; Core stability exercises; Treadmill walk; Single knee to chest stretch

Introduction:

According to the North American Spine Society (NASS), spinal stenosis describes a clinical syndrome of buttock or leg pain. These symptoms may occur with or without back pain. It is a condition in which the nerves in the spinal canal are closed in, compressed or both due to either osseous or soft tissue encroachment [1]. Lumbar spinal stenosis by aetiology can be classified as either developmental/primary or degenerative/secondary. Primary stenosis is caused by congenital malformations or defects in postnatal development resulting in a small neural canal. It occurs rarely [2]. Degenerative lumbar stenosis occurs more frequently, there could be shrinkage of the vertebrae, intervertebral joint space and the formation of marginal osteophyte which in turn can further reduce the intervertebral disc space available to the spinal nerves. Spinal stenosis can also result from spondylolisthesis, postsurgical scarring, intervertebral disc herniation, or from combinations of these conditions. Other less frequent causes of secondary stenosis are fractures, tumours, infection or systemic diseases such as Paget's disease [1]. Anatomically lumbar spinal stenosis can be classified as central or peripheral [2]. Central stenosis involves narrowing of the spinal canal around the thecal sac containing the cauda equina, and occurs as a result of the facet joint arthrosis and hypertrophy, thickening and bulging of the ligamentum flavum, bulging of the intervertebral disc, or spondylolisthesis [2]. With lateral stenosis, there could be an encroachment of the spinal nerve in the lateral recess of the spinal canal or in the intervertebral foramen resulting from facet joint hypertrophy, loss of disc height, intervertebral disc bulging, or spondylolisthesis [1].

Lumbar spinal stenosis may or may not be accompanied with back pain. However, patients with lumbar stenosis usually report severe pain and weakness in their lower extremities, impairments of sensation and reflexes and reduced mobility in weight bearing position due to pain [2]. Aggravating factors for symptoms include activities such as standing and walking during which the lower back of the spine will be held in extension with more risk of compression on the spinal canal. On the contrary, activities such as sitting and lying will put the lower spine in flexion, widens the spinal canal and usually eases symptoms. There appeared to be no sufficient evidence for the efficacy of Non-Steroidal Anti-inflammatory Drugs (NSAIDs) in the management of spinal stenosis which has been widely reported as the medication of choice for decreasing inflammation, soft tissue swelling, and neural compression [3,4]. The efficacy of the use of epidurals is largely questionable as it tends to be more effective for patients with spondylosis and radicular pain symptoms due to herniated intervertebral discs rather than for spinal stenosis [3,4].

The question of what could be the effects of non-surgical treatment approaches as therapeutic exercises and acupuncture on lumbar spinal stenosis appeared to have been subjected to little investigation [5]. Motohiro et al [5] examined the effects of acupuncture stimulation of pudendal nerve, spinal nerve roots, at paravertebral points and at the lumbar levels where disc prolapsed occurred. The results indicated that acupuncture produced pain reduction at the paravertebral level in 50%–60% of cases of patients with lumbar spinal stenosis. Electroacupuncture stimulation of the pudendal nerve was more effective than the stimulation at the paravertebral level while stimulation at the nerve root reportedly produced the strongest and longest lasting analgesic effects. A non-surgical treatment approach in the form of traction, stretching and strengthening exercises for the lumbar spine have been advocated for those with spinal stenosis [6,7]. However, there is the scarcity of findings from studies reporting the efficacy of these interventions. Whitman et al [6] observed improvement with mobility and coordination after interventions encompassing manual therapy, treadmill walking and strengthening exercises but did not report any positive effects on pain. Koc et al [8] reported that both physiotherapy and epidural injection were effective, but no statistical difference was found at 6 months compared to those who received only medication (control group). Thus, it could be that a treatment regimen consisting of acupuncture and spinal based exercises might be more effective than using any of these treatment techniques in isolation. Considering the potential analgesic effects of acupuncture combined improvement with mobility, muscle strength and coordination from spinal

based exercises, the present study was designed to investigate the effects of the combination of acupuncture, core stability exercises and treadmill walking on spinal stenosis via a case study.

Methods:

Consent: A detail explanation on what the study will involve and what the patient is expected to do was provided, and patient gave a written informed consent.

Patient and Case Presentation

A seventy years old patient with chronic low-back pain who was referred to the department of Physiotherapy, Aminu Kano Teaching Hospital, Kano in November, 2015. Patients reported the gradual onset of severe pain and weakness in the lower back, right hip, and right leg. The symptoms were reportedly first noticed in the month of June, 2015. He also reported recurrent feelings of pins and needles in the skin area at the back of the right knee down to the right foot. His major concern was the inability to stand and/or walk for more than 5 minutes without having to stop and then sit down due to pain aggravation. Prolonged standing and doing any activities in a weight bearing position were other aggravating factors. Resting in the form of sitting and pain medications were the symptoms alleviating factors reported by the patient. However, the patient reported giving up on taking pain medications (NSAIDs, acetaminophen, tricyclic antidepressants and opiates) as it has failed to relieve the patient's pain any further at 2 months prior to first visit to the physiotherapy department. Patient had received epidural or nerve blocks without any long-lasting effects at 2 months prior to first appointment in the physiotherapy department. The patient reported no red flag factors and signs of cauda equina syndromes such as abdominal pain, night pain, rectal bleed, bowel or bladder irregularities, unexpected weight loss and bilateral leg pain. The patient is a self-employed businessman who used to play Scotch prior to exacerbation of his symptoms in June 2015. The patient had no symptoms of cardiac, respiratory or neurologic dysfunction and no previous history of trauma and/or road traffic accident was reported.

Physical Examination

Patient has mesomorphic body somatotype. An observational postural assessment showed symmetrical shoulders and iliac crest levels, moderate bilateral genu valgus and normal feet alignment. The patient walked slowly with an antalgic gait associated with reduced weight bearing on the right lower limb. Posteroanterior thrust on the spine elicited pain at L4/L5 levels and L5/S1 vertebral levels. Lumbar spine active ranges of movements (AROM) in all directions were within normal limits except extension and right side flexion which was limited by 50% due to pain.

Assessment of sensory and myotomal functions was carried out according to Mueller, et al [9]. Sensory function test was carried out at the following dermatomal spinal segmental levels L2, (mid-anterior thigh), L3 (medial femoral condyle), L4 (medial malleolus), L5 (dorsum of the foot at third metatarsophalangeal joint and S1 (Lateral heel). Light touch and deep pain were tested with cotton wool and pinprick. Sensory function appeared normal and intact except at L5 and S1 on the right lower limb whereby the patient cannot differentiate between the point of a sharp pin and the dull edge. Myotomal function was tested at the following spinal segmental levels; L2 (hip flexors/iliopsoas), L3 (knee extensors/quadriceps), L4 (ankle dorsiflexors/tibialis anterior), L5 (long toe extensors/extensor hallucis longus) and S1(ankle plantar flexors/gastrocnemius, soleus). Myotomal function was normal and comparable in both the right and the left lower extremities. Straight leg raising test (SLRT) was negative bilaterally. Hip joint and sacroiliac joint screening tests were carried out as described by Cyriax and Cyriax [10] and the results were not suggestive of any hip and/or sacroiliac joint pathology. On the first visit, patient rated his back pain as 6/10 and leg pain as 8/10 on Numerical Pain Rating Scale (NPRS).

Functional Mobility Test: Functional mobility was assessed with timed-up-and-go test. With the patient seated in the chair with knee and hip joints maintained at 90°, feet in contact with the

floor and with the forearm resting on the arm rest. The timed-up-and-go test was carried out as described by Nordin et al [11]. The timed-up-and-go test has been validated and showed good intra-rater and inter-rater reliability ($r = 0.93$ and 0.96 , respectively) [11].

Radiological Investigation

Magnetic Resonance Imaging (MRI) lumbosacral spine report from the radiologist, dated 18th March, 2015 indicated features of multilevel disc prolapse causing theca sac compression with bilateral neural foramina compromise and mass effect on bilateral transversing nerve roots. Computerized Tomography (CT) Scan report dated 4th March, 2015 indicated the presence of marginal anterior osteophytes with L2-L3 and L3-L4 disc space, adjoining endplate sclerosis and vacuum phenomenon

Clinical impression: Impaired functional mobility associated with pain in the lower back and right lower limb secondary to lumbar spinal stenosis.

Problem List

1. Back and leg pain
2. Impaired functional mobility caused by inability to walk at the normal average walking speed and inability to walk and stand for more than 5 minutes due to pain
3. Impaired ability to do functional Activity of Daily Living (ADL) in weight bearing position for more than 5 minutes due to pain.

Goals of Treatment

1. To reduce the patient back and leg pain to 0-2/10 via the use of acupuncture treatment, therapeutic exercises, education on avoidance of provoking postures and promoting progressive independence in advancing home program exercises over 12-16 treatments.
2. To maintain lumbosacral spinal muscle performance and achieve progressive improvement in the quality of performance via core stability exercise, single knee to chest stretch and treadmill walking over 12-18 treatment sessions
3. To Increase the level of functional mobility without pain by 75-100% by the use of conditioning exercises as treadmill walking protocol over 12- 18 treatment sessions.
4. To Increase the level of functional ADL in weight bearing position without pain by 75-100% over 12- 18 treatment sessions

Outcome measures:

Pain intensity was assessed using NPRS [12]. A modified Schober's test was used to assess spinal range of movement [13]. Rolland and Morris Disability questionnaire (RMDQ) with 24 items was used to measure functional limitation due to back pain. Functional mobility was assessed using a Time up and Go test, i.e. the time it will take to rise from a chair, walk three metres, turn around, walk back to the chair, and sit down [11], other outcome measure includes the time of first appearance and/or aggravation of symptoms (TFS) while doing treadmill walk exercise. Also, patient was asked to do a self-assessment of the overall improvement in activities of daily living on a scale of 0% to 100% (0% = no improvement to 100% = total improvement). Measurements were carried out prior to the first intervention, at the end of every week till the end of the 8-week intervention.

Interventions

Acupuncture Treatment

The patient was properly instructed on what to expect in terms of the acupuncture treatment, the possible side effects and contra-indications to acupuncture treatment. In this case study, acupuncture was performed by the Researcher who is a physiotherapist with over 20 years of experience and certified Acupuncturist by Chattered Association of Acupuncturist, UK. The patient was in a prone lying position, with proper pillow support under the head, shoulder hip

joints and ankle joint. The selected acupuncture points [(Shensu (BL23), Dachangshu (BL25), Ciliao (BL32), Weizhong (BL40), Kunlum (BL60) and Huantiao (GB30)] in this study were those that are widely accepted for treating lower back and spinal problems [14, 15]. At each point, the skin was wiped with alcohol, and the therapist's hands were cleaned with alcohol gel prior to needle insertion. Disposable stainless steel needles (0.2mmx40mm, Seirin) were inserted to a depth of 10mm using the sparrow pecking acupuncture technique (alternate pushing and pulling of the needle). When the subject felt dull pain or acupuncture sensation ('deqi': numbness, soreness and or radiating sensation), the needle manipulation was stopped, and the needle was left in position for another 20 minutes. Acupuncture treatment was carried out twice in a week for 8 weeks.

Therapeutic exercises:

Treadmill Walk

A modified Bruce protocol for the treadmill was carried out as described by Ganiyu and Gujba [16]. The patient was asked to do a 5-minute warm-up walk at 1.6 m/seconds on a 2.5% grade for 5 minutes. This was then followed by a continuous multistage run. The speed of the run was adjusted by adding 14% of 1.6 m/second each minute for a maximum period of 10 minutes followed by a cool down phase of 5 minutes. The patient was instructed to notify the researcher when his back and or leg symptoms first appeared and/ or appeared to be on the increase during the treadmill walk. This time was recorded as TFS. Other Criteria set for stopping the exercise were severe aggravation of back and leg pain such that patient could not continue with the exercise, breathlessness, and dizziness[17]. Treadmill walking exercises were carried out twice per week for 8 weeks. While doing the exercise,

Core stability Exercises

The Researcher demonstrated to the patient the locations of the core-stability muscles in the body and how to activate those muscles. The techniques of core-stability muscle activation used in this study were as described by Sokunbi et al [18]. Core-stability exercises were carried out for 20 minutes twice weekly for 8 weeks.

Single Knee to Chest Stretch

The starting position for this exercise was crook lying position. Patient was required to pull one knee close to his chest until a comfortable stretch is felt in the lower back and buttocks, to hold this position for 20 seconds and then repeat with opposite knee. A total of 10 repetitions with the right and the left knee were carried out [19]. Single knee to chest exercise were carried out for 20 minutes twice weekly for 8 weeks.

Education, Advice and Home exercise program:

Patient was educated on why trunk extension and axial loading may be aggravating symptoms. Patient was advised on the need to prevent and/or minimise posture and movements that could aggravate pain and symptoms as much as possible. Patient was given a booklet containing instructions and pictorial illustration of the core stability and single knee stretching exercises and was advised to carry out the exercises at least twice daily

Results:

Effects of Treatment on Pain Intensity

Figure 1 shows the effects of treatment on back pain, leg pain and time of first notice (onset) of aggravation of pain while doing treadmill walking (TFS). The results show that back pain was completely resolved after 5 weeks of treatment while leg pain was reduced from 8/10 to 1/10 after 6 weeks of treatment. Patient reported a TFS score of 2 minutes in the first week of treatment and a score of 10 minutes after the 4th week of treatment.

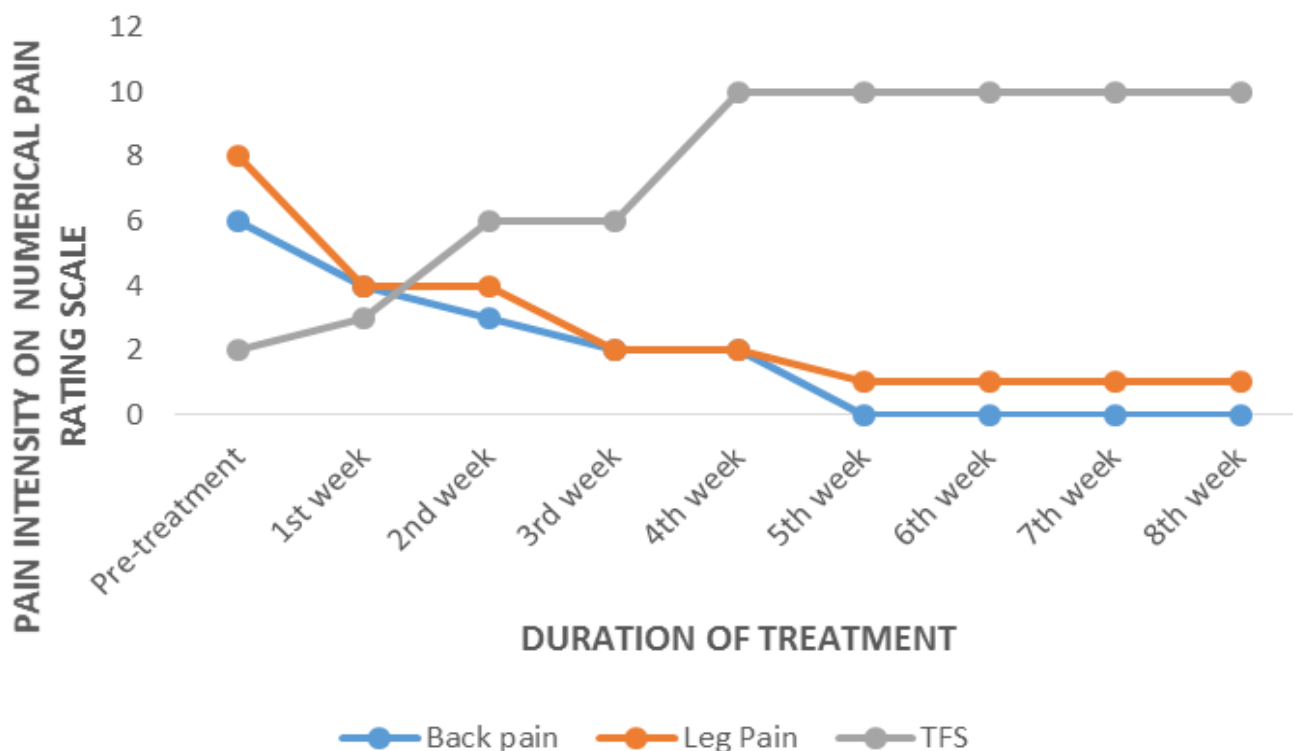


Figure 1. Effects of Treatment on Pain intensity

Effects of Treatment on Functional Limitation, Functional Mobility, and Activities of Daily Living

Figure 2 shows that functional limitation due to back pain was reduced by 62.5% (from 18 out of 24 pre- intervention to 3 out of 24) after 8 weeks of treatment. Functional mobility measured with time up and go test showed reduction in the time required to walk 3-meter distance from 29 seconds pre-intervention to 10 seconds after 8 weeks of treatment. Also, patient reported 90% recovery with activities of daily living (ADL) at the end of 8-week treatment (Figure 2).

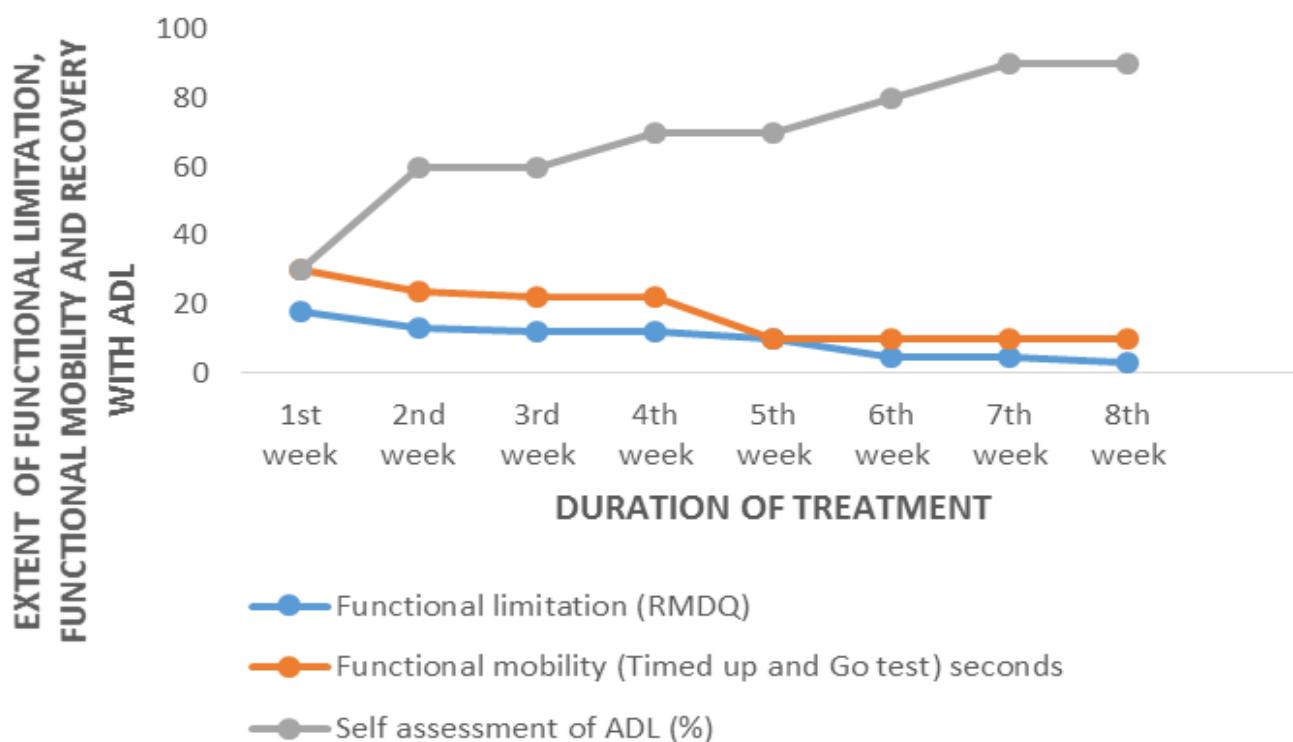


Figure 2: the effects of treatment on functional limitation due to back pain, functional mobility and recovery with ADL

Discussion

The outcome of this case study shows favourable effects in the form of reduced pain and functional limitation due to pain, increase in functional mobility and ADL in low back pain patient with lumbar spinal stenosis. Patient gave history of back and leg pain aggravated by standing and walking and eased by sitting. Approximately 65% of patients with lumbar spinal stenosis report neurogenic claudication; defined as poorly localized pain, paraesthesia or cramping of one or both lower extremities which is brought on by walking and relieved by sitting or rest [2]. More so, the patient in this case study was presented with bilateral neural foramina compromise and mass effect on bilateral transversing nerve roots coupled with marginal anterior osteophytes with L2-L3 and L3-L4 disc space, adjoining end plate sclerosis and vacuum phenomenon, these findings from clinical assessment and radiological investigations indicated that the patient had lumbar spondylosis and lateral foraminal stenosis. Simotas [20] reported that it is important to establish a correlation between clinical signs and symptoms with findings from imaging studies in patient with spinal stenosis. The improvement with regards to reduce pain and functional limitation and improved functional mobility and ADL was similar to the findings of [19].

The analgesic effects of the treatment techniques used in this study might be partly due to the CNS reaction in response to stimulus created by manual acupuncture needles. Acupuncture analgesia improved the noxious descending inhibitory controls and pain gate mechanism, and therefore helped the patients' pain levels. Acupuncture activate the pain-control system increases the concentration of β -endorphin, enkaphalin, serotonin, and norepinephrine levels in brain tissue and plasma, thus creating analgesic effects and positive effects on mood, energy levels, pleasure reception, and regulation of the immune system [20]. Studies have demonstrated efficacy of acupuncture in the management of low back pain and post-surgical spinal rehabilitation [15,16]. Manual acupuncture needle stimulation at acupuncture points as BL 23 and BL 25 taken deeply past the transverse process of the fourth and fifth vertebra respectively have been reported to stimulate the sympathetic ganglion and may be necessary to provide efficacious treatment for lumbar spinal stenosis [23]. However, it is difficult to ascertain to what extent acupuncture has helped this patient, as psychological components could not be measured. Also, positive reinforcement might co-exist in acupuncture and therapeutic exercises use in this study. Improvements in pain intensity and functional disability have been reported in groups of patients with low back pain suffering from a spondylosis, or a spondylolisthesis and a significant decrease of symptoms in the rehabilitation of post spinal surgical operation [16,24].

Studies on the effects of stabilisation and/or single knee to chest stretch exercises on back pain patients with spinal stenosis appeared to be scarce thus limiting comparison with the findings of this case study. However, treadmill walking in patients with lumbar spinal stenosis has been shown to be safe, easily administered and inexpensive [21]. The theory behind core stability and single knee to chest and treadmill walk exercise program decreasing pain and increasing functional mobility is multifactorial including the effects on the hypothalamic-pituitary axis and mechanical effects [25]. Spinal based exercises have been shown to stimulate the release of pain relieving amines and peptides as serotonin and β -endorphin especially when exercise intensity reaches the anaerobic threshold and is associated with the elevation of serum lactate level [18, 25]. The therapeutic benefit of treadmill exercises for treating chronic low back pain, besides improving cardiovascular fitness and general wellness, might be similar to the benefit of core-stability exercises which include improvement in motor control and segmental spinal stability [16]. Previous studies in which similar spinal based exercises in this case study were used in patient with lumbar spinal stenosis showed improvement with mobility and function but no significant improvement in the form of pain reduction was reported [6]. The current study indicates that acupuncture combined with spinal based therapeutic exercises may help in reducing pain and functional limitation with an increase in functional mobility and ADL in patient with Lumbar spinal stenosis.

In terms of contribution to knowledge, it appears that the effects of acupuncture treatment on lumbar spinal stenosis has not been widely reported globally though there are limited studies from China which were also reported in Chinese. The present case study has been carried out to reflect a typical multimodal treatment regimen and pattern of treatment obtainable in outpatient physiotherapy clinics whereby acupuncture is combined with other spinal based exercises to effects pain reduction and improvement in functions.

Limitations

This present study is limited in that it is a single case study, so the results cannot be generalized. Thus, large studies in the form of blinded, randomized, controlled trials investigating the efficacies of the Individual interventions used in this study are needed to produce findings that can be generalized to all cases of low back pain with spinal stenosis. The design and outcome of such studies should identify the relative efficacy of individual interventions if other interventions besides acupuncture are also involved.

Although the patient in this case study reported giving up on taking pain medications to the intervention used in this study, the extent of the influence of his other activities such as physical and recreational activities on the outcome of this study was not ascertained. It could also be that patients who must necessarily be on pain medications should be allowed into future randomised trials if a record of the dosage and the type of pain medication can be controlled throughout the study.

Clinical Application

A combination of acupuncture, spinal based exercises and treadmill exercise may be recommended for the rehabilitation of patient with lumbar spinal stenosis. Acupuncture may have beneficial effects, including pain relief and functional improvement in patient with lumbar stenosis. Core stability exercises may empower the patient with a better coping strategy for dealing with the pain. One of the most popular types of exercise equipment used by physiotherapist in rehabilitation is the treadmill, which provides a straightforward, efficient aerobic workout. For many patients and therapists, treadmill exercises are a good choice for an exercise routine because walking is well tolerated by most individuals regardless of fitness level and back condition.

Conclusion

Findings from this case study indicate 16 treatment sessions of manual acupuncture and therapeutic exercises in the form of core stability exercises, single knee to chest stretch and treadmill walk may be an effective technique of treatment in patients with lumbar stenosis with low-back pain and spinal stenosis.

Declaration

On behalf of all Co-Authors, the corresponding Author, states that this research work is original and has not been published in whole or in part elsewhere.

Authorship (author(s) contribution or attribution)

All Authors contributed to the design, implementation analysis of data and writing of this manuscripts.

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