Effectiveness of Progressive Inhibition of Neuromuscular Structures (PINS) and Spinal Mobilization with Leg Movement (SMWLM) in Lumbar Disk Herniation with Radiculopathy: A Case Report with Two Year Follow-up

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***Abstract*- Background and aim:** Lumbar disc herniation with radiculopathy has been one of the most difficult conditions to manage in orthopedic manual therapy. While there are many clinical studies concerning the standardization of surgical treatment, there is to date no standardized literatures for the most effective non-operative care for lumbar disc herniation with radiculopathy which suggest that extreme measures to ameliorate lumbar disc herniation with radiculopathy are urgently warranted. In this study, a 35 year old man who was diagnosed with lumbar disc herniation and was planned for lumbar surgery due to failure of medical interventions was successfully treated using non-operative management.

Method: The management of the patient included Progressive Inhibition of Neuromuscular Structures (PINS), Spinal Mobilization with Leg Movement (SMWLM) and Therapeutic exercises inform of lumbar stabilization and stretching exercises. The patient was seen three times in a week over the period of 6 weeks after which the patient was discharged home without having lumbar surgery. Patient was assessed before and after treatments and during one and two year follow-ups using; Visual Analogue Scale (VAS) in the back and leg, Sciatica Bothersome Index (SBI), Sciatica Frequency Index (SFI) and Rolland-Morris Disability Questionnaire (RMDQ) for sciatica.

Results: After six weeks of management the patient had decreased in functional limitation (from 19 to 6), back pain (from 8 to 0), leg pain (from 10 to 2), sciatica frequency (from 18 to 8) and sciatica bothersomeness (from 18 to 8). These outcomes were maintained after one and two year follow-ups.

Conclusion: Progressive inhibition of neuromuscular structures and spinal mobilization with leg movement are effective in the management of patients diagnosed with lumbar disc herniation with radiculopathy.

Implication: Progressive inhibition of neuromuscular structures and spinal mobilization with leg movement may be considered as useful therapeutic non-operative measures for patients diagnosed with lumbar disc herniation with radiculopathy.

***Index Terms*-** Progressive Inhibition of Neuromuscular Structures; Spinal Mobilization with Leg Movement; Lumbar Disc Herniation with Radiculopathy.

I. Introduction

The term radiculopathy which commonly referred to as sciatica describes the symptoms of sciatic nerve pain radiating down the posterior leg [1]. It has also been used to describe paresthesia from the low back to below the knee or referred to the posterior thigh, calf, and foot [2]. Sciatica is strongly associated with low back pain (LBP), and it has multiple causes among which lumbar disk herniation (LDH) is one [3, 4].

Studies comparing surgical management of LDH to different forms of conservative treatment tend to favor surgery with respect to short-term outcome [5, 6]. However, there are less striking differences observed in long-term follow-up of 1 year or more [2, 7]. For this reason, there is a general consensus that treatment of sciatica should be conservative in the first 6 to 8 weeks after onset because most new cases resolve in the short term [8]. For patients failing six weeks of conservative care, the current literature supports surgical intervention or prolonged conservative management as appropriate treatment options for lumbar radiculopathy in the setting of disc herniation [9].

However, there are no standardized guidelines for appropriate non-operative care which suggest that more treatment options to ameliorate lumbar radiculopathy are urgently warranted [10]. In this study, we reported the management of a 35 year old man who was diagnosed with LDHR and was planned for lumbar surgery due to failure of medical interventions.

II. Materials and Methods

2.1 Case reports

Two years ago, a 35 year old man (BMI=25.23kh/m^2) with no history of previous back problems wakened with pain in his left buttock area. Two days after the onset of his buttock pain it spread, overnight, down the left leg with tingling into the big toe area of his left foot. Some days later the big toe tingling alternated with tingling along the lateral border of his foot and into the lateral two toes. He had undergone numerous forms of treatments for over 6 months, but without significant success. However, following lifting of a 50kg back of maize two years ago, which exacerbated his disorder he had a lumbar puncture (which proved negative) and

skeletal traction for a week. Following this, his left buttock pain increased which came with a severe low back pain. At no time prior to skeletal traction had he ever experienced worsening lower limb pain. This was so serious that the patient could not even stand or sit on the treatment bed due to unbearable pain. The MRI of the patient revealed L5-S1 diffuse annular bulge with posterior left paracentral disc protrusion and inferior migration along with a small sequestration causing spinal canal compromise and indenting the left exiting and traversing nerve roots (see Figure 1). The patient was diagnosed as having pre-cauda equina syndrome and was booked for lumbar surgery. Prior to surgery, a consult was sent to physiotherapy department requesting physiotherapists to commence pre-operative management while the patient was on a waiting list.

2.2 Examination

On more positive questioning to determine his area of pain, it was interesting to note that, although his main lower leg pain was posterior, he had what he described as a different pain in the middle of the left buttock. Standing and sitting provoked pain in his left leg, and he was unable to bend forwards because of increased leg pain. Coughing caused both back pain and left leg pain but leg pain was the most incapacitating. Passive straight leg raise (SLR) on the left was causing posterior leg pain at 35°. Passive SLR with neck flexion and ankle dorsiflexion produced severe lower leg pain. Manual muscle testing revealed weakness of the calf muscles. Tingling was felt in the big toe and lateral border of the foot. In addition, the patient reported that anything that caused his back pain also caused his leg pain but at times the pains used to come differently with leg pain being the most. Manual palpation revealed pain and tenderness around L4 through S1 coupled with left piriformis tightness. Further palpation revealed active trigger points at the central fibers of the piriformis muscle around the middle two-thirds of the left buttock. This was reported by the patient as the most painful and was considered as the primary point. The secondary point was found just above the archilles tendon around the distal part of the left leg.

2.3 Treatment

The treatment of the patient included Progressive Inhibition of Neuromuscular Structures (PINS) which was applied for 10 minutes during the first two visits. During the third visit, spinal mobilization with leg movement (SMWLM) was introduced which was given after each successful PINS application. The patient was seen three times in a week over the period of 6 weeks after which he was discharged home without having lumbar surgery. Patient was assessed before and after treatments and during one and two year follow-ups using; Visual Analogue Scale (VAS) in the back and leg, Sciatica Bothersome Index (SBI), Sciatica Frequency Index (SFI) and Rolland-Morris Disability Questionnaire for sciatica (RMDQ) [7, 8] (see Table 1).Therapeutic exercises (lumbar stabilization and stretching exercises) were given as home regimens and the patient was asked to keep coming to the hospital after every 8 weeks in order to ascertain the effectiveness of the administered interventions or should in case the therapist would encounter something manageable during follow-ups but nothing significant was obtained.

2.3.1 Progressive Inhibition of Neuromuscular Structures (PINS)

Participant Positioning: The patient was placed in a prone position.

Therapist Positioning: The therapist assumed a stride stance with the feet widely apart and facing the patient's affected lower extremity.

Treatment Procedure: The technique was performed by palpating two related points termed primary point and secondary or end point. Primary and end points are areas of most and least sensitivities respectively found along the continuum of neuromuscular structures. In this technique, a moderate ischemic compression was steadily maintained on the end point by the use of an index finger of the right hand without relieving pressure up to the completion of the technique. The index finger of the left hand was used to apply pressure on the primary point for about 30 seconds after which another sensitive point was palpated by the middle finger of same hand proximal to the end point without relieving pressure on the index finger. If the patient indicated that this latter point was more sensitive than the posterior point, then pressure was maintained on the second point and relieved on the first point without relieving the end point pressure. This was maintained for 30 seconds before the third point was identified. When the third point was identified as more sensitive than the second point, pressure was relieved from the second point and maintained on the third point for another 30 seconds. The same pattern was followed progressively along the dysfunctional neuromuscular structure (sciatic nerve) until the last point approximately 2 cm proximal to the end point is found. Pressure was then maintained simultaneously on the two points (the last point and the end point) for 30 seconds and then relieved [11] (see Figure 2).

2.3.2 Spinal Mobilization with Leg Movement (SMWLM)

Participant Positioning: The patient was placed in a side lying position.

Therapist Positioning: The therapist assumed a stride stance with the feet widely apart and facing the patient by the side.

Treatment Procedure: This technique was performed with the patient in a side lying position, with the affected leg uppermost. The patient lied on the unaffected side facing the therapist, and an assistant therapist supporting his affected leg. The therapist flexed over patient and placed one thumb reinforced over other on the spinous process of the herniated vertebra (L5 vertebra) as palpated with reference to posterior superior iliac crest. The therapist then pushed down on the L5 spinous process and maintained that pressure while the patient was asked to actively perform Straight Leg Raise (SLR) for the leg supported by the assistant therapist provided there is no too much pain. This position was maintained for 30 seconds after which the therapist released the pressure on the L5 spinous process and the patient was asked to lower his supported leg down to the couch. The patient rested for 2 minutes before another repetition was performed. On day one, three (3) repetitions were only applied and this lasted for about 10 minutes. After this was successful during the first visit then, on the subsequent visits as the patient improved, the assistant therapist applied over-pressure on the supported leg of the patients as the patient performed the SLR [12]. This was sustained for 30 seconds after which the leg was lowered to the starting position

and then without resting, the patient performed SLR again against the assistant therapist's over-pressure for another 30 seconds. The patient rested for 60 seconds after each 2 sets of consecutive mobilizations which made 1 complete repetition. 2 sets of consecutive mobilizations for 3 repetitions with 60 seconds rest period after each repetition was given to the patient within the time limit of 10 minutes (see Figure 3).

2.3.3 Therapeutic Exercises

These exercises comprised of Lumbar Stabilization Exercises (LSEs) and Stretching Exercises (SEs):

1. **Lumbar Stabilization Exercises**

Lumbar Stabilization Exercises in form of curl-ups, horizontal side bridge and bird-dog [13] were given as home regimens. These exercises were performed for 10 minutes, given by 8 repetitions for 8 seconds each followed by a rest period of 10 seconds between successive repetitions.

- **Curl-ups:** The patient was in supine position with hands supporting lumbar spine and both knees bent at 90 degrees and hips bent at 45 degrees. The patient then lifted up the thoracic and cervical spine as one unit maintaining rigid block position with no cervical motions (chin poking or chin tucking) and held the position for 8 counts.
- **Horizontal Side Bridge:** The patient assumed a side line position and supported his/her body weight using the ipsilateral elbow. The patient then crossed the contralateral arm against the chest and contralateral foot in front of the ipsilateral food. The patient then bridged by lifting the hip up while maintaining the trunk straight and supporting the whole body on elbow and feet. This position was held for a count of 8 after which the patient came back to the starting position before carrying out another repetition.
- **Bird dog:** The patient was on his hands and knees (quadruped position). The patient then simultaneously rose up the contra-lateral arm and ipsi-lateral leg above the flow and stretched them out completely. After a count of 8 the patient then switched limbs and did the exercise for the same duration.

2. **Stretching Exercises**

Stretching exercises in form of plantar stretching, calf stretching and hamstrings stretching [14] were given to the patient. These exercises were performed for 10 minutes just like the lumbar stabilization exercises.

- **Plantar stretching:** The patient was sitting on a chair with the feet resting on the flow. He then placed a tennis ball under his foot. The patient then put weight into various parts of the plantar surface from the front of the heel out to the ball of the foot, looking for places that hurt or feel tight. The patient gave enough weight to reach that point between pleasure and pain, and sustained the pressure on each point for at least 20 seconds.
- **Calf stretching**: The patient stood erect, leaned forward and rested his forearms on the wall. The patient then stretched the lower leg section of the SBL by putting one foot back and resting into the heel. After the heel reached the floor, then the patient flexed the knee forward toward the wall to increase the stretch on the soleus.
- **Hamstrings stretching:** The forward bends described above for calf stretching was used to lengthen the hamstring group. Swinging the upper body left and right during these bends was done to ensure that the entire hamstrings muscle group, not just one line through it, got activated and stretched.

III. Results

Following PINS application, patient reported that his leg pain had reduced and was able to sit up for 2 minutes. At no time prior to PINS application had the patient ever had the chance to sit up with bearable pain. During the second visit, the patient was able to take few steps after PINS application. During the third visit, when SMWLM was introduced, the patient reported decreased in symptoms and was able to sit up for more than an hour. Since then the patient kept reporting significant improvement in symptoms up to the completion of the study which lasted for six weeks. After six weeks of management the patient had decreased in functional limitation (from 23 to 6), back pain (from 8 to 0), leg pain (from 10 to 2), sciatica frequency (from 24 to 8) and sciatica bothersomeness (from 24 to 8). All these outcomes were maintained after one and two year follow-ups (see Table 1).

IV. Discussions

Lumbar disc herniation is a common condition that frequently affects the spine in young and middle-aged patients [15]. The lumbar intervertebral disc is a complex structure composing of collagen, proteoglycans, and sparse fibrochondrocytic cells that serve to dissipate forces exerted on the spine. As part of the normal aging process, the disc fibrochondrocytes can undergo senescence, and proteoglycan production diminishes [16]. This leads to a loss of hydration and disc collapse, which increases strain on the fibers of the annulus fibrosus surrounding the disc. Tears and fissures in the annulus can result, facilitating a herniation of disc material, should sufficient forces be placed on the disc [15, 17].

Regardless of etiology, herniations represent protrusions of disc material beyond the confines of the annular lining and into the spinal canal. Back pain may occur due to disc protrusions that do not enter the canal or compromise nerve roots [15]. The more treatable condition of lumbar radiculopathy, however, arises when extruded disc material contacts, or exerts pressure, on the thecal sac or lumbar nerve roots [15, 16]. The pain associated with lumbar radiculopathy occurs due to a combination of nerve root ischemia and inflammation resulting from local pressure and neurochemical inflammatory factors present within the disc material [15-19].

The literature supports both conservative management and surgical intervention as viable options for the treatment of radiculopathy caused by lumbar disc herniation [2, 5-7]. However, methodological drawbacks limit the effect that published RCTs can have on informing clinical practice for this condition [9]. Surgical intervention may result in faster relief of symptoms and earlier return to function [5, 6], although long-term results appear

to be similar regardless of type of management [2, 7]. Therefore, the ultimate decision regarding type of treatment should be based on a surgeon-patient discussion, in light of proper surgical indications, duration of symptoms, and patient wishes [9, 17].

In this study, we presented the management of a 35 year old man who was diagnosed with lumbar dick herniation and was booked for lumbar surgery due to the ineffectiveness of all medical interventions. After the surgical decision, the patient requested that a physiotherapist should first attend to his condition prior to having lumbar surgery. Physiotherapists were invited and following PINS and SMWLM application the patient symptoms were abolished within 6 weeks of treatment after which the patient was discharged home without having lumbar surgery.

V. Conclusions

Our finding suggests that PINS and SMWLM may be used in the management of patients diagnosed with lumbar disc herniation with radiculopathy (LDHR). Despite the limitations of the study to make cause and effect conclusions, the degree of improvement achieved over a very short period of time and after two year follow-ups should not be overlooked. It is therefore recommended that randomized clinical trials (RCTs) may be conducted to establish the efficacy of these findings.

Adverse effect

The patient reported slight increased pain after some hours of PINS application which subsided within the first twenty four hours.

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Informed consent: Informed consent has been obtained from the patient.

Author contributions

PT. Danazumi developed this idea and administered the treatment to the patient. PT. Ibrahim helped with the supervision of the whole manuscript.

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Figure 1: Magnetic Resonance Imaging of the Patient.

Table 1: Study Outcomes with 2 year follow-up

Outcomes	Baseline	6 Weeks	1 Year	2 Years
RMDQ	**19**	**6**	**0**	**0**
VAS Back	**8**	**0**	**0**	**0**
VAS Leg	**10**	**2**	**0**	**0**
SBI	**18**	**4**	**0**	**0**
SFI	**18**	**4**	**0**	**0**

Key:

RMDQ=Rolland-Morris Disability Questionnaire: A 23-item scale, higher values indicate high level of disability.
VAS Back= Visual Analogue Scale for back pain: A 10-point scale, higher values indicate high level of pain.
VAS Leg= Visual Analogue Scale for leg pain: A 10-point scale, higher values indicate high level pain.
SBI=Sciatica Bothersome Index: A 24-point scale, higher values indicate increase in bothersomeness of sciatica.
SFI=Sciatica Frequency Index: A 24-point scale, higher values indicate increase in frequency of sciatica.

Figure 2: PINS application image

Figure 3: SMWLM application image