12-14-2016

The Use Of Manual Therapy In The Treatment Of A Patient With Chronic Low Back Pain And Sciatica: A Case Report

Elia N. Darazi
University of New England

The Use of Manual Therapy in the Treatment of a Patient with Chronic Low Back Pain and Sciatica: A Case Report

Elia N. Darazi, BS, MBA

E Darazi, BS, MBA is a DPT student at the

University of New England, 716 Stevens Ave. Portland, ME 04103

Address all correspondence to Elia Darazi at: edarazi@une.edu

The patient signed an informed consent allowing the use of medical information for this report and received information on the institution's policies regarding the Health Insurance Portability and Accountability Act.

The author acknowledges Brian Swanson, PT, DSc, OCS, FAAOMPT for assistance with case report conceptualization as well as Sara Stinson, PT, DPT for assistance and supervision with the patient's care during the clinical practicum.

ABSTRACT

Background: Chronic low back pain (CLBP) is one of the most common conditions encountered in an outpatient physical therapy (PT) setting. While there are many different approaches used in the treatment of CLBP, the purpose of this case report is to detail the successful utilization of a short-course of manual therapy (MT) for a patient with CLBP and sciatica.

Case Description: The patient was a 60-year-old male who presented to PT with a medical diagnosis of nerve root compression-left sciatica. At the initial evaluation, he presented with radiating left sided low back and lower extremity pain of approximately six months duration. This prevented sleep and limited work duties as well as his sitting tolerance to less than one hour. Prior treatment included over the counter pain medication and self-taught stretches without relief. His primary goal was to perform his job without interference and to be able to fall asleep without pain. Outcome measures included the modified Oswestry Disability Index (ODI) and the Numeric Pain Rating Scale (NPRS). MT intervention included soft tissue mobilization, spinal mobilization, musculature stretching, and passive range of motion, for a period of six weeks to address functional mobility and decrease pain.

Outcomes: With MT intervention**,** ODI score improved from 11.1% to 2.2%, NPRS score at rest reduced from 5/10 to 0/10. Sitting tolerance improved to more than one hour. The patient met his goals of return to pain-free sleep and work duties.

Discussion: This case report demonstrated that a MT focused intervention can decrease pain and improve function in a 60-year-old male with CLBP and sciatica. Further studies should investigate the use of MT in a larger population with CLBP.

MANUSCRIPT WORD COUNT: 2,776

BACKGROUND and PURPOSE

Low back pain (LBP) is the second most common cause of disability in adults, with total costs estimated to be between $100 and $200 billion annually on the US economy.[1] The prevalence of chronic LBP rose significantly over a 14-year interval (1992 to 2006), from 3.9% to 10.2%, with a significant increase in the number of individuals who sought care from a health care provider.[1] Low back pain becomes classified as chronic when the duration of pain exceeds 12 weeks.[2] Treatment of LBP may be conservative or surgical, conservative therapy appears to be the mainstream initial treatment of chronic LBP, before a consideration of a surgical option.[2] A surgical option is only recommended when there is evidence of worsening nerve damage.[3] Physical therapy intervention falls under the conservative treatment option. In a physical therapy outpatient setting, chronic lower back pain is one of the most common conditions encountered;[4,5] the primary evidence-based treatment options include: exercise therapy and manual therapy (including spinal manipulation). Both have been shown to benefit many patients.[6,7]

A published randomized controlled trial[8] described the use of manual therapy techniques with adjuvant exercise for the treatment of low back pain. The trial was based on seventy-two subjects with chronic low back pain. The participants in this study were seen for a total of six weekly sessions, where manual therapy intervention was administered (primarily consisted of muscle energy techniques). In addition, they were asked to perform their exercise program twice daily; which comprised of stretches, strengthening, or none-specific exercises tailored to each participant. The study concluded by stating that manual therapy with adjuvant exercise appears to be beneficial in the treatment of LBP.[8]

A different published randomized trail[9] discussed the effect of a different approach to low back pain. The article discussed the effect of core exercise program on pain and active range of motion in patients with chronic low back pain. The exercise group in this article was treated over

the course of four weeks, three times a week, 30 minutes per session of conditioning core exercises. The research article concluded by stating that this exercise program is effective in pain reduction and improved active range of motion (AROM) in patients with chronic low back pain.[9]

While both published articles found improvement in term of pain for patients with low back pain, there is currently conflicting literature that supports the sole use of one treatment method over another within the physical therapy profession. Therefore, the purpose of this case report is to report on the effects of a short-course of manual therapy for a patient who present with chronic low back pain with sciatica symptoms.

CASE DESCRIPTION

Patient History and Systems Review

The patient signed an informed consent allowing the use of medical information for this report. The patient was a 60-year-old male who presented to physical therapy following referral by his primary care physician with a medical diagnosis of nerve root compression- left sciatica. At the time of initial evaluation, he presented with left sided low back, buttock, and thigh pain, that radiated down the leg reaching the foot, which began about six months ago. The patient reported that the intensity of pain varied on a daily basis, with decreases in pain level occurring with motion. He reported a consistent daily pattern of symptoms, with stiffness and pain in the morning, improving as the day progressed, but returning at night, often preventing him from sleeping or finding a comfortable positon to sleep in. Provocative factors included sitting, and pain was alleviated with standing and moving around. Overall, the patient's primary complaint included pain in the form of radiating tingle that prevented him from sleeping and interfered with his work duties, where he is unable to sit at his desk for more than one hour. The patient's previous medical history included: osteoarthritis of the hands, ankles, and feet, total hip

replacement of the right hip in 2010. Previous treatment for this pain included over the counter pain medication (600mg naproxen a day), and self-taught stretches without any noticeable relief. The patient had not sought previous formal therapy for this episode of pain.

Overall health was self-rated as very good, and he rated his quality of life as excellent. He denied smoking and drinking and reported being active and independent in the performance of activities of daily living (ADLs) and instrumental activities of daily living (IADLs). There was no significant known family history. The patient reported that he lived in a private home with his wife, and worked as a graphic designer with his time spent between two different office locations, one with a standing desk and the other with a traditional seated desk. The primary goal of the patient was to eliminate pain in order to perform his job without interference and to be able to fall asleep without back, buttock, or leg pain. Table 1 details the results obtained from the systems review.

Clinical Impression 1

The patient was a 60-year-old male presenting with the health condition of sciatica on the left side. At the impairment level, the patient presented with pain in the low back, left buttock and posterior left thigh. He presented with strength deficits in his bilateral hip external rotators and tenderness to touch in the left gluteal area. Pain in this area resulted in a limited ability to perform activities of daily living, sit for greater than one hour, and participate in community and work duties. Pain also constrained the patient from falling asleep and finding a comfortable position to sleep in.

The patient received a diagnosis of left sciatica due to nerve compression. Possible diagnosis included herniated nucleus pulposus, lumbar stenosis, and sacroiliac joint pathology. Further tests and measures planned to confirm the diagnosis included: straight leg raise, thigh

thrust test, and quadrant lumbar test. In addition, range of motion and lower extremity strength were assessed to better understand how any motion and strength deficits influenced the patient's functional mobility, or contribute to the pain experienced. The patient was a good candidate for a case report due to the conflicting evidence reporting the effect of physical therapy treatment particularly manual therapy, for sciatica pain.[10]

Examination – Tests and Measures

During the initial evaluation, standardized outcomes were measured and objective data were collected from the examination (Table 2). The patient completed one self-report outcome measure, the modified Oswestry Disability Index (ODI), as well as reporting his pain-level at rest on the Numeric Pain Rating Scale (NPRS). The ODI is a self-reported measure which assesses the impact of LBP on the ability to manage everyday activities. The ODI breaks down everyday life activities into ten categories. The categories are comprised of pain intensity, personal care, lifting, walking, sitting, standing, sleeping, social life, traveling and employment/homemaking. The ODI has been found to have good responsiveness in people with chronic low back pain.[10] The minimal clinical important difference (MCID) has been reported as a difference of 8 points in people with chronic LBP.[11] The NPRS is a useful, quick, self-report tool that measures the patient's pain level on an 11-point numeric scale. The NPRS has been found to have excellent interrater/ intrarater reliability, excellent internal consistency and large responsiveness in lower back pain.[12] In addition, the NPRS has a MCID of one point when assessing various chronic musculoskeletal pain.[13]

Gross AROM and gross muscle strength (MMTs) of the lower extremity and the lumbar spine were also assessed. Hamstring length found to be 85 degrees on the right side, and 70 degrees on the left side due to nerve pain, no other restricted AROM was identified. The patient

reported a feeling of "stiffness" at end-range lumbar/trunk flexion (forward bending). Goniometric measurements (Table 2), were used to measure spine AROM. AROM testing revealed no other significant finding pertaining to the patient's symptoms. Lumbar joint mobility assessment found slight hypomobility in two segments, all others lumbar segments were within normal limits (table 1). The patient reported tenderness-to-touch with palpation of the following structures: left piriformis muscle-belly, left piriformis muscle attachment, and left greater sciatic notch. Examination findings prompted a further assessment of the sciatic nerve integrity on the left side. The last step of the examination was neurological testing in order to rule out or assess any neurological pathology that could contribute to the patient's pain. The patient underwent the following tests: supine Straight Leg Raise (SLR) test with a positive result of neural pain reported at 70 degrees of leg raise, and lumbar quadrant tests with a negative result. The positive SLR test is suggestive of radiculapothy.[14] The SLR, when preformed in a supine position, has been shown to be sensitive in reproducing symptoms associated with lumbar radiculopathy and evidence of nerve root compression (sciatica). [14]

Clinical Impression 2

The findings from the examination data revealed signs and symptoms consistent with the referring diagnosis of left sciatica (nerve root compression on the left). The findings included reported pain in the left lower extremity, positive SLR, AROM finding (decreased lumbar flexion), tenderness to palpation, and gross strength finding (myotomes); which directed the therapist to the thought of minor root irritation. The patient continued to present as appropriate for this case due to his age, lifestyle, motivation, unsuccessful self-care, severity of pain at rest, fluctuating severity presentation, and the duration of low back pain with the associated radiculopathy. Based on the findings from the examination and the primary care physician

referral, the plan was to proceed with physical therapy intervention. An ICD-10 code of M54.3 (sciatica) was given based on medical diagnosis.

Prognosis for a patient with sciatica is favorable, with most pain and related disability resolving within weeks.[15] Positive prognostic factors for this patient included: general overall health, quality of life reported, motivation to improve functional ability, understanding of deficits, and medical diagnosis. Negative prognostic factors for this patient included: chronic presentation, failure of other interventions, and patient's age. Given all prognostic factors including comorbidities, favorable prognosis for sciatica[14], and the evidence that support the effectiveness of physical therapy interventions in improving patient symptoms and outcomes:[16,17] the patient's prognosis was good.

The plan for this patient was for him to attend one session per week due to his work schedule, with each session lasting 30-mintues, for a total of eight weeks. The treatment plan included lumbar mobilization, lumbar facets gapping, lower extremity muscle stretching, and soft tissue massage to restricted structures as indicated. After examination and evaluation, functional goals were established for the patient (refer to table 3).

Intervention

Coordination, communication, documentation

Patient communication included the evaluation findings, proposed plan of care, and home exercise program (HEP). The patient was instructed on exercises to perform at home, and the therapist communicated with the patient at every visit regarding adherence to the HEP. The patient's initial evaluation, treatment notes, and discharge note were documented using an electronic medical record system (EMR). EMR documentation was shared with the referring physician and was made available to the patient upon request.

Patient related instruction

Following the examination, the patient was educated regarding the findings and how they contributed to his condition. In addition, the patient was educated on the role of physical therapy to improve his functional mobility and achieve his treatment goals. A HEP including pictures and descriptions (appendix 1) was given to the patient at the first visit. Instructions regarding each exercise including performance, duration, and repetitions were provided. The patient verbalized understanding of examination findings, plan of care, and HEP.

Procedural interventions

The course of therapy consisted of 30-minute sessions, one session per week for eight weeks. The in-clinic intervention consisted of primarily manual therapy interventions. The interventions selected were based on one of the categories (manual therapy) put forth by the Guide to Physical Therapist Practice.[15] Manual therapy techniques included soft tissue massage/mobilization, spinal mobilization (facet gapping mobilization of the spine), and muscle stretching with passive motion.

A typical flow of each treatment session consisted of:

1. A subjective inquiry regarding patient's pain, functional change, and any reported subjective measures
2. A 30-second stretch to; Left and right hamstrings muscles, left and right gluteal muscles, and left and right piriformis muscle stretch.
3. Soft tissue mobilization to the left piriformis insertion, and left piriformis muscle belly and/or bilateral lumbar paraspinals.
4. Posterior-Anterior (PA) mobilization to lumbar segments L2-L5.
5. Lumbar facets gapping (LFG) in side-lying position.
6. Lumbar rotational facets gapping (LRFG) in side-lying position.

7. Post treatment patient's report of pain-level changes, and a review of HEP and HEP adherence at home.

Table 4 provides a detailed timeline of each therapy session. A 30-second stretch to the mentioned muscles was selected based on current literature supporting the duration of the stretch.[19] The musculature selected for stretching was based on specific examination findings, and guided by the literature supporting a link between hip and back pain.[20] Soft tissue mobilization was incorporated into all treatment sessions due to the evidence supporting their inclusion in treatment of low back pathologies.[21, 22]

Lumbar mobilization (includes PA mobilization, LFG, and LRFG) was selected based on evidence supporting spinal mobilization as an effective intervention in the reduction of pain and the improvement in function.[17,23, 24, 25] The Kaltenborn mobilization method was used.[26] Table 5 describes positioning and interventions technique used.

OUTCOME

Over the course of therapy, the patient reported decreased pain and improved overall daily function. An improvement in his ODI score from 11.1% disability to 2.2% disability at the time of discharge indicated improvements in daily function. His NPRS score improved from 5/10 at rest to 0/10 which indicated significant improvement in daily pain levels. In addition, improvements were noted in the SLR; at discharge the patient demonstrated a negative result. Previously mentioned structures were no longer reported by patient as tender/painful at discharge. Lumbar segmental mobility at L3-L4, L4-L5 was noted to have no change in mobility grade (grade 2- slightly hypomobile) through PA joint testing at discharge. In addition, AROM, and MMT did not demonstrate significant changes at discharge. Table 2 details examination findings at initial evaluation and at discharge. At discharge, the patient's subjective reporting

included the ability to sleep through the night, to resume daily activities, and to perform pain-free work duties with improvement in his sitting tolerance to more than one hour. All plan of care goals (Table 3) were met by discharge, and the patient reported being able to manage his radicular symptoms on his own by performing HEP at the onset of symptoms (Appendix 1).

DISCUSSION

Over the course of physical therapy, the patient demonstrated improvements in functional outcomes and other objective measurements. He exceeded the minimal clinical important difference in the measurement of pain (NPRS), and everyday activity management as it relates to low back pain with the use of the ODI. The patient's plan of care was established for a period of eight weeks, however he was discharged by the end of week six due to the measureable improvements in all outcome measures and subjective reporting. It was hypothesized that the patient's pain was due to minor restrictions in his lumbar spine in addition to muscular tightness and soft tissue restrictions. The use of manual therapy as discussed in this report can be beneficial in addressing chronic pain and improving function. In addition to the manual therapy course, the therapist complimented the treatment with a HEP and checked patient compliance status at every visit. In this case, the therapist decided to use the same techniques (with minor variations) for a few sessions and re-evaluate its effect. The patient reported pain relief following the first session, which prompted the therapist to keep the course of treatment consistent (Table 4). The treatment course did not result in joint motion change, but rather provided a pain relief that may have been due to the neurophysiological effect of joint mobilization.[27] This pain improvement then facilitated the patient's participation in the treatment and functional exercises.

This case study outlines the success with the use of physical therapy in the treatment of this patient with chronic low back pain and sciatica. With the sole use of manual therapy and a

HEP, the patient made significant improvements over the course of a six-week episode of care which allowed him to resume daily activities and work duties without pain. As with any case report, cause and effect between the manual therapy intervention and the clinical improvement of the patient cannot be inferred. However, the improvement in the chronic symptoms of the patient were likely due to the benefits of the intervention applied. Further research with a larger sample size and extended duration is warranted to investigate and report on the outcome of using a sole manual therapy approach in the management of chronic low back pain.

REFERENCES

1. Freburger JK, Holmes GM, Agans RP, et al. The rising prevalence of chronic low back pain. *Arch Intern Med.* 2009;169(3):251-8. doi: 10.1001/archinternmed.2008.543.
2. Simpson AK, Cholewicki J, Grauer J. Chronic low back pain. *Curr Pain Headache Rep*. 2006;10(6):431-6. doi:10.1007/s11916-006-0074-3.
3. Low Back Pain Fact Sheet. National Institute of Neurological Disorders and Stroke website. http://www.ninds.nih.gov/disorders/backpain/detail_backpain.htm. Updated November 3, 2015. Accessed September 18, 2016.
4. Freburger JK, Carey TS, Holmes GM. Physician referrals to physical therapists for the treatment of spine disorders. *Spine J*. 2005;5:530–541. doi 10.1016/j.spinee.2005.03.008.
5. Jette AM, Davis KD. A comparison of hospital-based and private outpatient physical therapy practices. *Phys Ther*. 1991;71:366–375.http://ptjournal.apta.org/content/71/5/366. Accessed September 5, 2016.
6. Hayden JA, van Tulder MW, Malmivaara A, Koes BW: Exercise therapy for the treatment of non-specific low back pain. *Cochrane Database Syst Rev*. 2005;(3): CD000335. 10.1002/14651858.CD000335.pub2.

7. Maher CG. Effective physical treatment for chronic low back pain. *Orthop Clin North Am*. 2004;35(1):57-64. doi 10.1016/S0030-5898(03)00088-9.
8. Geisser ME, Wiggert EA, Haig AJ, Colwell MO. A randomized, controlled trial of manual therapy and specific adjuvant exercise for chronic low back pain. *Clin J Pain.* 2005;21(6):463-70.
9. Cho HY, Kim EH, Kim J. Effects of the core exercise program on pain and active range of motion in patients with chronic low back pain. *J Phys Ther Sci*. 2014;26(8): 1237-40. doi: 10.1589/jpts.26.1237.
10. Luijsterburg PA, Verhagen AP, Ostelo RW, et al. Effectiveness of conservative treatments for the lumbosacral radicular syndrome: a systematic review. *Eur Spine J.* 2007;16(7):881–899. doi: 10.1007/s00586-007-0367-1.
11. Maughan EF, Lewis JS. Outcome measures in chronic low back pain. *Eur Spine J.* 2010;19(9):1484-94. doi: 10.1007/s00586-010-1353-6.
12. Childs JD, Piva SR, Fritz JM. Responsiveness of the numeric pain rating scale in patients with low back pain. *Spine*. 2005 1;30(11):1331-4. doi:10.1097/01.brs.0000164099.92112.29
13. Salaffi F, Stancati A, Silvestri CA, et al. Minimal clinically important changes in chronic musculoskeletal pain intensity measured on a numerical rating scale. *Eur J Pain*. 2004;8(4):283-91. doi: 10.1016/j.ejpain.2003.09.004.
14. Rabin A, Gerszten PC, Karausky P, et al. The sensitivity of the seated straight-leg raise test compared with the supine straight-leg raise test in patients presenting with magnetic resonance imaging evidence of lumbar nerve root compression. *Arch Phys Med Rehabil*. 2007;88(7):840-3. doi:10.1016/j.apmr.2007.04.016.
15. Koes BW, van Tulder MW, Peul WC. Diagnosis and treatment of sciatica. *BMJ.* 2007;

23;334(7607):1313-7. doi:10.1136/bmj.39223.428495.BE.

16. Burton AK, Tillotson KM, Cleary J. Single-blind randomised controlled trial of chemonucleolysis and manipulation in the treatment of symptomatic lumbar disc herniation. *Eur Spine J*. 2000;9(3):202-7. doi:10.1007/s005869900113.

17. Jewell DV, Riddle DL. Interventions that increase or decrease the likelihood of a meaningful improvement in physical health in patients with sciatica *Phys Ther*. 2005; 85(11), 1139-1150. http://ptjournal.apta.org/content/85/11/1139. Accessed June 22, 2016.

18. Guide to Physical Therapist Practice 3.0. American Physical Therapy Association. http://guidetoptpractice.apta.org/. Accessed on July 9, 2016.

19. Page P. Current concepts in muscle stretching for exercise and rehabilitation. *Int J Sports Phys Ther*. 2012;7(1):109-19. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3273886/. Accessed July 9, 2016.

20. Reiman MP, Weisbach PC, Glynn PE. The hips influence on low back pain: a distal link to a proximal problem. *J Sport Rehabil*. 2009;18(1):24-32.

21. Furlan AD, Imamura M, Dryden T, Irvin E. Massage for low-back pain. *Cochrane Database Syst Rev*. 2008;(4):CD001929. doi: 10.1002/14651858.CD001929.pub2.

22. Branchini M, Lopopolo F, Andreoli E, et al. Fascial Manipulation for chronic aspecific low back pain: a single blinded randomized controlled trial. *F1000Research*. 2015;4:1208. doi:10.12688/f1000research.6890.2.

23. Bronfort G, Haas M, Evans RL, et al. Efficacy of spinal manipulation and mobilization for low back pain and neck pain: a systematic review and best evidence synthesis. *Spine J.* 2004; 4(3):335-56. doi: 10.1016/j.spinee.2003.06.002.

24. Powers CM, Beneck GJ, Kulig K, et al. Effects of a single session of posterior-to-anterior spinal mobilization and press-up exercise on pain response and lumbar spine extension in

people with nonspecific low back pain. *Phys Ther*. 2008;88(4):485-493. doi: 10.2522/ptj.20070069.

25. Shah SG, Kage V. Effect of seven sessions of posterior-to-anterior spinal mobilisation versus prone press-ups in non-specific low back pain - randomized clinical trial. *J Clin Diagn Res*. 2016;10(3):YC 10-3. doi: 10.7860/JCDR/2016/15898.7485.
26. Kaltenborn FM. *Manual Mobilization of the Joints, Volume II The Spine*. Minnesota: OPTP 2011.
27. Slaven EJ, Goode AP, Coronado RA, et al. The relative effectiveness of segment specific level and non-specific level spinal joint mobilization on pain and range of motion: results of a systematic review and meta-analysis. *J Man Manip Ther*. 2013; 21(1): 7–17. doi:10.1179/2042618612Y.0000000016.
28. Kendall FP, McCreary EK, Provance PG, et al. *Muscles Testing and Function with Posture and Pain*. 5th ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2005.
29. Norkin CC, White DJ. *Measurement of Joint Motion: A Guide to Goniometry.* 4th ed. Philadelphia, PA: F.A. Davis Company; 2009.

TABLES and FIGURES

Table 1. Systems Review	
Cardiovascular/Pulmonary	Not impaired
Musculoskeletal	Impaired: Lower extremity active range of motion- within functional limits Lower extremity gross manual muscle testing- All manual muscle testing were 5/5 except for: Right hip external rotators 3+/5, and left hip external rotators 4/5 Lumbar active range of motion-within functional limits. Lumbar flexion end-range (58 degrees). Hamstring 85 degrees on right, 70 degrees on left. Lumbar segmental mobility: Slight hypomobility (grade 2) was noted in the following segments through a posterior to anterior (PA) joint mobilization testing; L3-L4, L4-L5. All others lumbar segments were within normal limits. Tenderness to palpation was noted in the following areas: Left piriformis muscle belly, left piriformis muscle attachment, and left greater sciatic notch Gross symmetry: Rounded shoulders with forward head posture were noted. Patient demonstrated slight posterior pelvic tilt with flattened lumbar lordosis with standing posture.
Neuromuscular	Impaired: Positive testing for neural tension of the Sciatic nerve on the left side. Lower extremity deep tendon reflexes - Normal (2+) Lower extremity dermatomes testing- Normal Lower extremity myotome testing- Normal
Integumentary	Not impaired
Communication	Not impaired
Affect, Cognition, Language, Learning Style	Not impaired. The patient has good affect, with no observable barriers to learning. Patient preferred learning style is pictures with demonstration.

376 **Table 2. Test and Measures**

Tests & Measures	**Initial Evaluation Results**	**At Discharge**
Thigh Thrust Test	Negative Bilaterally	Negative Bilaterally
Quadrant Lumbar Test	Negative Bilaterally	Negative Bilaterally
Gross Lower Extremity Manual Muscle testing (MMTs) as described by Kendall FP et al.[28]	Gross Muscle group Right Left Hip Flexors 5/5 5/5 Hip external rotators 4/5 3+/5 Knee flexors 5/5 5/5 Knee extensors 5/5 5/5 Ankle dorsiflexors 5/5 5/5 Ankle plantarflexors 5/5 5/5	Gross Muscle group Right Left Hip Flexors 5/5 5/5 Hip external rotators 4/5 4/5 Knee flexors 5/5 5/5 Knee extensors 5/5 5/5 Ankle dorsiflexors 5/5 5/5 Ankle plantarflexors 5/5 5/5
Gross Active Range of Motion (AROM) as described by Norkin CC, White DJ. [29]	Lower extremity Lumbar 85° R HS Flexion: 58° 70° L HS Extension: 32° All others WFL Lateral Flexion: R: 17° L:15°	Lower extremity Lumbar 85° R HS Flexion: 59° 82° L HS Extension: 32° All others WFL Lateral Flexion: R: 18° L:17°
Numeric Pain Rating Scale (NPRS)	5/10 pain rating at rest.	0/10 pain rating at rest.
Straight Leg Raise (SLR)	Positive on left- at 70°.	Negative Bilaterally.
Oswestry Disability Index (ODI)	11.1% disability score	2.2% disability score

377 Key: WFL=within functional limits, ° =degrees, HS= Hamstrings, R=Right side, L=Left side

Table 3. Plan of care- Goals

Short Term Goals (STG): Patient to demonstrate the following in 4 weeks: 1. Patient disability will be reduced as measured by the modified Oswestry score to less than 10%. 2. Patient left low back/buttock/thigh pain will decrease to 2/10 at rest as measured by the NPRS in order to improve quality of life. 3. Patient will be able to sleep through the night.
Long term Goals (LTG): Patient to demonstrate the following in 8 weeks: 1. Patient disability will be reduced as measured by the modified Oswestry score to less than 3%. 2. Patient left low back/buttock/thigh pain will decrease to 0/10 at rest as measured by the NPRS in order to improve quality of life. 3. Patient will be able to resume pain-free activities and work duties.

Table 4- Session detailed timeline of each intervention

Intervention	Session 1	Session 2	Session 3	Session 4	Session 5	Session 6
Stretch to GM on L and R	30 seconds each side	30 seconds each side	30 seconds	NP	NP	NP
Stretch to HS on L and R	30 seconds each side	30 seconds each side	30 seconds	30 seconds	30 seconds	30 seconds
Stretch to PM on L and R	30 seconds each side	30 seconds each side	30 seconds	30 seconds	30 seconds	30 seconds
Soft tissue massage to PM on L	5 minutes	2 minutes	6 minutes	NP	2 minutes	NP
Soft tissue massage to LP	NP	3 minutes	NP	3 minutes	NP	NP
Grade 2 PA mobilization to segments L2-L5	5 minutes	8 minutes	5 minutes	5 minutes	5 minutes	8 minutes
LFG	5 minutes	5 minutes	5 minutes	10 minutes	8 minutes	8 minutes
LRFG	5 minutes	5 minutes	5 minutes	8 minutes	8 minutes	10 minutes
Post session EDU	5 minutes	2 minutes	2 minutes	2 minutes	2 minutes	2 minutes

Key: NP= Not performed, GM= Gluteal muscles (gluteus medius and gluteus minimus), HS= Hamstring muscle, PM= Piriformis muscle, LP= lumbar paraspinals muscles (iliocostalis, longissimus, and spinalis). PA= Posterior to anterior glides of the lumbar segments, LFG= Lumbar facets gapping, LFRG= Lumbar rotational facets gapping, EDU= Reports of pain changes, education and a review of the home exercise program.

Table 5- Joint mobilization techniques

Posterior to anterior glides/mobilization	The patient was placed in a prone position (on stomach facing down). The therapist stood at the patient's side and placed the hypothenar eminence surface of their right/left hand over the spinous process of L2 with wrist in slight extension, reinforced by the other hand. With the therapist's shoulders directly above the segment, a force was applied in a posterior to anterior manner producing an oscillatory motion in the joint. The process was repeated for segments L3, L4, and L5.
Lumbar facets gapping technique	The patient was placed in a side lying position on his right side (uninvolved) side. The therapist stood in front the patient and flexed the left hip and knee until a

	motion was felt in the L4-L5 interspace via palpation. The therapist then placed the patient's left (top) foot behind the right (bottom) knee in the popliteal fossa. The therapist griped the patient's right arm and shoulder and introduced a right side bending & left rotation motion by pulling the patient's arm in an anterior direction until a motion was felt in the same lumbar interspace. The therapist then placed their left thumb on the spinous process of L4 segments while maintaining the setup; using a log-roll technique, the therapist rolled patient towards him to position the involved segments in a vertical position. The therapist placed right hand/thumb below the spinous process of L5, then the therapist used his left arm and the patient body to apply high velocity (speed), low amplitude thrust in an anterior direction only. The process was repeated for segments L4-L3, L3-L2, and L2-L1.
Lumbar rotational facets gapping technique	The patient was placed in a side lying position on his right side (uninvolved) side. The therapist stood in front the patient and flexed the left hip and knee until a motion was felt in the L4-L5 interspace via palpation. The therapist then placed the patient's left (top) foot behind the right (bottom) knee in the popliteal fossa. The therapist griped the patient's right arm and shoulder and introduced a right side bending & left rotation motion by pulling the patient's arm in an anterior direction until a motion was felt in the same lumbar interspace. The therapist then placed their left thumb on the spinous process of L4 segments while maintaining the setup; using a log-roll technique, the therapist rolled patient towards him to position the involved segments in a vertical position. The therapist placed right hand/thumb below the spinous process of L5, then the therapist used his left arm

	and the patient body to apply high velocity (speed), low amplitude thrust in an anterior and superior. The process was repeated for segments L4-L3, L3-L2, and L2-L1.

406

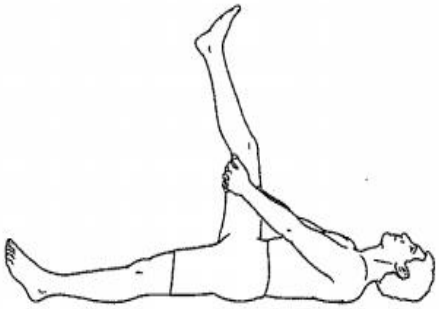
407

408 **APPENDICES**

409

410 **Appendix 1- Home exercise program (HEP)**

HIP / KNEE - 38 Stretching: Hamstring (Supine)



Supporting left thigh behind knee, slowly straighten knee until stretch is felt in back of thigh. Hold 30 seconds.

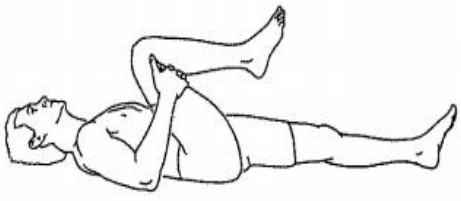
Repeat 3 times per set. Do 1 sets per session.
Do 1 sessions per day.

HIP / KNEE - 48 Piriformis (Supine)

Cross legs, left on top. Gently pull other knee toward chest until stretch is felt in buttock/hip of top leg. Hold 30 seconds.

Repeat 3 times per set. Do 1 sets per session.
Do 1 sessions per day.

BACK - 18 Knee-to-Chest Stretch: Unilateral



With hand behind left knee, pull knee in to chest until a comfortable stretch is felt in lower back and buttocks. Keep back relaxed. Hold 30 seconds.

Repeat 3 times per set. Do 1 sets per session.
Do 1 sessions per day.

411