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The Use of Mechanical Diagnosis and Treatment and Physical Therapy Intervention in a 31-year-old Female with Low Back Pain After a Motor Vehicle Accident: A Retrospective Case Report

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APPENDIX (B):

GRADUATE CAPSTONE EXPERIENCE
FINAL TRANSMITTAL FORM

Student Name: Brianna Fields
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Dissertation/Thesis/Capstone Project: THE USE OF MECHANICAL DIAGNOSIS AND TREATMENT AND PHYSICAL THERAPY INTERVENTION IN A 31-YEAR-OLD FEMALE WITH LOW BACK PAIN AFTER A MOTOR VEHICLE ACCIDENT: A RETROSPECTIVE CASE REPORT

The capstone documentation submitted by the aforementioned student has been read and approved by the student's capstone committee. The committee is composed of three members of the faculty, and at least two committee members are from the student's College.

The document is, therefore, accepted and approved on behalf of the University.

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The Use of Mechanical Diagnosis and Treatment and Physical Therapy Intervention in a 31-year-old Female with Low Back Pain After a Motor Vehicle Accident: A Retrospective Case Report

By

Brianna Fields
B.A., Governors State University, 2013

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December 2018

APPENDIX (D):

THE USE OF MECHANICAL DIAGNOSIS AND TREATMENT AND PHYSICAL THERAPY INTERVENTION IN A 31-YEAR-OLD FEMALE WITH LOW BACK PAIN AFTER A MOTOR VEHICLE ACCIDENT: A RETROSPECTIVE CASE REPORT

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B.A., Governors State University, 2013

CAPSTONE PROJECT

Submitted in partial fulfillment of the requirements

For the Degree of Doctor of Physical Therapy

Governors State University
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2019

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ABSTRACT

Background/Purpose: Over 2 million people in the United States are injured each year in motor vehicle accidents (MVA) and experience subsequent low back pain (LBP). The purpose of this retrospective case report is to present the evidence and clinical reasoning behind a Mechanical Diagnosis and Treatment (MDT)-based physical therapy plan of care for a patient with LBP post-MVA.

Case Description: The patient was a 31-year-old African-American female with LBP after a MVA. The patient's goals for physical therapy were to reduce pain with functional activities such as sitting, standing, walking, and return to pain-free function in duties such as caring for her young child and working as a web producer.

Outcomes: After 8-weeks in therapy, the patient demonstrated improvements in LBP, increased lumbar active range of motion (AROM), increased lower extremity muscle strength, and improvements on the Oswestry Disability Index (ODI).

Discussion: This case report suggests that MDT-based physical therapy intervention may be used to treat a patient with LBP post-MVA. This is demonstrated by improvements in LBP, AROM, lower extremity muscle strength, and the ODI.

Keywords: Mechanical diagnosis and treatment, low back pain, physical therapy, motor vehicle accident

INTRODUCTION

Over 2 million people in the United States are injured in motor vehicle accidents (MVA) annually.[1] Low back pain (LBP) is reported, as a primary complaint.[2] In 50% of people who seek medical care post-MVA, 30-42% report LBP at 6-months post-MVA and 20% of report LBP at 7-years post-MVA.[2] In a one year period, the cost of medical care and productivity losses associated with patient injuries surpassed $63 billion in the United States.[3] A meta-analysis by Wang, Guo, Lu,and Ni concluded that non-surgical treatment of LBP, such as physical therapy, was safe and effective and resulted in more patients returning to work.[4] One such method of physical therapy that is used to treat LBP is Mechanical Diagnosis and Treatment (MDT).

MDT is a method of therapy that uses the patient's response to repeated or sustained end-range movements and then structures interventions around the patient's directional preference.[5] Directional preference is determined by the reduction or abolishment of pain or centralization (in which pain moves from a peripheral location in the spine or body to a central location along the spine until it is eliminated).[5] MDT emphasizes self-management through home exercise programs, postural correction, and patient education.[5]

MDT was used in a case report by Robinson which describes a female patient with lumbar radiculopathy who had pain with bending.[6] Over the course of 4 weeks, directional preference was assessed for the patient at each visit and the patient was assigned exercises designed to alleviate pain with directional preference.[6] At the end of treatment, the patient had decreased pain and increased lumbar range of motion.[6] A case report by Spoto and Dixon describes a male patient with lumbar radiculopathy who has pain with long periods of sitting from driving and pain with bending forward.[7] The patient underwent an integrated approach to

therapy with interventions such as MDT, strengthening and stretching, soft tissue massage, joint mobilization, and postural and functional movement retraining.[7] At the end of 7 weeks, the pain reported minimal to no pain.[7]

The purpose of this retrospective case report is to present the evidence and clinical reasoning behind a MDT-based physical therapy plan of care for a patient with LBP post-MVA. The effectiveness of the MDT-based interventions along with strengthening and functional training performed can add to the body of evidence based practice for this condition. This retrospective case report details the outcomes of these interventions as conservative care in a patient with non-radiating LBP resulting from a MVA. These interventions may be used in conservative care therapy which could help reduce costs associated with surgery to treat LBP or costs associated with time spent out of work.

CASE DESCRIPTION

Subject

This case report describes a 31-year-old African-American female patient who presented to therapy with LBP after a MVA. She reported a previous history of LBP but stated the pain became more severe after the MVA in July 2018. Activities such as driving, sitting or walking for prolonged periods, and lumbar flexion exacerbated the pain. She had been taking Ibuprofen to relieve pain at an unknown dosage. She was a single mother with a previous history of anemia while pregnant and a history of depression in 2005 but no other history of surgeries or physical therapy treatment. She reported an independent level of function in all activities of daily living but was having difficulty with household tasks and caring for her young child which required

frequent bending and lifting. Her pain disrupted her employment as a web producer since the job required an extended amount of time sitting at a desk which caused pain.

Systems Review

Active lumbar range of motion (AROM) was found to be limited in all directions with the most restriction in right side gliding. Lower extremity muscle strength was weakened bilaterally apart from the bilateral knee extensors. Neurological screening was found to be typical as she denied numbness or tingling in the lower extremities and light touch sensation was intact. There was no involvement of bowel or bladder and she denied any unexplained weight loss. Her x-ray imaging results were unremarkable. No cardiopulmonary or cognitive screening was performed.

CLINICAL IMPRESSION #1

The patient presented to therapy with a main complaint of LBP and a goal of returning to her prior level of function in her work and home life. Since the patient presented with pain specifically with lumbar flexion activities, decreased muscular strength, and decreased lumbar AROM, she was deemed appropriate for physical therapy intervention focused on strengthening and improving pain and lumbar AROM through MDT. MDT was chosen as the patient displayed a directional preference for lumbar extension as evidenced by her history of pain with flexion activities and was further justified in her AROM screening. The following tests and measures were completed to assess baseline measures of lumbar AROM, lower extremity muscle strength, and functional limitations to determine the efficacy of treatment. AROM by visual estimate was used to assess lumbar AROM, manual muscle testing (MMT) was used to measure the strength of the lower extremity musculature, pain was measured via the Numeric

Pain Rating Scale (NPRS), and the Oswestry Disability Index (ODI) was utilized to determine the patient's perceived disability and functional limitations.

EXAMINATION

Tests and Measures

Active Range of Motion (AROM)

AROM was measured by visual estimate with the patient standing and performing lumbar movements actively. She had moderate loss of motion in flexion, extension, and left side gliding, and major loss of motion in right side gliding. AROM was used to assess limitations in motion of the lumbar spine and then used as a determining factor of the patient's directional preference and if exercises were effective in restoring pain-free motion. The patient verbalized a decrease of pain with lumbar extension. The case report by Williams, Vaughn, and Holwerda also measured AROM using qualitative measurements such as minimal, moderate, major, or no loss of motion.[10] Clare, Adams, and Maher used AROM, specifically lumbar extension, to determine the effectiveness of directional preference using lumbar extension in patients with LBP.[11] A study by Haswell, Williams, and Hing determined that active AROM to provoke symptoms flexion and extension are widely accepted and AROM in side bending has acceptable interrater reliability in patients with LBP.[12]

Manual Muscle Testing (MMT)

A 12-point scale for MMT was used which rates the muscle strength from 0 to 5, with 0 indicating no muscle contraction and 5 indicating strong muscle contraction.[13] MMT was measured in sitting and revealed the bilateral lower extremity musculature to be grossly 4/5 with bilateral knee extensors 4+/5. Strength for the gluteus and trunk was not measured by

MMT but was observed functionally as she was having difficulty in lifting tasks. MMT was used to assess limitations in strength and to determine if the patient had any weakness associated with her back pain which could impede the patient in functional tasks. Determining lower extremity strength was useful to assess and teach proper body mechanics in order to return the patient to functional tasks in the household such as lifting her small child. In a systematic review by Cuthbert and Goodheart MMT is reported a valid and reliable test of muscular strength with reliability rated between 0.62-0.99 demonstrating good to excellent reliability.[14] A case report by Williams, Vaughn, and Holwerda examined a patient with low back pain (LBP) with a lateral component in which MMT was used to assess strength in the lower extremity musculature in the major muscle groups.[10]

Numeric Pain Rating Scale (NPRS)

The NPRS was used to determine the patient's average daily LBP and if the exercises were effective in reducing pain. The NPRS is a numeric scale in which a patient rates the intensity their pain on a scale from 0 to 10, with 0 representing no pain and 10 signifying the worst pain imaginable.[15] It is an accepted measure of pain shown to have concurrent and predictive validity.[16] The test/retest reliability has been rated between 0.63-0.95 and interrater/intra-rater reliability of 0.84-0.98.[17] A 2-point change in pain demonstrates a meaningful improvement in LBP.[6] The MCID for chronic musculoskeletal pain is 1-point.[17]

Oswestry Disability Index (ODI)

The test of functional limitation used for this patient was the Oswestry Disability Index (ODI). The patient scored at 48% which is indicative of moderate disability. This outcome measure was chosen to measure the intensity of the low back pain (LBP) and how it affects

daily activities. The ODI is a self-administered questionnaire that is commonly used on patients with LBP.[18] It is a valid, reliable, and responsive tool that is generally acceptable for use on patients with LBP.[18] The minimal clinically important difference (MCID) is 10.5 points.[18] The internal consistency has been reported as 0.85.[19]

Components measured in the ODI that the patient used as goals were to reduce pain, to increase the amount of time she can sit without pain to improve her tasks sitting at a desk at work or with driving, and the ability to lift heavier objects which she required in order to lift her small child and care for her. The ODI was used to determine the impact of the interventions on the patient's level of disability and was used to focus on goals. The questionnaire was re-administered every 30 days and the MCID was calculated to determine if progress was being made in pain reduction and returning to activities of daily living. It was important to determine if the exercises are positively impacting the patient's livelihood because directional preference was key in her plan of care. In order to determine if she was moving in the correct direction as indicated by the response of her body, her daily pain and return to activities were used as an indicator. The ODI reflected if there was improvement in these aspects of her life. A case report by Santolin shows a 30-year-old female with tasks such as bending and sitting at a computer that aggravate her pain.[20] She was treated with McKenzie based directional preference exercises and the ODI was administered and used to determine effectiveness of the interventions.[20]

PT Diagnosis

Upon physical examination, the patient presented with decreased lumbar ROM, decreased strength in the lower extremity musculature, and low back pain. These impairments

impeded her quality of life and disrupted her functional ability to complete activities of daily living such as caring for her young child and completing her job duties as a web producer.

PT Prognosis

The patient had a good prognosis secondary to her expressed motivation to participate in physical therapy, lack of co-morbidities, and the objective results from her initial examination. Upon the initial examination, the patient demonstrated deficits in lumbar AROM and pain which was relieved with lumbar extension signifying that MDT interventions would result in improved lumbar AROM and decreased pain.

Plan of Care

The plan of care included weekly sessions with a physical therapist in an outpatient clinic. The plan focused on functional lower extremity strengthening, finding a directional preference for the lumbar spine and treating AROM and pain deficits through MDT. Physical therapy sessions were approximately 60 minutes with the patient meeting 2-3 times a week for the first few weeks and then 1-2 times a week once her symptoms became more self-manageable which occurred in the final weeks of therapy.

Goals

The short-term goal set for 1 week was for the patient to independently perform repeated lumbar AROM exercises as her home exercise program (HEP). Independence in performing HEP was important to the patient's progress to allow her to self-manage her symptoms and treat her LBP. The long-term goals set for 4 weeks were for the patient to report a decrease in her average pain as 3/10 as rated on the NPRS, to demonstrate proper posture with sitting to decrease pain at work, to bend and lift 40 pounds to facilitate caring for her

young child, to sleep through the night without waking due to pain, to be able to stand for 60 minutes to aid in meal preparation and cooking, and to score 20% or less on the ODI to achieve MCID.

CLINICAL IMPRESSION #2

The data gathered from the patient's history and evaluation indicated that the patient would benefit from physical therapy. The goals of physical therapy were to reduce LBP, increase lumbar ROM, increase lower extremity strength, and to return the patient to functional activities. Interventions were introduced to progress the patient through MDT and strengthening exercises to improve ROM, reduce pain, and increase lower extremity strength. HEP was introduced to progress in lumbar extension exercises and reduce pain. The patient was given written and verbal instructions to complete the lumbar extension HEP daily every 2-3 hours. A frequency of every 2-3 hours, or 6-8 times a day, is supported for MDT.[10,18] AROM was to be reassessed at every session to determine the effectiveness of the MDT based exercises. A complete reassessment of tests and measures including re-administering the ODI was planned for every 30 days. The physical therapy interventions are described in detail below.

INTERVENTIONS

Since the data for this retrospective case report was collected before the patient was completely discharged from PT, the data only includes the patient's participation in 45-minute to 60-minute sessions in a span of 8 weeks for a total of 11 visits. The interventions selected for the management of this patient's condition included patient education, MDT, lumbar mobilization, modalities, strengthening especially focused on the gluteal muscles, and use of the Repeating end-range passive exercise table (REPEX).

Mechanical Diagnosis and Treatment (MDT)

The patient went through a progression of MDT exercises focused on lumbar extension in order to reduce her low back pain (LBP). She was progressed through lying prone, prone on elbow, prone press-ups, lumbar mobilization, finally press-ups with therapist overpressure on the lumbar spine as depicted in Figure 1. She was also instructed in lumbar extension in standing as well, as shown in Figure 2, to allow for lumbar extension for when she is unable to get into prone position. In a randomized experimental study of 60 adults with low back pain, half received therapy consisting of general exercise conditioning for core stability and the other half received therapy for MDT.[21] The MDT exercises were more effective than general exercise in reducing the research subjects' pain over a 2-week treatment program with sustained results after a 2-week follow-up.[21]

Figure 1: Lumbar extension exercise progression.

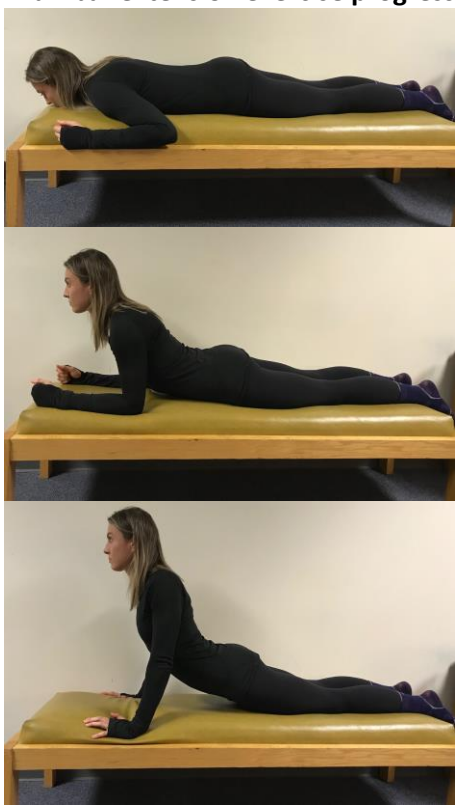
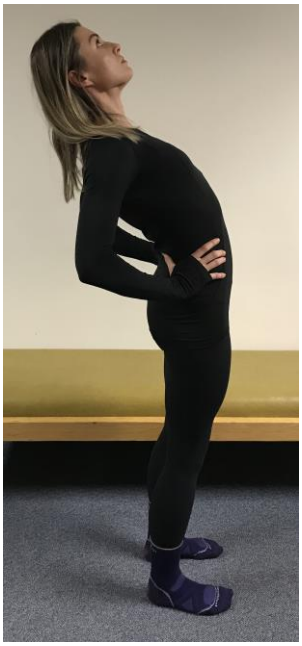


Figure 2: Lumbar extension in standing.



Strengthening

The patient participated in strengthening exercises specifically targeting the gluteus muscles and muscles for core stability. The patient performed bridges, clamshells, straight leg raises in prone, supine, and side-lying positions, and Supermans, (in which the patient contracts muscles in the back and glutes to lift the legs and arms off the table) as shown in Figures 3-8. She also performed functional strengthening exercises with step-ups and lifting progressively heavier crates to exercise and train the patient in proper form for lifting heavy items from the floor or for picking up her young child depicted in Figures 9-10. Each exercise was performed in 20 repetitions.

Figure 3: Bridges.

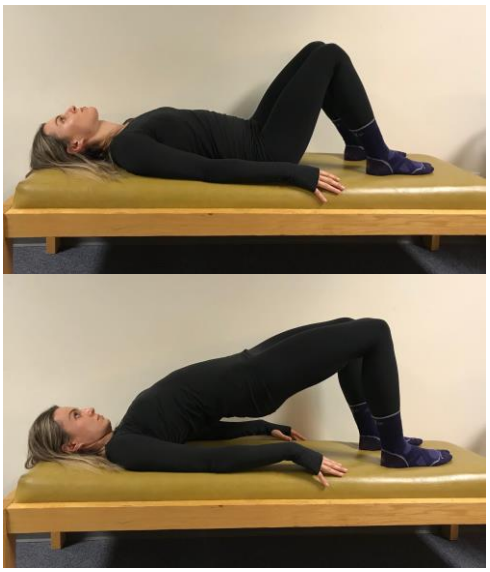


Figure 4: Supine straight leg raise.

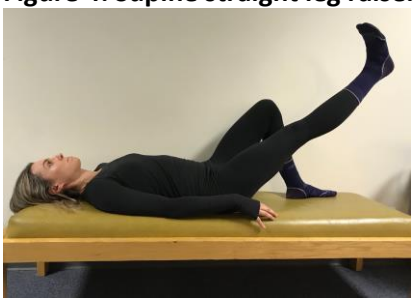


Figure 5: Side-lying straight leg raise

Figure 6: Prone straight leg raise.

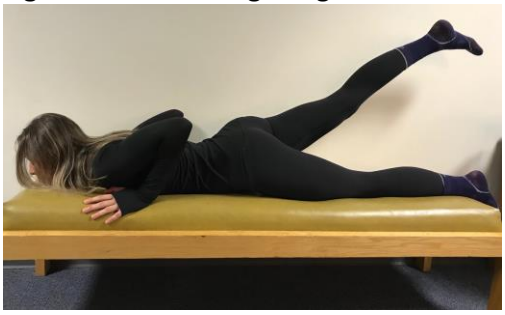


Figure 7: Clamshells.

Figure 8: Supermans.

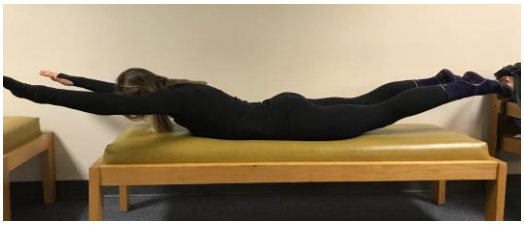


Figure 9: Step ups.

Figure 10: Lifting.

Repeating End-Range Passive Exercise Table (REPEX)

After a few days in which the patient completed lumbar extension exercises at home and in the clinic, it was determined that she could use the REPEX. The REPEX performs repeated passive sagittal movements of the lumbar spine with the primary goal of reducing pain.[22] At

subsequent visits, the time spent in the REPEX and the degree of extension would increase to the patient's tolerance. At the patient's last visit, the REPEX was set to level 3 or 18 degrees of lumbar extension, for 20 minutes. Dionne et al reported that patients with LBP who used the REPEX reported less pain and required fewer therapy visits.[22] The patient also chose heat to accompany the REPEX intervention. Chou et al determined that superficial heat is more effective than a non-heated control for acute or subacute LBP.[23]

Patient Education

Education was key in helping the patient manage her LBP. She was given a home exercise program which detailed lumbar extension exercises to be completed every 2 to 3 hours. She was also instructed in keeping proper posture with sitting and lifting. Since the patient's directional preference for relieving pain was lumbar extension, she was instructed to maintain an arch in her back with lifting and to sit with a lumbar roll to keep her back from rolling into flexion. Promoting lumbar extension in patient education prevents further exacerbation of pain.[6]

OUTCOMES

This retrospective case report details the progress of 11 sessions over a span of eight weeks as the patient was not yet fully discharged when the data was collected. The patient was compliant and independent in completing the assigned HEP. By eight weeks of treatment, the patient demonstrated a decrease in LBP from 6/10 NPRS on average and 8/10 NPRS at its highest to 3/10 NPRS on average and 5/10 NPRS at its highest as shown in Table 1. This exceeds the MCID of 1-point. She demonstrated an overall increase in lumbar AROM. She presented with moderate losses of AROM in flexion, extension, and left side gliding and major loss of AROM in right side

gliding at the initial evaluation. At the eleventh visit she demonstrated minimal losses in flexion and extension and normal AROM for bilateral side gliding. This is shown in Table 2. She demonstrated an increase of lower extremity strength from 4/5 grossly excluding bilateral knee extensors of 4+/5 to 4+/5 grossly excluding bilateral hip flexors of 4/5 as portrayed in Figure 11. Improvement in gluteus and trunk strength was noted in improvement in functional activities such as lifting progressively heavier weights. Jeong et al[24] reported that exercises strengthening the gluteus muscles and lumbar stabilization exercises showed a decrease in the low back pain disability index and resulted in increase in strength in lumbar musculature. She showed improvement of ODI score from 48% to 18% which exceeds the MCID of 10.5 points, which is described in Table 3. She also reported goals met in functional activities and activities of daily living such as increasing sitting tolerance from 1 hour to unlimited time and walking tolerance from ½ mile to unlimited distance. There was no change in standing tolerance which was reported at 1 hour. She also stated she could sleep through the night continuously and she was having less pain at work due to her ability to tolerate sitting longer.

Table 1: Numerical Pain Rating Score Outcomes Throughout MDT-based Physical Therapy Treatment Plan

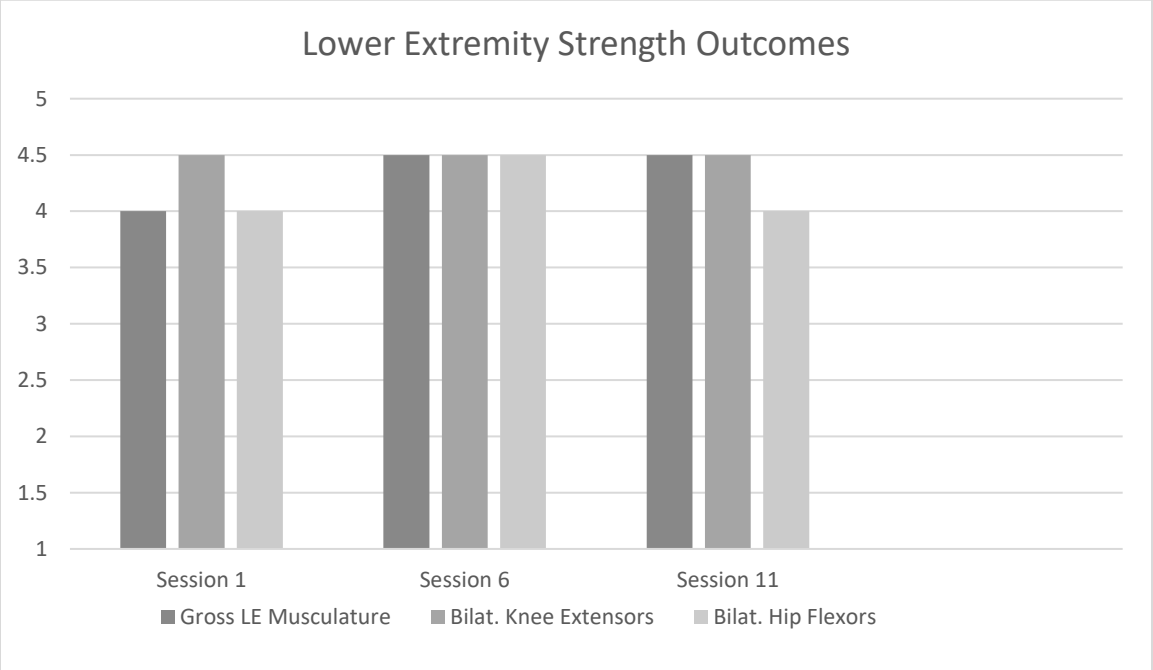
Session	NPRS average	NPRS highest
1	6/10	8/10
6	4/10	7/10
11	3/10	5/10

Table 2: AROM Outcomes Following MDT-based Physical Therapy Treatment Plan

Session	ROM			
	Lumbar extension	Lumbar flexion	Left side glide	Right side glide
1	Mod loss	Mod loss	Mod loss	Maj loss
6	Min loss	Min loss	Min loss	Min loss
11	Min loss	Min loss	WNL	WNL

(Key: Min= minimal, mod= moderate, maj= major, WNL= within normal limits).

Figure 11: Lower Extremity Strength Outcomes Following MDT-based Physical Therapy Treatment Plan



(Key: LE= lower extremity, Bilat= bilateral).

Table 3: Oswestry Disability Index Scores Throughout MDT-based Physical Therapy Treatment Plan

Session	ODI Score
1	48%
6	26%
11	18%

DISCUSSION

The purpose of this case report was to present the evidence and clinical reasoning behind a MDT-based physical therapy plan of care for a patient with LBP post-MVA. The patient's main impairments were LBP, decreased ROM, decreased strength, and difficulty with functional tasks such as sitting, standing, walking, and lifting. Over the course of eight weeks, the patient felt relief from pain, increased ROM, increased lower extremity strength, and restored functional movements. MDT-based lumbar extension exercises were chosen to decrease pain and restore ROM. The effectiveness was evidenced by the patient reporting immediate decreases in pain and overall lower daily pain rating and a restoration of ROM. Robinson[6] described a case report of a similar patient who experienced decreased pain and increased AROM following MDT-based exercise. Lower extremity strengthening was chosen to strengthen musculature to promote lumbar extension, truck stability and control, and general strength to aid in walking, standing, and lifting tasks. The patient improved in MMT scores excluding bilateral hip flexors which decreased in strength. The ODI was chosen to measure disability as reported by the patient. The patient saw a decrease in score from 48% to 18% indicating the patient exceeded the MCID and improved from moderate disability to minimal disability. Santolin described a case report of a patient reporting complete resolution of symptoms with the ODI at 0% after completing MDT-based exercises.[20]

With the high cost associated with healthcare in LBP post-MVA, a case report detailing the outcomes of MDT-based physical therapy will add to the body of work supporting a therapy based on patient self-sufficiency. Patients perform pain relieving exercises independently and recognize pain aggravating activities and adjust habits. Patients may also choose to self-treat

LBP in the case of future occurrences. MDT is shown to be an effective method of treatment in a case series by Morker, Bathia, and Kanase.[25] They reported the outcomes of three patients who were treated for LBP using MDT.[25] The patients demonstrated clinically significant decrease in pain, increase of ROM, and improvement in function in a period of two weeks with sustained effects at a twelve month follow up.[25]

Limitations to this study include the fact that this case report was completed before the patient was discharged. It is unknown if the patient had any setbacks or changes in symptoms after the last date seen. The patient had begun to reintroduce many daily mechanical stresses into her life so it is unknown how symptoms changed after that. Another limitation is that there is no control in the case report to compare MDT-based treatment to another form of therapy.

In conclusion, this retrospective case report details the improvements in pain, ROM, MMT, and functional activities for a patient post-MVA in a MDT-based physical therapy plan of care. The results of this case report cannot be generalized to a larger population due to the small sample size, however, it adds to the body of work suggesting MDT-based physical therapy is acceptable practice with notable gains in therapy. Future research with larger sample sizes or comparing MDT to other treatment methods would strengthen evidence for this practice.

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