A Case Study Examining the Effectiveness of Mechanical Diagnosis and Therapy in a Patient who Met the Clinical Prediction Rule for Spinal Manipulation

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Low back pain (LBP) is cited as the second most common ailment for which treatment is sought by individuals¹. Physical therapy interventions for LBP may include passive and active programs including spinal manipulation^{2,3} and exercises based on a determined direction of preference. Spinal manipulative therapy may include thrust and non-thrust treatments. Exercise based on direction of preference is a hallmark of the mechanical diagnosis and therapy (MDT) approach and is defined as the movement that decreases, centralizes, or abolishes the patient's symptoms⁴⁻¹⁰. Both spinal thrust manipulation (STM)^{2,3} and the MDT approach⁴⁻⁹ have

been identified as efficacious treatment methods for patients with low back pain.

Preliminary efficacy exists for both MDT and STM during treatment of LBP^{1-3,11,12}. Further evidence supports the use of classifying patients based on clinical prediction rules (CPRs) through the clustering of signs and symptoms^{11,12,14,15}. Childs et al¹² investigated the CPR of Flynn et al¹¹ and found it discriminative in identifying patients with acute low back pain who can benefit from early use of STM. In the validation study of Childs and colleagues¹², the comparative group received exercises that differed from the concepts and prescriptive elements germane to the MDT approach. To date,

there is no published research that compares the relative effectiveness of STM to MDT in patients who meet Flynn et al's CPR¹¹.

Schenk et al⁹ has provided the most parallel research on this topic in a study comparing MDT to spinal mobilization in patients classified as having a lumbar posterior disc derangement. MDT was determined to be more beneficial as measured by the Numerical Pain Rating Score (NPRS) and Oswestry Disability Index scores (OSW)⁹ as compared to a group that received manual physical therapy. This case study describes the intervention on a patient who was a consented subject in a randomized controlled trial comparing MDT vs. SMT in subjects who met four out of five criteria on the CPR for spinal manipulation.

Patient Characteristics

The patient, a 49-year-old female with a chief complaint of asymmetrical left low back and left posterior thigh pain, was recruited from a physical therapy outpatient clinic of the Catholic Health System in western New York State. Informed consent was obtained from her prior to treatment. The location of the patient's symptoms is depicted in the self-administered pain drawing (Figure 1). The mechanism of injury was a fall from a bike, which occurred four days prior to

ABSTRACT: This single-subject case study was conducted as a part of a randomized trial investigating the efficacy of mechanical diagnosis and therapy (MDT) and spinal thrust manipulation (STM) in patients who meet a clinical prediction rule (CPR) for spinal manipulation. Following initial examination, a patient who met the CPR was treated initially with STM and then eventually with MDT. The Oswestry Disability Questionnaire (ODI), Fear-Avoidance Beliefs Questionnaire, and the Numerical Pain Rating Scale (NPRS) were administered at the initial examination and at a two-week follow-up. Data were analyzed based on changes in the pain rating scale, ODI, and straight leg raise scores from initial examination to discharge. In accordance with a study protocol in which the patient was part of, this patient was changed from STM to MDT after the second physical therapy visit due to failure of overall improvement. The patient received MDT during the third session and continued with this approach until discharge. This patient responded favorably to MDT presenting with a 20° improvement in SLR on the left and 10° on the right, 6 points lower on the NPRS, and a 4% decrease on the OSW after a total of 6 visits.

KEYWORDS: Clinical Prediction Rule, Low Back Pain, McKenzie, Spinal Manipulation

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FIGURE 1. Pain drawing at initial examination.

the initial physical therapy examination. The patient's entry criteria at initial examination included the following: 1) no pain below the knee, 2) symptom duration of four days, greater than 35° of hip internal rotation, and lumbar hypomobility as assessed using spinal spring tests. The patient's Fear-Avoidance Beliefs Questionnaire work (FABQw) subscale score was 31, which exceeded the score of 19 identified in the CPR. The randomized trial included patients who met 4 of 5 of the CPR criteria. This patient met 4 out of the 5 criteria (Table 1), which has been found to predict a positive response from STM¹¹; therefore, she was enrolled in a randomized clinical trial sponsored by the authorship team.

Examination

After obtaining informed consent, the patient underwent a physical therapy examination. Functional questionnaires including the OSW, FABQw, and NPRS were administered followed by a subjective interview and an objective physical exam. Jensen et al¹⁶ suggested that 10- and 21-point scales provide sufficient levels of discrimination, in general, for

chronic pain patients to describe pain intensity. The physical examination process incorporated assessment of posture and structural alignment, spinal active range of motion, myotomal tests, lumbar repeated movements, reflex assessment, straight leg raise measures, palpation, and spring testing.

Upon initial evaluation, the patient's baseline OSW was 30%. Fritz and Irrgang¹⁷ found the minimum clinically important difference, defined as the amount of change that best distinguishes between patients who have improved and those remaining stable, was approximately 6 points for the modified OSW. The patient had no significant past medical history. The postural exam revealed a decreased lumbar lordosis. Spinal flexion active range of motion was found to be within normal limits and was measured with a single inclinometer. Rondinelli et al¹⁸ found the median range of error was 8.5° using the single inclinometer. Repeated flexion in standing and in supine caused the patient's symptoms to worsen in the left posterior thigh, while repeated lumbar extension in standing for 10 repetitions resulted in movement of the symptoms from the posterior thigh to the left

low back indicating a centralization of symptoms.

Repeated extension in lying led to a further centralization of symptoms to the lumbar spine following 20 repetitions. Centralization was defined as the movement of symptoms from a more distal location to a more central location^{5,6,10}. Straight leg raises measured 0°–70° on the left and 0°–80° on the right. Palpation revealed tenderness in the lumbar paravertebrals bilaterally.

Clinical Impression

The patient's physical therapy diagnosis was low back pain with hypomobility, and the MDT classification was posterior asymmetrical derangement based on the symptom location and response to repeated movement testing¹⁰. The MDT derangement classifications and more recent derangement terminology are found in Table 2.

Intervention

To simulate the prescription associated with the randomized controlled trial, the patient was assigned to receive spine manipulation first. Treatment sessions 1 and 2 consisted of the lumbopelvic thrust technique¹¹ administered to the left (symptomatic) side. Because no audible or palpable cavitation was heard, the treating physical therapist administered the lumbopelvic STM to the right side in accordance with the original CPR design. In addition to STM, the patient received instruction on the hand-heel rock range of motion exercise for 30 repetitions and 20 repetitions for sessions 1 and 2, respectively, again in accordance with the original CPR design. The hand-heel rock involved movement into flexion and then extension from the quadruped position. These exercises were performed both in the clinic and at home.

After two treatments of STM on the patient's left side, no change in NPRS was found. As dictated in the procedures of the parent RCT, if the patient failed to improve with the randomly assigned treatment, the intervention would be changed to the alternative treatment, which in this case, was MDT. The NPRS

TABLE 1. Study classification criteria outlined in this study.

Criterion	Flynn et al's CPR
Duration of symptoms	< 16 days
Extent of distal symptoms	No symptoms distal to knee
Hip IR ROM	≥ 1 hip w/ > 35° IR
PIVM testing	≥ 1 hypomobile segment in L-spine
FABQ work subscale score	< 19 points

Note: The criteria for thrust manipulation are described above according to Flynn et al's CPR¹¹.

IR = internal rotation, ROM = range of motion, PIVM = passive intervertebral motion, FABQ = fear avoidance belief questionnaire.

was used for deciding to switch this subject into the other treatment group. Clinically, the decision to change groups based on symptom response and location of symptoms was supported by Werneke et al¹⁹, who found a pain diagram could be used to categorize symptoms as low back, buttock/thigh, or distal to the knee based on the distal-most extent of symptoms.

The patient began MDT treatment at a rating of 6 out of 10 in the left posterior thigh on the NPRS. A review of the patient's physical therapy documentation showed that the patient had reported that symptoms were less severe but noted "increased stiffness" in the lumbar region after each session with STM.

The patient received MDT during the third session. According to the direction of preference determined at the initial evaluation, the movements that resulted in centralization were repeated in standing and repeated extension in lying (EIL) for 2 sets of 10 repetitions each. Extension in standing led to centralization of symptoms from the left posterior thigh to the left lumbar region while extension in lying centralized symptoms to the lumbar area. On the return to PT for the 4th visit, the patient described symptoms in the left lumbar area, which were rated as a 4/10. MDT was continued in the fourth session and consisted of repeated extension in lying (EIL) for 3 sets of 10 repetitions with belt overpressure. Symptoms were abolished after the performance of repeated movements. Upon return for visits 5 and 6, the patient described central lumbar symptoms rated as a 3/10, and 2/10, respectively. The patient performed repeated extension in standing and repeated ex-

tension in lying for 3 sets of 10 repetitions each without overpressure. Repeated extension in standing led to a decrease in central pain and repeated EIL abolished symptoms at each visit. As a home exercise program, the patient performed 10 repetitions of extension in standing or repeated extension in lying motions on an hourly basis from session 3 until discharge.

In addition to physical therapy administered in the clinic, the patient was also asked to complete a daily log of adherence to the home exercises. Intervention included 6 treatments within a 3-week period. According to the study protocol, at the conclusion of the 2nd visit, the patient was reassessed using the NPRS. Following discharge from the study, the patient was re-evaluated using the NPRS and OSW. The patient intervention and symptom response are represented in Table 3.

Outcomes

The OSW scores indicated a 4% difference from the 30% baseline level with the score decreasing to 26%. The NPRS decreased from 6 to 0 when comparing pre- to post-test scores. Bilateral straight leg raises improved as the left straight leg raise increased 20° and the right straight leg raise measure increased by 10°.

Discussion

This study analyzed the outcomes of a patient treated initially with STM and later with MDT. The safety and efficacy of both methods of treatment for low back pain have been established^{1,4-9,13,20}. The patient report of increased stiffness combined with no change in the NPRS led the treating physical therapist to

switch the patient to the MDT intervention. The patient's baseline NPRS score was above the average of female participants in a study by George et al²¹, who found that higher NPRS scores were predictive of less positive outcomes in people treated for acute low back pain.

The subject met all five of the CPR criteria, with the exception of the FABQw. Flynn et al¹¹ made two points that supported including this patient in the present investigation. According to Flynn and colleagues¹¹, the presence of four of the five variables in the prediction rule increases the likelihood of success from 45% to 95%. In addition, the authors mentioned that the best univariate predictor of success with manipulation was the duration of the current symptoms; the more acute symptoms, as found in this patient, were more likely to respond favorably to manipulation. This factor made this patient a subject of interest as to whether MDT might be effective in patients who meet the CPR for thrust manipulation.

The FABQw has been found to have good predictive validity in a person's ability to return to work^{22,23}. The patient scored a 31 on the Fear-Avoidance Beliefs Questionnaire work subscale, although she continued working. Fritz and George²³ found that cut-off scores up to 34 on the Fear-Avoidance Beliefs Questionnaire are relatively sensitive and specific for predicting a decrease in disability and a decreased likelihood of prolonged work restrictions when provided with appropriate care. Despite reporting reduced pain after using exercises based on direction of preference, the patient reported a decrease in disability of only 4 points on the ODI. The subject initially received STM and the ODI was not tabulated after this intervention.

This finding is in contrast to other studies that have found a more dramatic change in function following STM¹¹ and/or centralization of symptoms with an MDT approach^{5,6,8}. This finding suggests that pain scores and disability scores may be less related when patients have high initial FABQw findings or that disability is a concept that is less responsive to change. The lack of clinically important change in the ODI and the high

TABLE 2. MDT derangement classifications.

Derangement	Posterior/ Anterior	Deformity	Response to Repeated End-Range Spinal Movement	More Recent Terminology
1	Posterior	None	Worse with flexion/better with extension	Central Symmetrical
2	Posterior	Acute lumbar kyphosis	Worse with flexion/better with prone progression	Central Symmetrical
3	Posterolateral	None	Worse with flexion/better with extension or extension with hips offset	Unilateral Asymmetrical Symptoms to Knee
4	Far lateral	Lateral shift	Worse with flexion/better with side-gliding	Unilateral Asymmetrical Symptoms to Knee
5	Posterolateral	None	Worse with flexion/extension or extension with hips offset	Unilateral Asymmetrical to Below Knee
6	Far lateral	Lateral shift	Worse with flexion/better with side-gliding	Unilateral Asymmetrical to Below Knee
7	Anterior	Accentuated lumbar lordosis	Worse with extension/better with flexion	Unilateral Asymmetrical Symptoms to Knee

TABLE 3. Patient's symptoms/outcomes with thrust manipulation and MDT.

Visit/Intervention	NPRS/Symptom Location Pre- Treatment	Treatment	NPRS/ Symptom Location Post- Treatment	OSW
1/initial examination/STM	6/10 lumbar and left posterior thigh	Lumbopelvic thrust Hand-heel rock x 30	Unchanged	30% (pre-treatment)
2/STM	6/10 lumbar and left posterior thigh	Lumbopelvic thrust Hand-heel rock x 20	Unchanged	
3/STM	6/10 left lumbar and left posterior thigh	EIS 10x2 EIL 10x2	Centralized to left lumbar Centralized to lumbar	
4/MDT	4/10 left lumbar	EIL with belt overpressure 10x3	Symptoms abolished	
5/MDT	3/10 central lumbar	EIS 10x6	Decreased and abolished	
6/MDT	2/10 central lumbar	EIS 10x6	Decreased and abolished	
Discharge status	0/10			26%

STM = spinal thrust manipulation, EIL = extension in lying, EIS = extension in standing, MDT = mechanical diagnosis and therapy.

initial FABQw in a patient who continued to work are points of interest that require further investigation.

Many patients with acute low back pain in the United States either seek chiropractic treatment²⁴ or are medically managed through analgesics prescribed by their primary care physicians, both of which involve a passive approach to care.

Additionally, a recent CPR investigation by Hallegraeff et al²⁵ found no additional benefit of four manipulations over two for those who met two of the five criteria from the Flynn et al¹¹ CPR. The patient in this study presented with a posterior asymmetrical derangement based on responses to repeated movement testing. Her movements allowed the therapist to

ascertain a directional preference, which suggests that an active approach would have been beneficial for this individual. Matching exercise along with the direction of preference assists in pain reduction and recovery of function⁴ and allows for self-management of the patient's condition. Although mixed results exist regarding active management based on

disease chronicity, an active self-management has been advocated as a useful approach for low back pain^{10,26,27}.

Conclusions

Understanding the appropriate approach to treatment by classification and sub-grouping of patients according to factors, for example, criteria based on a CPR or a direction of preference based on patient response, may lead to improved efficiency in the treatment of low back pain. MDT may foster a patient's independence and lessen dependence on the physical therapist because the patient may learn exercises, movements, and postures to effectively manage present and future episodes of low back pain¹⁵. Future research should focus on aspects concerning the abilities of patients to self-manage low back pain symptoms after intervention with a physical therapist to determine if fostering patient independence through exercise can reduce recidivism. Although a CPR has been established in previous studies to identify patients who would benefit from STM as a treatment for acute low back pain^{10,13,28}, further research is required to determine if classification of patients according to examination and CPR criteria produces favorable outcomes relative to MDT.

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