Case Report

Utilization of mechanical diagnosis and therapy (MDT) for the treatment of lumbar pain in the presence of known lumbar transverse process fractures: a case study

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Background: Spinal fractures are typically considered a contraindication to mechanical diagnosis and therapy (MDT).

Objective and importance: The purpose of this case study is to illustrate how MDT was used safely and effectively to treat lumbar pain in a patient with multiple lumbar transverse process fractures.

Clinical presentation: The subject was a 24-year-old female with left L2-5 transverse process fractures, sustained 10 weeks prior in a pedestrian versus motor vehicle accident.

Intervention (and technique): After collaboration with her physiatrist, an MDT examination revealed a presentation consistent with the lumbar derangement syndrome.

Conclusion: After three visits, utilizing patient generated forces with the extension principle of treatment, her pain, Oswestry disability index (ODI) score, and function all improved.

Keywords: Mechanical diagnosis and therapy, McKenzie method, Low back pain, Derangement, Directional preference, Fracture, Red flags, Classification

Background

With CT scanners replacing the use of x-rays in the assessment of patients sustaining trauma, the diagnosis of transverse process fracture is becoming more common.^{1,2} Fractures of the thoracic or lumbar transverse process have been found in about 10% of cases involving blunt torso trauma.² This finding is significant because it should be seen as a marker of potential serious injury to the abdominal organs.³ In some cases, however, transverse process fractures can occur in isolation, having no association with neurologic deficit or structural instability.¹ Patients with isolated transverse process fractures do not require any form of interventional surgery or bracing therapy¹ but may have pain management needs and experience limited employment status.² The healing time for a transverse process fracture has been reported as ranging between a few weeks to 3 months.⁴⁻⁶

Since patients with isolated fractures of the thoracic or lumbar transverse processes may have pain and functional deficits, it seems logical that referral to physical therapy services may be indicated.

Homnick *et al.*² proposed that patients with isolated lumbar transverse process fractures would benefit from aggressive pain management and physical therapy referral for early mobilization. There are specific interventions recommended in the literature for use by physical therapists when treating lumbar vertebral compression fractures. These interventions include bracing,⁷ therapeutic exercise,^{7,8} postural taping,⁸ and manual therapy.⁸ To our knowledge, there are no clinical reports to date regarding the most effective treatment approach for a patient presenting with residual low back pain and known lumbar transverse process fractures. Suggested treatments for those with healing transverse process fractures include rest, ice, analgesic medications, strengthening of abdominal and lumbar musculature, trunk flexibility exercises, and the use of bracing or corsets.^{5,6}

The treatment approach used in this case was mechanical diagnosis and therapy (MDT) or the McKenzie method; it is a system of assessment, classification, management, and prevention of spinal and extremity joint symptoms. Mechanical diagnosis and therapy uses the symptomatic and mechanical responses to repeated end range movements and sustained postures to classify patients into one of

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Figure 1 Lumbar MRI without contrast, 7 weeks post accident. The level shown is L4, with the arrow indicating the left-sided transverse process fracture. MRI findings: L2, L3, L4, and L5 left transverse process fractures. There is minimal displacement at L3 and L4. L5/S1 includes a very small central disk protrusion.

three mechanical syndromes: derangement, dysfunction, or postural.⁹ Evidence supports the reliability of the MDT assessment of the lumbar spine when used by clinicians having formal training in MDT.^{10–12} There is also support to suggest favorable outcomes when assessment leads to the identification of a directional preference, and exercises are prescribed matching this directional preference.^{13,14}

A standard objective of the MDT assessment includes screening the patient's history for features that may indicate serious spinal pathology, also known as red flags. When serious spinal pathology is suspected (cancer, infections, fractures, cauda equina syndrome, etc.), further mechanical therapy is traditionally considered contraindicated and the patient must be referred to a specialist for further evaluation.⁹ The purpose of this case study is to share and discuss the safe and effective assessment and treatment of a patient presenting with low back pain and multiple known fractures to the transverse processes of the lumbar spine. We also illustrate, by example, how the principles of MDT can be used effectively.

The patient who is the subject of this case study granted permission to have her case presented in the medical literature, as long as no personal details were mentioned and anonymity was maintained.

Patient Characteristics

A 24-year-old female was referred to physical therapy with reports of left-sided lumbar pain. Ten weeks prior, the patient had been involved in an accident where she had been hit by a motor vehicle while walking. She had undergone x-rays and a CT scan after the accident, which revealed left L2–L4 transverse process fractures.

Approximately 6 weeks following the accident, the patient was evaluated by a physiatrist due to ongoing symptoms. A subsequent MRI was ordered to rule

out disk involvement. The MRI did not suggest any disk pathology but did reveal a fourth fracture to the left transverse process of L5. All levels had no evidence of osseous healing. Figure 1 illustrates the fracture at the L4 level. Owing to the lingering pain and numbness in the lumbar region, the patient was referred to physical therapy for an MDT assessment. The physical therapy assessment occurred approximately 3.5 weeks after her initial consult with the physiatrist (10 weeks post accident).

Examination

Owing to the patient's multiple transverse process fractures, the evaluating therapist spoke to the referring physiatrist, who did not feel that active lumbar movement to end range was contraindicated in this case. The physical therapist and physiatrist decided that, due to the presence of multiple fractures, the evaluation and treatment would focus on patient-generated forces only.

The patient had recently returned to part time work as a dental hygienist. She had not returned to her prior general exercise routine. Left low back tightness and partial numbness were reported as constant symptoms. Left low back pain was reported as intermittent. She reported being sometimes worse with sitting, noting that prolonged and unsupported sitting on the stools at work was problematic. She reported tenderness when sitting against the back of a hard chair. She was sometimes worse in the evening and with activity. She was waking two to three times per night, due to pain, but could return to sleep relatively easily upon repositioning. She was better with standing, walking, and lying. Though she had experienced some prior low back pain, which she attributed to her workouts, she had not received prior treatment for low back pain. She was in good general health. She reported some right shoulder pain associated with a diagnosis of acromioclavicular joint sprain, sustained in the same accident. Functional outcome measures collected at the initial visit were the following: Oswestry disability index (ODI) and a lumbar computerized adaptive test (CAT) based on software developed by Focus on Therapeutic Outcomes, Inc. (FOTO, Knoxville, TN, USA). The patient rated herself at 22% (11/50 points) on the ODI indicating moderate disability¹⁵ and 57/100 on the lumbar CAT, which would translate functionally to an individual exhibiting moderate difficulty with usual work and household duties.¹⁶

The patient was found to be worse with posture correction but was no worse when sitting with the McKenzie lumbar roll. Movement loss was assessed consistent with the MDT evaluation. Lumbar flexion, extension, and lateral movement via side glides were assessed with attention to the amount of available

Figure 2 Chronological timeline of assessments and treatments.

range of motion, pain response, willingness to move, and curve reversal.⁹ A moderate loss of lumbar extension was noted, and the patient reported stiffness. Lumbar flexion was minimally limited with left low back pain reported during movement. Side glides were not limited to either side and had no effect on symptoms.

Assessment of the patient's symptomatic and mechanical responses to repeated movements was also conducted, consistent with the MDT evaluation. Owing to time constraints, the response to repeated lumbar flexion and extension was the focus at the initial visit, as sagittal plane movements often have the greatest effect on symptoms.⁹ Repeated flexion in

standing produced left low back complaints, but the patient was found to be no worse symptomatically and there was no change to her mechanical baseline post flexion testing. Similarly, repeated extension in standing (REIS) produced complaints of lumbar stiffness and right low back pain, but the patient was no worse symptomatically and there was no change to her mechanical baseline post extension testing. Response to repeated lateral movement testing via side glides was not assessed at the initial visit.

Clinical Impression

At the conclusion of the first session, the patient was given the provisional mechanical diagnosis of lumbar derangement syndrome: unilateral and asymmetrical to the knee. Time had not allowed for extensive testing with repeated movements, but the nature of her symptoms had eliminated dysfunction and postural syndromes as mechanical possibilities. Although a directional preference for extension had not been confirmed by the end of the first session, the patient was asked to trial a program of REIS from the time of the evaluation until the time of her next follow-up visit. This decision was made as she was no worse in response to extension testing performed during the course of the evaluation and also due to her reports of being sometimes worse sitting and better standing or walking. She was instructed to discontinue the prescribed exercise if her symptoms worsened or peripheralized.

Intervention

This patient returned to physical therapy on two subsequent occasions.

At the second visit, the patient reported compliance with the prescribed home exercise program, consisting of REIS. She felt that her overall condition was unchanged. She continued to feel worse in response to sitting and driving. She was not experiencing pain at the time of the visit but reported the presence of left-sided lumbar tightness.

The concept of force progression was utilized when REIS was performed with her sacrum in contact with a treatment table. With this modification, the trunk extends over a fixed or stabilized pelvis. This produces a 'greater and more specific force' to the lower lumbar spine⁹ in comparison to the standard REIS technique, where the trunk extends over a pelvis that is freer to move.

An alternative force was also explored with repeated extension in lying (REIL). Instead of the start position being standing (loaded), the start position is in prone lying (unloaded). Less compressive forces are present with REIL, and the greatest extension stretch to the lumbar spine is achieved when extension is performed in this manner.⁹

When repeated lumbar extension was performed in either of these ways, REIS with the sacrum in contact with the treatment table or REIL, the patient reported a favorable symptomatic response with regard to her lower back tightness, which remained better after the exercise. She also demonstrated a positive mechanical response: improvement in her available lumbar extension range of motion.

At the end of the second session, her symptoms of tightness had been abolished. She was encouraged to utilize a lumbar roll to manage the discomfort reported with sitting and to assist in maintaining the symptomatic and mechanical improvements that occurred in response to the extension exercises. She was encouraged to continue REIS with the sacrum against a countertop, or REIL, for 1 set of 10 repetitions, six to eight times per day.

At the third and final visit, she reported her perceived improvement as 80%. She was only experiencing pain when there was direct pressure to her left lumbar region, such as when she sat in a hard chair. She reported no pain and demonstrated no limitation with lumbar active range of motion. She was encouraged to continue the extension program as prescribed. She had not returned to her prior general exercise routine, but this was not due to her lumbar symptoms and she was confident that she could return to this in the near future.

Outcomes

The patient returned to the referring physiatrist 1 month after her last physical therapy session (16 weeks post accident) for reassessment. She reported no functional limitations and had resumed her previous level of activity. Her ODI score at that time was 6% (3/50 points), improved from 22%, which was a clinically significant change¹⁷ with a residual minimal disability. She was discharged from further care and encouraged to resume her prior functioning. A follow-up was performed via email 6 weeks following her last physical therapy session (18 weeks post accident). Her final lumbar CAT score was 78/100, which surpassed the projected goal of 61/100 and reached a clinically meaningful change of more than 15 points.¹⁶

Discussion

Though suspicion of spinal fracture is a red flag that alerts clinicians to the need for further evaluation by a specialist,⁹ this patient presented to physical therapy having already been evaluated by a specialist. It had been determined, through collaboration with the referring physiatrist, that there was no need for limitations on patient's ability to perform active lumbar movement, including end-range movements. As a result, an MDT evaluation was conducted, allowing patient-generated forces only. The patient's

symptomatic and mechanical responses, as well as the concepts of force progression and force alternative, were utilized to guide the treatment. The mechanical diagnosis of lumbar derangement syndrome was confirmed over the course of two visits, and the patient was successfully self-managing her symptoms at the time of her last therapy visit. Favorable changes were noted in the patient's ODI score at the time of her physician follow-up. The patient's ending lumbar CAT score, gathered approximately 8 weeks post physical therapy evaluation, represented a clinically meaningful change. The ending score of 78/100 translates to a functional level consistent with normal activities and the ability to perform rigorous daily activities.¹⁶

McKenzie and May emphasized the importance of recognizing clinical presentations that suggest the potential of serious spinal pathology.⁹ It was further highlighted by these authors that the appropriate course of action when these conditions are suspected is to discontinue further mechanical therapy and refer the patient to the appropriate specialist for further evaluation. Some conditions are highlighted as absolute contraindications to mechanical therapy, among these are cauda equina syndrome, fractures, cord signs, and spinal infection. Other conditions, such as ankylosing spondylitis, osteoporosis, or even cancer, can benefit from cautious and appropriate management, when a mechanical component is also present.⁹

In our opinion, the subject of this study falls into the latter category, that of a relative contraindication. The subject had already been evaluated and diagnosed by a specialist who was familiar with the principles of MDT and felt that treatment with patient-generated forces was safe. In this specific case, we do not imply that the prescribed lumbar extension exercises had a beneficial effect on the known fractures but rather on the underlying derangement syndrome. We also feel it is important to highlight that not every fracture would be appropriate for treatment as some are unstable and require more conservative guidelines to allow successful healing. Pursuing treatment with MDT in these instances would run the risk of further injury to the fracture site or surrounding structures. As an example, it would not be advised to introduce repeated end-range extension exercises in the case of an acute spondylolysis.^{18,19}

We do recognize several limitations to this case study.

The patient reported a perceived improvement rating of 80% at the time of her last physical therapy session. This last session occurred 12 weeks post injury, which coincides with the time frame that would be expected for healing of the transverse

process fractures.⁴⁻⁶ It is not possible to know with certainty if the patient's symptomatic and functional improvements were solely a response to the reduction of the lumbar derangement syndrome versus a result of natural bone healing, or possibly a combination of both. Post treatment imaging would have provided further information regarding the status of healing at the fracture sites, but additional imaging was not indicated as the patient was ultimately managing well from a symptomatic and functional perspective.

Though the patient's last lumbar CAT score was favorable at 18 weeks post injury, no further contact was made with the patient with regard to her symptomatic or functional status after that point.

Despite the favorable outcome in this case, we cannot project that every patient with transverse process fractures would respond similarly, especially if other cases did not involve a concurrent lumbar derangement syndrome.

All therapists involved in treating the subject had advanced training with the McKenzie Institute International. Since prior research has indicated varying degrees of reliability with the McKenzie assessment based on the level of training,¹⁰⁻¹² we question if success utilizing the MDT system for treatment might also vary with the level of training.

This case study highlights the assessment and treatment of a patient presenting with low back pain and moderate disability, utilizing the principles of MDT in the presence of multiple, known lumbar transverse process fractures. The case study raises the question as to whether some spinal fractures could be considered a relative rather than absolute contraindication to MDT. The use of symptomatic and mechanical responses, as well as the cautious use of force progression and force alternatives, allowed for successful and safe treatment. There is further need for randomized clinical trials utilizing MDT in the assessment and treatment of homogenous groups with lumbar pain, for example, grouping patients according to similar spinal pathology, such as those exhibiting isolated, stable fractures not requiring surgery or bracing.

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Appendix

Glossary of terms⁹

Centralization: The phenomenon by which distal limb pain emanating from although not necessarily felt in the spine is immediately or eventually abolished in response to the deliberate application of loading strategies. Such loading causes an abolition of peripheral pain that appears to progressively retreat in a proximal directional. As this occurs, there may be a simultaneous development or increase in proximal pain.

Derangement syndrome: The most common mechanical syndrome, characterized by rapid and lasting changes in pain intensity, location, and mechanical presentation with the performance of movements or the adoption of sustained postures. Loading strategies produce a decrease, abolition, or centralization of symptoms. Opposite loading strategies may cause production, worsening, or peripheralization of symptoms.

Directional preference: The phenomenon of preference for postures or movement in one direction, which is a characteristic of the derangement syndrome. It describes the situation when postures or movements in one direction decrease, abolish, or centralize symptoms and often decrease a limitation of movement.

Force alternatives: A change in the manner in which a force may be applied during the exploration of loading strategies to reduce derangements. For instance, alternative start positions (standing or lying), force directions (sagittal or lateral), or dynamic (repeated movements) or static forces (sustained positions).

Force progressions: Within each principle of treatment direction (extension, flexion, or lateral), there is a range of loading strategies available. These involve greater or more specific forces, but are still in the same plane of movement. Force progressions are used to determine the correct directional preference when lesser forces are not able to maintain improvements.

Loading strategies: Describes the applied movements, positions, or loads required to stress particular structures, and may be dynamic or static – dynamic would be a repeated movement and static, a sustained posture. The significant loading strategies, postures, and repeated movements are those that alter symptoms.

Mechanical response: Change in mechanical presentation, for instance an increase or decrease in range of movement in response to a particular loading strategy.

Symptomatic response: The behavior of pain in response to a particular loading strategy, for instance, centralization, peripheralization, worse, or better.

Peripheralization: The phenomenon when pain emanating from the spine, although not necessarily

felt in it, spreads distally into, or further down, the limb. This is the reverse of centralization.

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