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Use of a Patient-Specific Outcome Measure and a Movement Classification System to Guide Nonsurgical Management of a Circus Performer with Low Back Pain A Case Report

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Abstract

Low back pain (LBP) can be detrimental to the career of a circus arts performer, yet there is minimal population-specific literature to guide care. Moreover, reluctance to discontinue training and the need to resume end-range lumbar motion can impede the success of conservative care. The purpose of this case report is to describe the use of a patient-specific outcome measure and a movement classification system to structure a home exercise program (HEP) for an adolescent training to be a circus performer. The patient was a 16-year-old female with a 10-month history of LBP. A Movement System Impairment examination indicated that she had lower abdominal weakness, gluteal weakness, and hip flexors that were short and stiff; hence, extension and rotation were repeated patterns of lumbopelvic movement associated with her LBP symptoms. The patient was seen for 16 visits over 16 weeks. The HEP focused on minimizing lumbopelvic extension and rotation movements while improving abdominal and gluteal strength and hip flexor flexibility. Resumption of acrobatic activities was guided by the Patient-Specific Functional Scale. As measured by this scale, her difficulty with five functional and acrobatic activities decreased from 4/10 at initial evaluation to less than or equal to 1/10 by discharge. It is concluded that using an outcome measure to assess difficulty of activities chosen by the patient and education on how to avoid movement patterns associated with LBP symptoms can help facilitate return to performance.

Half of adolescents who take part in sports outside of school have at least one episode of low back pain (LBP).¹ In particular, those who participate in a sport that requires repetitive trunk motions may be at an even greater risk for developing LBP and prolonged disability.^{1,2} Aerial arts require the use of end-range trunk motions, such as extension and rotation, coupled with additional loading, for example when lifting other participants in opposed directions. The patient presented in this case report is an adolescent training to be a circus

performer. Due to difficulty managing LBP symptoms, she sought care from a performing arts physical therapist.

A challenge in treating performing athletes is balancing their motivation to return to sport with adequate time for injured tissues to heal. An outcome measure that quantifies symptoms with patient-chosen activities can help inform this balance. In contrast, region-specific outcome measures, such as the Modified Oswestry Disability Questionnaire (Modified OSW),³ do not capture limitations in populations with unique physical activity demands. An outcome measure developed by Stratford and colleagues⁴ addresses this issue by having patients choose and rate the difficulty of five activities that are important for them. This type of measure can help integrate management of an athlete's motivation to return to sport with consideration of how certain activities affect symptoms.

Treatment of a circus performer can be especially challenging because they need to use end-range trunk motions and are often reluctant to discontinue training completely. Additionally, to our knowledge, there are no published studies to guide physical therapy intervention for circus performers. The purposes of this case report are to describe 1. the use of a patient-specific outcome measure to structure return to sport with an athlete who will not completely cease all symptom provoking activities, 2. a Movement System Impairment examination of a patient with chronic LBP, and 3. an individualized treatment for a circus performer.

Methods

Subject Information

A 16-year-old female circus performer with LBP was referred to physical therapy. She was 5'5" tall, weighed 125 pounds, and had a body mass index of 20.8 kg/m². Her LBP began gradually some 10 months prior to her first physical therapy visit at our clinic. On initial evaluation, she reported an average pain of 4/10 on the Verbal Numeric Scale (VNS), which has been demonstrated to be reliable and valid for use with adolescents. She reported no previous history of LBP and denied associated symptoms in her legs. Imaging results from plain radiographs, magnetic resonance imaging, computed tomography scan, and a bone scan were unremarkable for pathology.

Before beginning physical therapy at our clinic, she was treated by an osteopathic doctor who performed adjustments to the lumbar spine and pelvis. The patient had also previously seen a physical therapist who prescribed abdominal strengthening, muscle energy techniques, and used sacroiliac joint (SIJ) mobilizations, Transcutaneous Electrical Nerve Stimulation (TENS), and an acupuncture pen. She also had an Aspen[®] LSO brace (Aspen Medical Products, Irvine, California) to help control LBP symptoms. Due to a lack of symptom relief with these modalities, the patient sought care from a performing arts physical therapist.

The patient was a home-schooled high school student with a very active lifestyle. She had been training in circus arts for over 10 years and was performing professionally with a local circus troupe in a variety of circus activities, including acrobatics, tumbling, trapeze acts, tightrope walking, hula hooping, lyra, juggling, and diabolo. She practiced and performed 6

to 7 days per week for 3 to 4 hours per day before her LBP injury. Her primary complaint was LBP associated with acrobatic activities, such as back walkovers and hula hooping. Additionally, her LBP symptoms prevented her from sitting for longer than 1 hour, which disrupted her ability to attend academic classes and travel by car to performance venues outside of the city. Lifting heavy objects also increased her pain, which interfered with her performance in acts that required lifting or supporting another person. Her goal for therapy was to perform in a circus troupe without LBP symptoms. The subject was informed that data concerning her case would be submitted for publication, and she approved this procedure.

Visual Appraisal

During subjective exam, it was noted that the patient preferred to sit with her legs crossed and her upper body leaning toward one side, resulting in side-bending and rotation of the low back.

Palpation

She was tender to palpation from L4 to S2 vertebrae and bilaterally from the posterior superior iliac spine (PSIS) to approximately 2 cm inferior to the PSIS.

Movement Tests

A Movement System Impairment examination was performed in order to identify what lumbopelvic movements provoked the patient's symptoms.⁵ If a trunk or limb motion provoked symptoms, then the patient was asked to repeat the same motion while the examiner manually blocked the associated lumbopelvic movement. If symptoms were reduced by blocking lumbopelvic movement, then the test was positive for that movement system impairment. If a motion was associated with lumbopelvic movement but did not provoke symptoms, then it was noted in the exam as a repeated pattern of lumbopelvic movement. Movement tests and the diagnosis of a movement-based impairment have been shown to be reliable in patients with LBP.⁶⁻⁹

During two trunk motion tests, a pattern of lumbopelvic extension and rotation was noted. When the patient performed the motion of a side-bend, there was an associated lumbar movement of lateral shift to the ipsilateral side. She had no pain with side-bending to the right but reported SIJ pain when side-bending to the left. She reported decreased pain when the examiner provided manual support to the trunk, blocking a left lateral shift in the lumbar region during a left side-bend. Due to the patient's report of pain in the SIJ region, the motion was also repeated with manual pelvic compression, but this did not reduce pain. With trunk rotation, she experienced no LBP symptoms but demonstrated decreased rotation excursion to the right. These trunk motion tests indicated that LBP symptoms might be associated with asymmetrical lumbopelvic movement.

During limb motion tests, a repeated pattern of lumbopelvic extension and rotation was again noted. With the motion of a straight leg raise, the patient demonstrated lumbopelvic extension and rotation when lifting each leg. She reported mild LBP symptoms but denied neural tension or SIJ pain. The examiner manually stabilized the patient's pelvis to prevent

lumbopelvic extension and rotation, which decreased the discomfort associated with the straight leg raise. She demonstrated lumbopelvic extension and rotation but no symptoms with the following limb motion tests: single leg stance, sitting knee extension, hip and knee flexion in supine, side-lying hip abduction, and prone hip lateral rotation with the knee flexed to 90°. These limb motion tests indicated that lumbopelvic extension and rotation were repeated patterns of movement and might be a contributing factor to her LBP symptoms with acrobatic activities.^{10,11}

Muscle Strength and Length

The patient's lower abdominal strength was less than 1/5, according to the lower abdominal strength test described by Sahrmann.⁵ When performing the lower abdominal strength test, the patient demonstrated lumbopelvic extension and rotation but reported no pain. She had difficulty recruiting the obliques and transverse abdominus and instead primarily used her rectus abdominus, as indicated by abdominal distension. Lower quarter muscle strength and length tests were performed according to the procedures described by Kendall and coworkers.¹² Manual muscle testing revealed that gluteal weakness was more evident on the left side than the right (Table 1). The 2-joint hip flexor length test demonstrated that the tensor fascia lata (TFL), rectus femoris, and iliopsoas muscles were stiff bilaterally. The TFL was the only hip flexor that was short bilaterally, and the right side was stiffer than the left.

Special Tests

The Cluster tests for the SIJ were performed as described by Cibulka and Koldehoff.¹³ The patient was positive for 3/4 tests, including uneven PSIS alignment in sitting, leg length change between prone with the legs straight to prone with bilateral knee flexion, and forward bend with one PSIS moving higher than the other.

Diagnosis

The patient's diagnosis was consistent with the movement system diagnosis of lumbar extension-rotation syndrome.⁵ Contributing factors included 1. reproduction of symptoms with lumbopelvic extension or rotation during sitting, side-bending, and straight leg raise; 2. repeated pattern of lumbopelvic extension and rotation with trunk and limb motion tests; 3. decreased abdominal and gluteal strength; and 4. short and stiff hip flexors. A differential diagnosis of SIJ dysfunction was considered due to tenderness in the PSIS area bilaterally and positive Cibulka cluster tests. However, she did not have pain relief with compression of the pelvis during the side-bending movement test. Therefore, avoidance of lumbopelvic extension and rotation was the movement based classification used to guide the intervention.

Prognosis

The patient was young, had no medical comorbidities, and was experiencing her first episode of LBP. Additionally, she reported decreased pain with stabilization of the lumbar spine during movement tests. For these reasons, she had a good prognosis, despite the 10-month duration of her current symptoms and the failure of previous conservative care interventions to decrease LBP symptoms.

Intervention

The intervention consisted of 1. education regarding her movement impairments of lumbopelvic extension and rotation and 2. a home exercise program minimizing lumbopelvic extension-rotation while improving abdominal and gluteal muscle recruitment and hip flexor flexibility.

Education—The Patient-Specific Functional Scale was used to discuss which activities were the most important to her and her current difficulty and pain with those activities (Table 1). Based on this discussion, the patient was given advice on how to manage her symptoms during daily and circus activities. For daily activities, the patient was instructed to avoid lumbopelvic extension and rotation during sitting by avoiding crossing her legs and using the back of the chair to support a neutral spine. Additionally, she was instructed to improve her sleeping posture by using a pillow between her knees at night.

Specific recommendations were given to limit her activity level during circus training. These included terminating all activities that required end-range lumbar extension, such as back walkover or rotation as in hula hooping. Aerials were the most important activity for her to resume since they were most commonly used in performances. In order to help her stay active and manage her symptoms, she was instructed to do only two or three acrobatic activities per day and then track how long she had pain afterward. If she had pain longer than 15 minutes, she should reduce her amount of activity or replace the most aggravating activity with a less vigorous one.

The patient's mother was also instructed in a taping technique of the low back to help control the amount of lumbopelvic extension and rotation (Fig. 1). The patient reported immediate pain relief with the tape, and it allowed her to spend a longer period of time sitting and performing acrobatic activities with less pain. The taping technique also gave her proprioceptive feedback so that she could feel when she started to extend or rotate in her low back.

Home Exercise Program—The home exercise program consisted of a progression of exercises in four phases, which each lasted for about 1 month (Table 2). Patient education on movement impairments was reinforced with the home exercise program, which was practiced during clinic visits. Feedback was provided to the patient at each visit, and she was given cues on how to minimize lumbopelvic extension and rotation with all exercises. Initially exercises focused on muscle recruitment. For example, to minimize substitution of other muscle groups during abdominal exercises, she was cued to avoid abdominal distension and relax the hip flexors (Fig. 2A). For the gluteal exercises, she was cued to use the gluteus maximus for hip extension rather than the hamstrings or lumbar extensors and to use the posterior gluteus medius for hip abduction rather than TFL (Fig. 2B). These exercises were performed the maximum number of repetitions possible while maintaining neutral lumbopelvic alignment, often only 5 to 10 repetitions, 3 times per day. Once the patient demonstrated that she was consistently able to control lumbopelvic motion with a specific exercise, the physical therapist progressed to the exercises of the next phase.

In phase II, the patient was better able to recruit the targeted muscle groups and so exercises progressed to focus on strengthening (Table 2). Abdominal and gluteal exercises were done on alternating days for 3 sets of 10 to 15 repetitions. The abdominal exercises were progressed to include trunk stabilization with increased leg range of motion, upper extremity movements, and trunk extension. The purpose of the prone back extension exercise was to help the patient resume pain-free trunk extension. For this exercise, she was instructed to recruit her lower abdominals to stabilize the low back while allowing more extension in her upper back and hips. The gluteal exercises were also progressed to include larger dynamic movements of the legs as she was able to maintain a neutral lumbopelvic alignment.

During phase III, the abdominal and gluteal exercises were progressed with both increased resistance and inclusion of balance training (Table 2). The extent of the balance challenge included in her home exercise program depended on her ability to perform the exercise with minimal increase in lumbopelvic extension or rotation in the clinic. Also during this phase, the frequency of the home exercise program was decreased to only a few exercises 3 days a week to balance her increased activity level with resumption of more circus activities. Tape was used more frequently to help manage symptoms during resumption of a higher level of activity.

In the last phase of therapy, exercises focused on integrating the muscle recruitment, strengthening, and balance components from previous phases into activities used in the circus (Table 2). The integration of physical therapy exercises with circus-specific activities was based on research demonstrating limited carryover of postural control in one position to postural control in another position.¹⁴ Therefore, in general, exercises were progressed from lying down to standing to being upside down (Fig. 2). As the patient gained the ability to control lumbopelvic extension and rotation in each position, she was instructed to think about the same control during acrobatic moves that transitioned through similar postures. For example, the original exercises of supine unilateral hip and knee flexion and side-lying hip abduction were repeated in a handstand position to simulate her need for lumbopelvic control during activities in which she was upside down (Fig. 2B). Hula hooping, which involved controlling 10 weighted hula hoops at once on multiple body parts, was one of the last activities that she was able to resume due to pain limitations. In standing, she did circling movements with her head, arms, upper back, and legs. Initially, she did only one movement at a time while minimizing lumbopelvic rotation, then exercises were progressed to using more than one body part, then to standing on a foam surface, and finally with the addition of quick weight shifts. By the end of therapy, she was able to hula hoop with one hoop without pain and was gradually starting to add more hoops.

Results

The patient was seen for a total of 16 visits over 16 weeks. All pain scores decreased over time, except for her last reported “worst pain” score (Table 3). The decreases in her worst pain and average pain over the last week were greater than 2, the minimal clinically important difference for the Verbal Numeric Scale (VNS).^{15–17} On her last visit, she reported 5/10 pain on the VNS during a conditioning class in which she was resuming a wide variety of circus arts activities that she had discontinued due to pain prior to therapy.

While overall her strength improved, at discharge she still had some weakness of the right posterior gluteus medius and abdominals (Table 1).

Her score on the Modified OSW decreased to 2% at discharge from 16% at the start of therapy;³ however, there was little change in her score between most visits (Table 3). The difficulty of five activities chosen by the patient, as measured by the Patient-Specific Functional Scale,⁴ gradually decreased over time (Table 4). By discharge, the length of time that she could sit was no longer limited due to LBP symptoms. She also no longer had LBP symptoms with movements requiring end-range lumbar extension, such as front and back walkovers. However, aerials and hula hooping, which required lumbopelvic rotation, continued to aggravate her LBP symptoms.

After discharge, the patient continued training and performing in the circus arts. At 1 year after completing physical therapy, she reported no pain with circus arts activities and was performing professionally.

Discussion

Athletes often have difficulty complying with cessation of all potentially injurious activities due to external and internal pressures to perform despite pain. The intervention described in this case report began with an assessment of the patient's current acrobatic activities; which of those were most difficult due to LBP, and which were most important for her to resume as soon as possible. This information was used to complete the Patient-Specific Functional Scale and inform decisions as to what activities were continued or discontinued.⁴ We found that having an honest conversation with the patient about how to participate in sports while eliminating the most exacerbating activities was an effective way to assess and progress her home exercise program.

Use of a patient-specific outcome measure is a valuable tool in the individualization of an exercise program for athletes.⁴ Little change between visits was demonstrated by our patient's scores on the Modified OSW.¹⁸ A review of specific activities listed on the Modified OSW, such as personal care and employment or homemaking, did not help guide treatment because there was no quantifiable change over time.¹⁸ In contrast, assessing her difficulty with activities identified on the Patient-Specific Functional Scale helped inform the decision regarding level of activity resumption and focus of her home exercise program. Because of the unique nature of circus activities, a high level of individualized treatment and outcome measurement is needed.

Another key advantage of the intervention was that the patient learned to minimize lumbar extension and rotation during functional and athletic activities. Initially, she had difficulty feeling when her lumbar spine was extended or rotated. However, she gained self-awareness first through verbal and manual feedback during strengthening exercises and then during acrobatic activities. The use of a low back taping technique also helped increase awareness of a neutral spine alignment while simultaneously restricting lumbar extension and rotation. By discharge, she was able to self-correct her alignment during acrobatics.

The described intervention potentially could have been improved by placing a greater emphasis on controlling lumbopelvic rotation in the initial phases of treatment. At discharge, the patient reported continued LBP symptoms when hula hooping with multiple weighted hoops. This continued impairment with rotation-related circus activities may have been recognized sooner if we had included a lower level activity that involved lumbopelvic rotation on the Patient-Specific Functional Scale.⁴ Based on our experience with this case, we recommend including a variety of both high and low difficulty activities on the Patient-Specific Functional Scale.

Conclusion

This case report demonstrates the use of the Patient-Specific Functional Scale and Movement System Impairment examination to individualize treatment for a circus performer with LBP. The patient in this case report was highly motivated to continue acrobatic activities despite LBP symptoms. Using an outcome measure to assess difficulty of activities chosen by the patient was informative when guiding gradual resumption of acrobatics. Education on how to avoid movements associated with LBP symptoms during exercise and performance also facilitated return to acrobatic activities.

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Figure 1.

For the low back taping technique, white tape was applied without tension to protect the skin over the lumbar region. The patient then sat in an un-weighted position by using her arms to support body weight, and her posture was corrected to a neutral position. Inelastic tape was then applied to form an “X” on her low back, with the middle of the “X” centered on the spine. To correct for rotation, the first diagonal was applied with tension to pull the spine back into a neutral position, and the second diagonal was applied with less tension. Horizontal strips were placed as needed for support. Additional strips of tape were applied as she moved into a standing position if needed. Care was taken to ensure that spinal motion but not hip motion was limited by the taping.

Figure 2.
Phases I through IV of exercise progressions for **A**, lower abdominals with hip flexion and **B**, gluteals.

Table 1

Manual Muscle Test (MMT) Grade (Range 0-5) at Initial Evaluation and Discharge

Muscle	Initial		Discharge	
	Left	Right	Left	Right
Gluteus Maximus	4	5	5	5
Posterior Gluteus Medius	3+	4	4	5
Lower Abdominals	< 1		3/5	

Table 2**Home Exercise Program**

Phase	I (1-4 weeks)	II (5-8 weeks)	III (9-12 weeks)	IV (13-16 weeks)
Focus	Muscle Recruitment	Strength	Balance	Performance
Target Muscle Group: Abdominals				
Exercise Description #1 Figure 2A	Hip and knee flexion from a hook-lying position while maintaining a neutral lumbar spine; return to hook-lying	Hip and knee flexion from a hook-lying position with both feet starting on a pillow	Hip and knee flexion from a standing position	Hip and knee flexion from a hook-lying position while in a handstand position
Patient-Specific Instructions	Control the leg movement with your lower abdominals by flattening your abdomen. Initially, recruitment of lower abdominals may be most successful during exhale, which activates the appropriate muscles. Place hands on hip crease to monitor for activation of the hip flexors.			
Exercise Description #2	Hip abduction and lateral rotation from a hook-lying position, return to hook-lying	Hip abduction and lateral rotation from a hook-lying position with varied width between foot and knee flexion angles	NA	Hip abduction and rotation while in a handstand position
Patient-Specific Instructions	Do not let lumbopelvic region rotate as hip abducts. Place hands on hips to monitor for lumbopelvic movement.			
Exercise Description #3	NA	Circling movements of the head, arms, upper back, and legs in standing	Circling movements of the head, arms, upper back, and legs in standing on a foam surface	Circling movements of the head, arms, upper back, and legs in standing with quick weight shifts
Patient-Specific Instructions	Rotate only in specified region and keep lumbopelvic region stable.			
Exercise Description #4	Arm flexion from a quadruped position, return to starting position	Arm flexion and contralateral leg extension in quadruped	Arm flexion and contralateral leg extension in quadruped on a foam surface	For progression see exercise #5
Patient-Specific Instructions	Do not extend or rotate in lumbar spine as arm flexes overhead.			
Exercise Description #5	NA	Back extension with use of arms in prone	Back extension while sitting on a ball	Back extension from a squatting position to arms overhead with TheraBand resistance
Patient-Specific Instructions	Keep abdominals contracted as you move into trunk extension. Focus on extending more in the upper back than the lower back.			
Target Muscle Group: Gluteals				
Exercise Description #1	Hip and knee extension from a hook-lying position while maintaining a neutral lumbar spine, return to hook-lying	Hip and knee extension from a hook-lying position at end of plinth, so that hip is in full extension before returning to start position	Hip and knee extension from a standing position	Hip and knee extension while in a handstand position
Patient-Specific Instructions	Use abdominals to prevent lumbar extension or rotation. Place hands on hips to monitor for lumbopelvic movement. Use the gluteals to extend the hip, rather than hamstrings or muscles of the low back.			
Exercise Description #2 Figure 2B	Hip abduction from a side-lying position	Hip abduction from a side-lying position with TheraBand	Hip abduction in standing	Hip abduction in a handstand position with back of heel lightly pressing into the wall
Patient-Specific Instructions	Place hand on hip to monitor for lumbopelvic rotation.			
Exercise Description #3	NA	Tendus (hip flexion, abduction and extension with knee straight and toes in contact with the floor)	Tendus in relevé (supporting leg in a position of peak heel rise) or hip/knee flexion of the supporting side	Quick tendus as if preparing to start an acrobatic move
Patient-Specific Instructions	Make sure that pelvis is level and do not “sit” or adduct hip on supporting side.			

Phase	I (1-4 weeks)	II (5-8 weeks)	III (9-12 weeks)	IV (13-16 weeks)
Focus	Muscle Recruitment	Strength	Balance	Performance
Exercise Description #4	NA	Forward lunges in standing	Lunges to the front, side, and diagonal	Quick weight shifts as if landing from an acrobatic move
<i>Patient-Specific Instructions</i>	<i>Use hip abductors to support pelvis and prevent hip adduction on supporting side.</i>			

Table 3

Outcome Measures by Phase of Intervention and at Discharge

Outcome Measure	Phase I	Phase II	Phase III	Phase IV	Discharge
VNS (range 0-10)					
Worst pain	10	6	5	2	5
Avg pain	4	4	2	1	1
Lowest pain	1	1	0	1	0
Modified OSW (%)	16	18	Missing	15	2

Table 4

Individualized Activity Measures by Phase of Intervention and at Discharge

Activity	Phase I	Phase II	Phase III	Phase IV	Discharge
Sitting	4	3	0	0	0
Aerials	7	4	2	2	1
Hula hooping	8	NA	NA	0*	0*
Front walk over	9	2	0	1	0
Back walk over	10	4	NA	1	0

NA, not applicable because patient did not perform activity in past week;

*When performed with one hula hoop.