Clinical Case Report Competition

West Coast College of Massage Therapy

April 2012

Third Place Winner

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The effects of spinal segmental stabilization in decreasing radiating low back pain and a posterior pelvic rotation

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The effects of spinal segmental stabilization in decreasing radiating low back pain and a posterior pelvic rotation

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Abstract

Objective: To determine the effectiveness of a structured exercise program to stabilize the lumbar spine, decrease pain, and reduce a posteriorly rotated left ilium. The study focused on examining the effects of core stabilization exercises combined with Swedish massage in order to improve the patient's level of pain and decrease the occurrence of pain in the future.
Methods: The patient was treated five times, each time performing a series of special tests followed by core stabilization exercises, and finishing with Swedish massage to the back and neck. The patient continued to practice the exercises at home, gradually increasing the length and intensity.
Results: By the end of the study, the patient's core strength and stability had improved, and the pelvic rotation was greatly decreased. The patient's pain was less, and her daily activities were completed with greater ease.
Conclusion: Spinal segmental stabilization with incorporation of active patient participation was a significant factor in the resolution of this patient's low back pain. The patient demonstrated a significant improvement in pain free function after the conclusion of the treatment.

Keywords

"Massage therapy", "chronic low back pain", "core strengthening", "segmental stabilization", "disc herniation", "supine-to-sit", "pelvic rotation"

Introduction

Low back pain (LBP) is a common condition affecting up to 50 percent of the general population (França, Burke, Hanada, Marques. 2010), and one of the most common reasons patients seek treatment from health care practitioners (Gregory, Seto, Wortley, & Shugart, 2008). Pain radiating from the lumbar region can indicate a range of pathologies, including severe neurological conditions, disc degeneration, auto-immune conditions, and muscle instability. Although sciatic pain is not specific for lumbar instability, it is present in 99% of cases where patients present with symptomatic lumbar disc pain (Gregory et al., 2008).

Sciatic pain originates in the lower back and radiates down the posterior thigh (Gregory et al., 2008). Within the lumbar spine, different postures and positions can increase pressure on the intervertebral disc. Continued forward flexion of the lumbar spine will increase pressure on the anterior portion of the disc, resulting in the posterior protrusion of the nucleus pulposus into the annulus fibrosis (McGee, 2008). This repetitive pressure may eventually result in pressure on the intervertebral nerves or the lumbar plexus, creating radiating pain in the low back.

The pelvis, the sacrum and the surrounding soft tissue must be addressed when discussing LBP. The lumbar plexus emerges from the intervertebral foramina of the lumbar spine and projects nerves through the muscles originating on the pelvis to the lower extremities. The sciatic nerve has a common site of entrapment at the piriformis muscle originating on the posterior sacrum.

Like in the rest of the body, muscle contractions influence the orientation of the bones creating the pelvic girdle (McGee, 2008). Weak stabilizing muscles and repetitive postures could result in a pelvic torsion, altering the position of the sciatic nerve through the piriformis muscle. Therefore, pelvic torsion could result in low back and sciatic pain (Youdas, Garrett, Harmsen, Suman, & Carey, 1996).

In conjunction with early return to physical activity, specific stabilization of the deep muscles of the low back and core reduces pain and disability in chronic LBP (Muthukrishnan, Shenoy, Jaspal, Nellikunja, & Fernandes, 2009). Therefore, this case study will investigate the effects of core strengthening exercises to improve spinal stability and to decrease the patient's posteriorly rotated left ilium. For the purposes of this study, the deep core muscles will refer to the multifidi, rotators, transverses abdominus, quadratus lumborum and pelvic floor muscles.

Subject Case History

The patient in this case is a twenty six year old woman who has suffered since 2006 from LBP with radiating nerve pain down the left leg. The original method of injury occurred from poor biomechanics while flexing forwards and lifting a heavy load. The patient describes the injury as a sharp, non-specific pain in the low back.

Immediately after the injury, the patient sought a doctor's referral for treatment from a physiotherapist who advised extension based exercises, stretching of the multifidi and

rotatores, and resistance strengthening of the gluteus medius. She was also prescribed Zopiclone to aid in sleeping. She found taking the Zopiclone to adversely affect her work day and ceased taking it. She currently takes Tylenol and muscle relaxants as needed.

Since the original injury, the patient has re-injured her low back twice via the same movement. She found the original physiotherapist's treatment plan to be painful, but does find certain yoga poses to be beneficial. Back pain currently occurs when the patient has been standing for too long, and when the back pain is in acute, both flexion and extension exercises are painful.

Assessment

In order to determine the best course of action, the patient was submitted to relevant special tests in order to discover the specific nature of her pain and where to focus treatment (see Table 1). The patient also performed two functional tests: a toe touch, and a squat and rise. The toe touch was completed with no pain and good functional range of motion. The squat and rise resulted in no pain, but some shakiness returning to a standing position.

Due to the results of the tests and the dynamic nature of the patient’s pathology, the study uses six special tests at the beginning of the treatment, as well as assessing core strength improvement. Prior to treatment, the patient was asked to perform: squat and rise, L-spine quadrant test, Valsalva maneuver, SI squish test, SI gapping test and supine-to-sit. Core

strength was assessed using protocols contained in Therapeutic Exercise (Kisner & Colby, 2007) (see Table 2).

Prior to the patient beginning home care, she was capable of engaging the core muscles for the full minute at phase one, but began to feel pain and shaking at 45 seconds of phase two. In phase three, the right leg is extended to 45 degrees, followed by the left. To ensure that muscles were not being strengthened asymmetrically, the patient alternated which leg she would begin with during home care. For charting purposes, the treatment consistently began with the right leg in 45 degrees of hip flexion and then tested the left.

Table 1 – Special tests and results

Region	Special Test*	Result
Lumbar spine	*L-Spine Quadrant test*	Negative (Patient stated this test would be impossible "on a bad day")
Lumbar spine	*Segmental Instability*	Negative
Lumbar spine	*Dural Slump*	Negative
Lumbar Spine	*Straight leg raise*	Negative
Lumbar Spine	*Valsalva*	Positive – Pain in L1-L3 area
Pelvis	*Forward Flexion*	Positive for SI restriction on Right side
Pelvis	*Standing Flexion*	Positive for SI restriction on Right side
Pelvis	*Seated Flexion*	Positive for SI restriction on Right side
Pelvis	*Knee to Shoulder*	Pain in anterior hip
Pelvis	*Sacrotuberous Ligament Stress test*	Pain in inguinal ligament
Pelvis	*Supine to Sit*	Left leg moves short to long = Posterior rotation of Ilium
Pelvis	*Pubic Shear*	Positive – Pain on Left SI joint
Pelvis	*SI Gapping*	Positive – Pain not specific
Hip	*Trandelenburg*	Negative
Hip	*Flamingo test*	Negative

* All tests were performed according to the procedure in McGee's *Orthopedic Physical Assessment, 5th Ed*

Table 2 – Core strengthening phases and protocols

Phase	Protocol
1	*Position – Supine* 1. Engage core muscles 2. Rotate pelvis so spine is flat against the table 3. Hold for 1 minute
2	*Continue from step 1* 1. Engage core muscles 2. Slowly raise both legs to 90 degrees of hip flexion and 90 degrees of knee flexion 3. Hold for 1 minute
3	*Continue from step 2* 1. Slowly extend right leg to 45 degrees of hip flexion with knee straight 2. Hold for 1 minute 3. Bring right leg back to 90 degrees of hip flexion 4. Slowly extend left leg to 45 degrees of hip flexion with knee straight 5. Hold for 1 minute 6. Bring left leg back to 90 degrees of hip flexion
4	*Continue from step 3* 1. Slowly extend both left and right legs to 45 degrees of hip flexion with knees fully extended 2. Hold for 1 minute

The assessment also determined a baseline for pelvic rotation using the supine-to-sit test. Since the left leg moved from short to long, the assessment measured the distance between the left and right malleolus before and after each treatment. Prior to treatment, the left malleoli was 5mm above the right malleoli (measuring with a standard measuring tape from the center of each malleoli) in supine. When seated, the left malleoli measured 2mm below the right, indicating that the left leg moved a total of 7mm during the test.

During assessment, the patient stated that the pain is usually centralized to the left low back, and then travels down the sciatic pathway into the left leg. Occasionally, muscle spasms occur around the lower thoracic spine. Other than her back pain, she has no other health concerns and is very active. However, when her back pain is acute, she has serious difficulty with simple daily activities. The patient estimated that flare ups of varying levels of severity happen approximately every eight weeks.

Treatment Plan

Due to the probable causes of the patient's LBP and her particular signs and symptoms, the researcher and patient formulated three specific treatment goals: increasing core strength, decreasing hypertonicity in the lumbar spine erectors, and decreasing the posteriorly rotated left side of the pelvis.

Judging by the hypertonicity and the tenderness upon palpation of the patient's lumbar erector muscles, it may be that the lumbar erector muscles are creating protective muscle

spasms in order to compensate for weakness in the deep core muscles. These uneven spasms and weaknesses may also be contributing to the pelvic rotation via the direct muscle attachments of muscles such as transverse abdominus, quadratus lumborum and iliocostalis lumborum onto the ilium. Therefore, core strengthening and decreasing hypertonicity and spasm could ease the patient's pain prevalence of acute LBP.

The study consisted of five treatment sessions over the course of eight weeks in 2011. Each treatment was scheduled for 1 hour and fifteen minutes long and followed the exact same format.

Treatment Protocol

1. *Interview (5 minutes)*

2. *Postural Assessment (3 minutes)*

3. *Functional/Special Tests (10 minutes)*
   a. Squat and Rise
   b. L-Spine Quadrant test
   c. Valsalva test
   d. SI Squish test
   e. SI Gapping test
   f. Supine-to-sit test

2. *Core strengthening (5 minutes)*
   (see protocol under Assessment)

3. *Swedish treatment of low back and neck (30 minutes)*
   a. Effleurage full back
   b. Palmar stroking of erector muscles
   c. Knuckle stroking to L-spine erector muscles
   d. Fingertip stroking to quadratus lumborum
   e. Fingertip stroking to L-spine erectors
   f. Effleurage to neck and shoulders
   g. Fingertip stroking to upper trapezius and scalenes
   h. Open-C technique to upper trapezius
   i. Fingertip stroking to levator scapula

4. *Reassess Supine-to-sit test (2 minutes)*

5. *Go over home care procedure (5 minutes)*

The patient's home care was based on the core strengthening assessment during treatment. When she was able to hold a particular phase for 1 minute without pain, the study would move on to the next phase. That phase then became included in the home care that she would practice 1 to 2 times a day until her next treatment.

Outcomes

The two main performance outcomes for this patient were measuring the improvement of core stability, and the decrease in discrepancy of the leg movement in her supine-to-sit test (see Table 4).

Core strength was significantly improved over the course of treatment (see Table 3). By the third treatment, she had no problems holding phase two with no shaking or pain. By the final treatment, she could maintain 45 degrees of hip flexion in the right leg, and minimal shaking and pain on the left side during phase three.

Table 3 – Core strengthening outcomes

Core Strengthening Outcomes							
Phase	1 – Oct. 13	2 – Nov. 3	3 – Nov. 8	4 – Nov. 18		5 – Dec. 8	
1	No pain	No pain	No pain	No pain		No pain	
2	45s = shaking/pain	55s = shaking/pain	No pain	No pain		No pain	
3			*Right side* 10s = shaking 40s = pain	*R side* 20s = shaking 50s = pain	*L side* 10s = shaking 55s = pain	*R side* No pain	*L side* 15s = shaking 50 sec = pain
4	**Did not reach phase four during treatment**						

The supine-to-sit test showed improvement in pelvic alignment. At the beginning of the study, the left malleolus was 5mm above the right in supine. By the end of the study, the left and right leg was even in both supine and seated positions, post treatment (see Table 4).

Table 4 – Supine-to-sit outcome markers pre/post-treatment

Supine-to-sit Outcome Markers				
	Pre- Treatment		**Post-Treatment**	
Tx #	*Supine*	*Seated*	*Supine*	*Seated*
1 – Oct. 13	L 5mm above R	L side = R side	L 5mm above R	L 2mm below R
2 – Nov. 3	L 5mm above R	L side = R side	L 5mm above R	L 1mm below R
3 – Nov. 8	L 3mm above R	L side = R side	L 3mm above R	L side = R side
4 – Nov. 18	L 2mm above R	L side = R side	L side = R side	L side = R side
5 – Dec. 8	L 2mm above R	L side = R side	L side = R side	L side = R side

Table 5 – Valsalva test outcomes

Valsalva Test Outcomes	
Tx 1	**Positive** Centralized, uncomfortable pain. Does not recede.
Tx 2	**Positive** Centralized, dull ache in L4-L5. Does not recede.
Tx 3	**Positive** Centralized ache. Recedes after three seconds.
Tx 4	**Negative**
Tx 5	**Negative**

The Valsalva test showed improvement throughout the study (see Table 5). At the start of the study, the patient's pain was acute and did not recede. By the fourth treatment, the patient had no pain during the test.

During the course of the study, the patient had no acute flare-ups of back pain. There was noticeably decreased hypertonicity in the lumbar erectors by the end of the five treatments, and her functional test (squat and rise) was no longer shaky in returning to standing

Discussion

Due to the complex nature of chronic LBP, the study focused on two possible causes with one possible solution. If the patient had a disc herniation due to weak core musculature and poor ergonomics, the nerve roots in the lumbar spine would be compressed and she would have pain in the low back and possibly down the leg. Due to the instability, the body would respond with protective muscle spasms. Left untreated, the spasm in the lumbar erectors and quadratus lumborum could affect the position of the pelvis (Youdas et al., 1996). Asymmetrical spasm results in asymmetrical rotation, allowing the piriformis on one side to become restricted around the sciatic nerve. This impingement will result in radiating pain down the leg and to the foot.

Spinal segmental stabilization (core strengthening) is a well documented and effective course of treatment for all kinds of LBP (Muthukrishnan et al., 2010), particularly back pain due to probable disc herniation with a radiating pain component. Therefore, regardless of whether she had a compression of the sciatic nerve at the piriformis or a

disc herniation compressing the lumbar plexus, the hypothesized solution was to stabilize the spine with core strengthening.

Segmental stabilization yielded significant results for this patient. She completed the exercises daily with increasing ease, and her pelvic rotation gradually decreased. By the end of the treatment, instead of having a 7mm difference from supine to seated, the medial malleoli were level, pre and post treatment.

After the conclusion of the study on December 8th, the patient ceased practicing her home care regularly. Two months after the last treatment, she experienced a flare up leaving her unable to use the toilet without severe pain. Due to the intense nature of the pain, she was unable to perform her exercises and resorted to medication. After taking Tylenol and muscle relaxants for two weeks, she was able to continue her home care. Since that point, she has not experienced an acute episode of pain. According to Moffett et al. (1999), core stabilization has beneficial effects one year after beginning treatment, with patient adherence to their treatment plan. Patients practicing specific stabilization exercises also function better in the long term than those who do not. Return to activity is highly recommended, since regular graded exercise programs have demonstrated better assistance in recovery and preventing recurrence (Legier, 2004).

Limitations

This study involved only a single individual and therefore may not be representative of the general population. Without the controlled conditions of a larger sample size, conclusions about causal relationships cannot be made. Much of the information

collected regarding the patient's injury is retrospective data, and is therefore subject to temporal telescoping and selective memory biases. Patient adherence to the home care routine was not exactly as originally stated in the treatment outline, and during the course of the study, the patient continued with her daily life. She continued with her job, and during the treatment she moved houses. The heavy lifting that accompanies moving could have aggravated her back and created more compensatory muscle spasms.

Conclusion

Over the course of the treatment schedule the patient showed marked improvement in all her baseline measurements. At the beginning of the study, the supine-to-sit test showed a 7mm discrepancy between legs. By the end of the study, the legs were even in both positions, and the Valsalva test was negative for the final two treatments. She reported no back pain and no sciatic pain in her final treatment, and the hypertonicity in her lumbar erector muscles was decreased.

Spinal segmental stabilization with incorporation of active patient participation was a significant factor in the resolution of this patient's LBP. Since there was no original doctor diagnosis of her pathology, it is impossible to say that her pain is cured. However, spinal segmental stabilization played a role in assisting this patient with the management of her non-specific chronic LBP. Further study is needed to replicate the results found here on a larger population size.

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