Journal of Spine Care

Case Report ISSN: 2398-970X

Use of taping to maintain centralization in a patient with low back pain with sciatica

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Introduction

Low back pain with leg pain is a condition that is commonly encountered in physical therapy [1]. A preliminary goal in treating these patients is to centralize their peripheral symptoms [2], as Skytte *et al.* [3] reported that patients that did not centralize were 6 times more likely to undergo surgery. The centralization phenomenon is defined as "the progressive retreat of the most distal extent of referred or radicular pain toward or to the lumbar midline [4]. Put simply, the leg pain gets better and "centralizes" to the back. In the Treatment Based Classification of Delitto *et al.* [5] patients whose symptoms centralize with a movement in one direction and peripheralize with an opposite movement are placed into a specific exercise classification [6].

Centralization has been shown to have value as a prognostic indicator of outcomes [3,7,8]. Wernecke and Hart [7] found that centralization of symptoms led to significantly fewer visits, and Donelson *et al.* [9] reported excellent and good outcomes in 98% of "centralizers" symptomatic for 4 weeks or less. Skytte *et al.* [3] reported that centralizers had less disability and required fewer surgeries at one year. Interpretation of centralization by health care providers is reliable, and consistently associated with a improved prognosis and patient outcomes [3,7-12].

Patients with low back and leg pain often exhibit a "directional preference," [2,13,14], which is defined as "the situation when movements in one direction will improve pain and the limitation of range, whereas movements in the opposite direction cause signs and symptoms to worsen [14]". If a patient has a decrease of pain with extension, for example, the pain is frequently exacerbated by flexion [9,15-19]. Centralization of symptoms commonly occurs when the patient moves in the direction of preference [14]. Long *et al.* reported that patients who received exercises matching the directional preference had significant reductions in pain and medication use and improved in all other outcomes (disability, degree of recovery, depression, and work interference). Delitto *et al.* [5] have devised a Treatment Based Classification (TBC) for low back pain. In this classification system, patients that display centralization of symptoms with extension and a peripheralization of symptoms with flexion are placed into the specific exercise extension syndrome classification [5,6,20]. The proposed treatment for this classification includes extension exercises and avoidance of flexion [6,13]. Brennan *et al.* [21] reported in a randomized controlled trial that patients receiving the treatment that matched to their classification in the TBC had better outcomes than patients randomized to an unmatched treatment.

Several studies have examined common factors that exacerbate low back pain. Activities that require lumbar flexion, such as bending forward and sitting, commonly exacerbate low back pain [22-25]. In a study evaluating the daily use and loading of the lumbar spine, Bakker *et al.* [22] found that flexed postures with activities of daily living (ADL's) were 10 times more common than extended postures. Sitting may induce posterior rotation of the pelvis, reduction of lumbar lordosis, and increases in muscle tension and disc pressure, which may contribute to low back pain [26]. Beattie *et al.* [27] found that maintaining lordosis in sitting kept the posterior margin of the nucleus pulposa in a more anterior position.

Clinical experience suggests it is not the centralization of symptoms that poses a clinical challenge; rather it is the correction and maintenance of faulty postures. Centralization of symptoms is of no long-lasting benefit to the patient if they repeatedly adopt postures or positions that cause their symptoms to peripheralize (such as sitting through a 2-hour class or bending over the sink to do the dishes). Lumbar rolls are effective [19,26] but they are a passive device, only address spinal position while seated, and rarely change behavior when not present.

In this case, centralization was achieved via specific exercises and manual therapy, but the patient was unable to maintain centralization with his ADL's, specifically with sitting and doing the dishes. The patient could achieve partial reduction independently, but required additional manual therapy to achieve full centralization of his symptoms. Werneke and Hart [7] stated that poor short-term outcomes in pain and disability were noted if symptoms did not centralize by the seventh treatment visit. As we could achieve full centralization in the clinic, we attempted to devise a plan to allow the patient to maintain centralization outside of the clinic. Taping was applied to the patient's back to maintain the centralization as well as the "avoidance of flexion" prescribed by the TBC [5].

Taping has long been used in the successful treatment of musculoskeletal disorders, including the hip, knee, ankle and foot [28-40]. Anti-pronation taping has been shown to induce changes in foot posture during standing, walking and running [40]. Taping has been shown to be effective in improving ankle proprioception and preventing ankle sprains [36,39]. While no studies to date have examined the effect of taping on low back pain, it is theoretically possible that tape could provide pain relief and a proprioceptive effect on the low back.

The purpose of this case report is to describe the management

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Received: October 19, 2016; **Accepted:** November 14, 2016; **Published:** November 17, 2016

of a patient with low back and lower extremity pain using extension exercises, manual therapy and taping to facilitate and maintain centralization of symptoms and improve function.

Case description

Historical examination

A 19-year-old male was evaluated following a 1 year history of low back pain. The patient did not recall one specific incident where he injured his back, but related the onset of back pain to skiing one year earlier. The patient's past work history included construction work, and he recalls his back hurting after work occasionally. His back pain had been constant but stable for the previous 11 months, but 4 weeks prior to presenting to physical therapy he had the onset of left leg pain with numbness and tingling down the posterolateral thigh to the medial border of the foot. A Magnetic Resonance Imaging study (MRI) conducted three weeks prior to this encounter revealed an L4-5 left paracentral disc protrusion obscuring the left L5 nerve root.

The patient had 3 sessions of chiropractic treatment several weeks prior to presenting to physical therapy. According to the patient, these treatments included lumbar rotational "adjustments" and offered no improvement. The patient was referred to physical therapy with a diagnosis of "L4-5 paracentral disc protrusion with left sciatica." At the time of the initial visit to physical therapy, the patient complained of radiating pain with bending forward and turning to the left. Sitting was much worse than standing, but he still had pain walking.

Self-report measures

The patient rated his current pain at a 4 or 5/10 on a Numerical Pain Rating Scale (NPRS) [41]. Stratford and Spadoni [41] reported the intraclass correlation coefficients (ICC) of the NPRS ranged from 0.64-0.86 and Childs *et al.* [42] reported that the minimum detectable change (MDC) was 2 points. The patient stated the pain had been as high as an 8/10 in the previous 24 hours. He did not relate a specific pattern to the pain, but did say that bending forward and turning to the left increased his leg pain. He also indicated that his left leg felt "weak" when going up and down stairs. His reason for seeking care was to get rid of the leg pain and can return to skiing. The patient was a university student, and his back and leg pain were interfering with sleeping, sitting through class and studying. His recreational activities were also limited. A systems review (assessed via an intake form) revealed that the patient was in good health and had not had any significant past medical problems. His initial Modified Oswestry Disability Index (ODI) score was 46 [43-46]. Davidson and Keating reported that the ICC for the modified ODI ranged between 0.84 and 0.92 and the MDC ranged between 10.5 and 15 [43]. Fritz and Irrgang [46] reported that the ICC for the modified OSW was .90, and the MDC was 6 points.

Physical examination

The MRI results indicated that the patient had a left paracentral disc protrusion. Studies have shown that a percentage of asymptomatic subjects have disc pathology [47-52]. The TBC avoids specific pathoanatomical diagnoses [5], but it is still clinically useful to attempt to determine if the identified pathology correlates with the patient's presenting symptoms [53]. Since the MRI revealed that the protrusion was obscuring the left L5 nerve root, the lumbar and sacral nerve roots were examined via myotomal testing, deep tendon reflexes, straight leg raise, and sensory testing. As the patient complained of weakness and leg pain, an attempt was made to determine if the identified lesion was contributing to the patient's impairments. It was noted that the patient had a weak extensor hallucis longus (EHL), an absent left Achilles tendon reflex, a positive ipsilateral and contralateral straight leg raise, and decreased sensation to sharp/dull over the L5 dermatome. Vroomen *et al.* [54] reported the kappas for weakness of the extensor hallucis longus, absent ankle tendon reflex and sensory loss were 0.82, 0.52 and 0.71 respectively in patients with suspected lumbar nerve root involvement. Hsieh *et al.* [55] reported intersession reliability of 0.88 for the straight leg raise measured with a standard goniometer. The lumbar spine was examined via active, passive and accessory motions to identify key physical examination findings that would assist in classifying the patient in the TBC [5,6]. The goal with the range of motion assessments was to determine if any positions or motions aggravated or relieved the patient's symptoms [2,5,8,9,56-61]. This is useful information as it leads directly to interventions the clinician can use, and identifies possible contributing factors such as poor posture [2,5,8,9, 25,56,60-64].

Tests and measures

Observation of posture revealed decreased lumbar lordosis in standing (evidenced by a flat lumbar spine and a decreased anterior tilt when the orientation of the anterior superior iliac spine was assessed in relation to the posterior superior iliac spine). Vroomen *et al.* [54] reported a 76% agreement between examiners when assessing a decrease in lumbar curvature. No lateral shift of the spine was noted. Razmjou *et al.* [65] reported the kappa for interrater agreement for presence of lateral shift was 0.52. The patient had poor seated posture with complete loss of lumbar lordosis and a forward head position. Fedorak *et al.* [66] found that the intrarater reliability of the visual assessment of cervical and lumbar lordosis was fair (kappa=0.50). Sitting for longer than 1 minute caused peripheralization of pain down the posterior thigh to the foot.

Gait analysis revealed decreased stance time on the left leg and decreased hip extension on the left at pushoff. Youdas *et al.* [67] reported an intertester reliability of 0.88-0.98 for the temporal aspects of gait in a clinical setting.

Active range of motion into flexion was measured from the tip of the third finger to the floor (fingertip-to-floor) [68], extension was measured qualitatively, lateral flexion was measured as the distance from the end of the third finger to the floor [69] and thoracolumbar rotation was measured with a long arm goniometer with one axis parallel to anterior superior iliac spine (ASIS) and one axis parallel to bilateral acromions (gross thoracolumbar rotation) [70]. Perrett *et al.* [71] found the fingertip-to-floor test to have excellent validity, reliability (ICC=0.99), and responsiveness. Lewis *et al.* [69] found that the fingertip-to-floor measurement had an interrater reliability of 0.96-0.99 for flexion and 0.86-0.96 for lateral flexion. Interrater reliability for thoracolumbar rotation has been reported to be poor to fair with kappa statistics ranging between 0.23 and 0.42 [70]. The patient presented with a gross limitation of flexion that reproduced his leg pain, decreased extension, and limited lateral flexion and rotation left greater than right.

Repeated active motions were performed as described by McKenzie [2], and the results are summarized in Table 1. Repeated movements have been found to be a reliable part of a spinal examination [14,59,65,72]. Fritz *et al.* [59] reported excellent interrater reliability of judgements of status change (kappa=0.823) with single, repeated and sustained movements. Razmjou *et al.* [65] reported that using repeated movements to define the centralization phenomenon and directional preference, agreement was 95% (kappa=0.7; P<0.002). The TBC of

Delitto *et al.* [5,6] states that a patient whose symptoms centralize with two or more movements in the same direction or centralize with a movement in one direction and peripheralize with an opposite movement should be placed in the specific exercise classification. Fritz *et al.* [6] reported the overall agreement on treatment based classification decisions was 76%. In this case, repeated flexion peripheralized the symptoms and repeated extension (both in standing and lying) centralized the symptoms. Fritz *et al.* [59] defined centralization as the condition in which "a neurological sign is improved, or paresthesia or pain is abolished or moves from the periphery toward the lumbar spine."

Passive physiological and passive accessory intervertebral motions (PPIVMs and PAIVMs) were performed as described by Maitland [73]. PPIVMs were assessed in sidelying. The vertebral segments were moved passively through a range of motion to assess any decrease or increase in motion as well as reproduction of symptoms. The author acknowledges that these examination techniques have questionable reliability [74-76], but Fritz *et al.* [77] found that lumbar spine mobility assessment can be useful in determining patients that may benefit from manipulation or lumbar stabilization. PPIVMS and PAIVMS may, therefore, have validity for clinical management of patients [77,78]. The patient presented with decreased passive lumbar flexion that caused an increase in low back pain. Passive extension was decreased at L4/5 and L5/S1 but was not painful. Sidebending left was decreased, as was left rotation. Left rotation also increased leg and back pain. Right rotation was limited and caused left low back pain but centralized his leg pain. PAIVMs consist of central posterior to anterior motions, unilateral posterior to anterior motions and transverse motions [78]. The patient was found to have decreased central and left unilateral PAIVMs at L4 and L5.

Manual muscle testing was performed as described by Kendall [79]. Weakness was found in the left extensor hallucis longus, the flexor hallucis longus and the hamstrings. The patient also had weak lower abdominals as he was not able to maintain his lumbar spine in neutral with level I lower abdominal exercises as described by Sahrmann [80]. The patient had a difficult time contracting his transversus abdominis and was also not able to fire his multifidus on the left [81-83], even with repeated cueing and tactile feedback [84]. Observation revealed atrophy over the left L4/5 and L5/S1 lumbar multifidus. Paraspinal spasm was noted with palpation from L1-L5 left, and increased tone and pain was noted in the left quadratus lumborum. Boline *et al.* [85] reported that visual observation of the lumbar spine musculature produced kappa coefficients that ranged from 0.34-0.84 and the kappas for palpation for soft tissue pain ranged from 0.40-0.79.

Neurological examination revealed 1+ patellar tendon reflexes bilaterally while the Achilles tendon reflex was 1+ on the right and absent on the left. As reported earlier, the agreement between two examiners on the absence of the Achilles tendon reflex is 86% [54]. Straight Leg Raise testing was positive on the left for reproduction of back and leg pain in a dermatomal distribution [54] at 20 degrees and the right at 45 degrees (contralateral straight leg raise). Vroomen *et al.* [54] reported a kappa for a positive SLR in a dermatomal pattern to be 0.68 and the kappa for crossed SLR was 0.70. The straight leg raise has been shown to have good sensitivity while the crossed straight leg raise has good specificity [86]. Sensory testing revealed decreased perception of light touch and sharp/dull along the L5 dermatome on the left. This was most prominent on the medial border of the foot. Vroomen *et al.* [54] reported a kappa of 0.71 for sensory loss in patients with suspected lumbar nerve root involvement.

Identified impairments included pain with lumbar flexion and left rotation as well as left lower extremity weakness and decreased sensation in left leg. The patient had poor posture with decreased lumbar lordosis.

Functional limitations identified in the initial examination included:

1. Inability to sit longer than 10 minutes without severe back and leg pain.

2. Unable to walk longer than 10 minutes without pain.

3. Unable to sleep longer than 2 hours without waking.

4. Unable to perform ADL's (such as brushing teeth and washing dishes) without pain.

5. Unable to perform recreational activities.

Evaluation

The examination and MRI results implicated the L4-5 intervertebral disc as the cause of the patient's back and leg pain. The goal of the examination was to reproduce the asterisk sign (i.e., the patient's back and leg pain) [79], and identify movements and postures that either centralized or peripheralized the patient's pain. In the TBC, if the patient's symptoms centralize with a specific movement (flexion, extension or pelvic translocations), he or she is placed in the specific exercise classification [5,21]. Movements that centralize symptoms are used for treatment, and movements or postures that peripheralize symptoms are avoided [2,5,13,21,59]. As stated previously, a primary treatment goal in patients with radiating leg pain is to centralize the patient's pain, as this has been shown in numerous studies to correlate with an improved outcome [1,7-12].

Diagnosis

Examination findings corroborated the MRI findings which had diagnosed an L4-5 left paracentral disc protrusion obscuring the left L5 nerve root. The patient had peripheralization of his symptoms with flexion and left rotation, decreased DTR's, decreased strength and sensation in the left lower extremity, and a positive straight leg raise and crossed straight leg raise. The straight leg raise test has a sensitivity of 72-97% and a specificity of 11-66% [47,50]. The crossed straight leg raise has a low sensitivity but a high specificity of (85-100%) for lower lumbar disk pathology [47,50]. According to Delitto *et al's* Treatment Based Classification, a physical therapy diagnosis was made that placed the patient in the specific exercise classification with an extension syndrome [5,6,20]. The Guide to Physical Therapist Practice would classify the patient as Practice pattern 4F: Impaired joint mobility, motor function, muscle performance, range of motion or reflex integrity secondary to spinal disorders [87].

Numerous Studies have shown that if the intervention can centralize the patient's symptoms, they vastly improve the likelihood of a favorable outcome [4,7,8,10-12]. The main goal in treating this patient was to centralize his symptoms (get the pain out of his leg) and progress him to stage II of the TBC as soon as possible. Stage II focuses on addressing impairments and improving function [5]. It is the author's experience that if the pain can be centralized but the patient has a difficult time maintaining centralization with function, taping can facilitate a more rapid transition to stage II of the TBC.

The following goals were set after the initial session:

Short term goals:

1. Decrease modified Oswestry score by 10 points in 2 weeks.

2. Improve posture through education and taping to allow the patient to sit 1 hour with pain ≤ 3/10 in 2 weeks.

3. Patient will be able to sleep through the night (not awakened by pain) in 2 weeks.

4. Centralization of patient's leg pain to allow walking 1 mile with no leg pain in 2 weeks.

5. Independent in self correction of peripheral symptoms in 2 weeks.

Long term goals:

1. Decrease modified Oswestry score by 50% in 6-8 weeks.

2. Patient will be able to wash dishes and brush his teeth with no pain in 4 weeks.

3. Patient will be able to sit 2 hours painfree during class in 4-6 weeks.

4. Patient will be able to able to walk and perform recreational activities (not including skiing) with pain no greater than 3/10 in 6 weeks.

5. Patient will be independent in a home program for range of motion and strengthening in 6 weeks so that he can manage symptoms independently.

6. Patient will be able to able to return to skiing not limited by back or leg pain in 8-12 weeks.

Criteria for discharge included complete centralization of the patient's symptoms, ability to sit for two hours with no increase in pain, and independence in self-management of symptoms. It was emphasized that self-treatment is infinitely preferable to dependence on therapy. The patient's goal of returning to skiing would probably not be met before we finished formal physical therapy, so it was explained to the patient that his back should be relatively painfree with no functional limitations for a period or 4-6 weeks before he returned to skiing.

Intervention

The examination revealed that flexion and left rotation caused a peripheralization of the patient's symptoms. Therefore, the intervention strategy would include:

1) Patient education regarding the condition and movements and postures that are to be avoided [5].

2) Active movements to centralize symptoms and restore motion [5,50].

3) Joint mobilizations to centralize the symptoms, restore range of motion and decrease pain [2,79].

4) Taping of the lumbar spine to assist in the "avoidance of flexion" prescribed by the TBC for patients classified into the extension syndrome.

5) Lumbar stabilization exercises to ensure that the patient had the strength and endurance to maintain functional posture with his activities of daily living and potentially reduce the likelihood of recurrence [84,88].

The intervention began with postural education to avoid postures and movements that peripheralized the pain. This included educating the patient on the concepts of a neutral spine and how to maintain this in sitting and standing. This was followed by biomechanical counseling to teach the patient how to lift and perform ADL's while maintaining a neutral lumbar spine. In a study evaluating the daily use and loading of the lumbar spine, Bakker *et al.* [22] found that flexed activities were 10 times more common than extended ones. Sitting may induce posterior rotation of the pelvis, reduction of lumbar lordosis, and increases in muscle tension, disc pressure, and pressure on the ischium and coccyx, which may be associated with low back pain [26].

Extension in lying exercises, as described by McKenzie [2], were prescribed based on the examination results and the classification of the patient into the extension syndrome of the TBC. In this case, the patient had increased pain and peripheralization of his symptoms with lumbar flexion, and centralization of symptoms to the buttock with repeated extensions. He was instructed in a home program of extension in lying consisting of 10 repetitions every two hours. If he could not find a place to perform the exercises, he would be instructed to do the extensions in standing. Flexion would be reintroduced once the peripheral symptoms had resolved.

Lumbar rotations and prone central and unilateral P–A's were used to help centralize the symptoms as an adjunct to the extension exercises. Both Maitland [79] and McKenzie [2] describe using rotations to the opposite side of the symptoms to assist in centralization of leg symptoms. The examination revealed that right rotation centralized the patient's symptoms and left rotation peripheralized the symptoms. In this case the patient had left sided back and leg pain, so he was positioned in left sidelying with the painful side down and gentle (grades II and III) right rotation mobilizations [79] quickly resulted in a 50-75% reduction in the leg pain (Figure 1). This was followed by

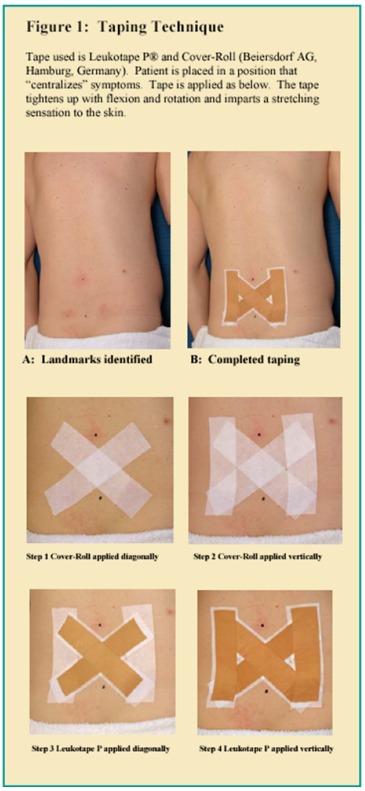

Figure 1. Tapping technique.

prone passive accessory movements of central and unilateral posterior to anterior mobilizations [79] which resulted in a further improvement in centralization.

Full centralization of symptoms was achieved with the treatment described above, but it was noted the patien would have an immediate peripheralization of his symptoms as soon as he attempted to put his shoes on (despite repeated efforts at biomechanical counseling). He also had rapid peripheralization of his symptoms any time he had to sit longer than 10 minutes. One of the main treatment recommendations for the Treatment Based Classification (TBC) specific exercise: extension syndrome is avoidance of flexion [20]. The tape was used to assist the patient in avoiding flexion and possibly improve proprioception, specifically in the presence of a long standing hypolordotic posture [89-91]. Taping the lumbar spine was introduced at the end of the treatment before the patient got up from the table, and allowed the patient to maintain centralization of his symptoms. The taping technique consists of applying strips of Cover Roll along the paraspinals from the first lumbar vertebra to the first sacral vertebra in a vertical fashion followed by two diagonal strips connecting the top of one vertical strip to the bottom of the other vertical strip (Figure 2). Leukotape is then applied over the four strips of Cover Roll to provide extra support. The Cover Roll/Leukotape combination is highly resistant to stretch, and is frequently used in the treatment of patellofemoral pain [29,32,35,37,92]. Patients report that the tape helps them identify movements and postures that may exacerbate or peripheralize their pain, and this helps them to immediately problem solve and generate alternative postures that decrease the stress on their low back. Patients often only need to be taped once or twice before they learn what movements and postures may be harmful. Patients are generally allowed to leave the tape on for up to a week, as long as they do not have any type of skin reaction to the tape [92]. The tape must be removed slowly and the adhesive residue removed with nail polish remover. The patient must inspect the skin for any signs of allergic reaction or skin breakdown. The patient described in this case report had very poor posture, and it was difficult for him to maintain centralization of symptoms without feedback or cues. This led to frequent episodes of peripheralizing pain with daily activities.

Lumbar stabilization exercises were initiated once pain was under control and the patient had progressed to stage II of the TBC. Hodges *et al.* [82,83,93] has demonstrated that the lumbar multifidus and transverses abdominus fire to stabilize the lumbar spine prior to initiating an extremity movement in people without low back pain. Hodges has also found that the firing of these muscles, and, hence, the dynamic stabilization of the lumbar spine is frequently delayed in patients with low back pain [82,83,93]. Studies have shown that there can be atrophy in the lumbar multifidus that does not improve following an acute bout of back pain [94-96].

Figure 2. Lumbar rotations.

It is important to note that while patients in the specific exercise classification are extensively counseled regarding correct body mechanics, it is imperative not to generate a fear of movement [97]. It was thoroughly explained to this patient that flexion and rotation may hinder his recovery at this stage of healing, but that these motions are necessary components of normal movement. It was explained that these motions must be minimized until the symptoms are under control, then the motions can be reintroduced (Actual interventions by session are described in Table 2).

Outcomes

The physical impairments measured during the initial examination and at discharge are listed in Table 3. At the end of the five weeks of treatment, the patient had centralization of his leg pain, full lumbar range of motion, improved straight leg raise, Achilles tendon reflex present bilaterally, and improved motor function. The patient could sit for two hours with no back pain and no leg pain. He demonstrated improved posture with sitting and functional tasks such as bending over a sink. The patient's pain improved from an 8/10 at the initial visit to a 2-3/10 at the discharge visit. His final modified ODI score was a 16. The patient reported improvement in sleeping, personal care, school and work activities, ability to engage in recreational/sport activities, and general function (Table 4 for patient reported outcome measures). The patient's stress level went up, but this could be due to the fact that the discharge visit occurred prior to final exam week.

Discussion

Numerous interventions have been reported for low back pain [98]. Frequently, the etiology is unknown which makes determining the optimal intervention difficult. Identifying subgroups of patients and tailoring the treatment to a specific treatment based classification has resulted in improved outcomes in multiple studies [5,21,99-102]. It has been the author's experience that many times there are gray areas in the classification approach. The patient described in this case clearly fit the specific exercise classification, but also benefited from lumbar mobilizations as well as taping to avoid postures and positions that peripheralized his symptoms. While this treatment was successful, it is possible that other interventions may have been as efficacious or that the patient may have improved over time without intervention.

The specific exercise classification in the TBC calls for exercises and postures that centralize symptoms while avoiding postures and movements that peripheralize symptoms [5,6,20]. The patient in this case had difficulty maintaining good posture, and, hence, centralization of his symptoms. Manual therapy and taping were introduced in an attempt to achieve and maintain centralization of symptoms. The manual therapy techniques were used to facilitate a rapid centralization of symptoms and the taping theoretically provided support and proprioceptive feedback to help the patient avoid symptom producing motions and postures. Spinal stabilization exercises and movements into flexion were introduced when the patient's pain had improved and his symptoms had centralized and become stable [84].

The main new treatment outlined in this case report concerns taping of the lumbar spine. It is described as an adjunct to the examination and treatment approaches pioneered by Maitland [79] and McKenzie [2] as well as the treatment based classification of Delitto *et al.* [5] It is hypothesized that the tape provided a mechanical restraint to lumbar flexion as well as proprioceptive feedback. While

Table 1. McKenzie repeated movements.

Session	Assessment	Treatment
Session 1, Day 1	• Subjective: See history in text • NPRS: 8/10 • Modified Oswestry score: 46 • Objective: See examination in text	• Education regarding condition • Postural counseling (avoidance of flexion) • Extension in lying (EIL) to be done for 10 reps every 2 hours
Session 2, Day 6	• Subjective: Felt great until he had to sit through 2 hour class, then leg pain returned with washing dishes 2 days prior that caused numbness left foot for last 2 days • NPRS: 6-7/10 • Objective: Kyphotic lumbar posture, flexion caused peripheralization of symptoms, SLR + left at 20 degrees	• Left sidelying Right rotation mobs f/b prone left unilateral P-A's at L4/5 grade III (centralized pain) • Prone EIL 10 reps • Taping technique L1-S1, told to take off at end of day and assess skin integrity • Postural education
Session 3, Day 8	• Subjective: Leg pain much better, no return of numbness. Tape "helped" posture, able to sit through 2 hour class with no leg pain and minimal back pain. Once tape was removed, did have increased leg pain with brushing teeth, resolved when he corrected posture. • NPRS: 5/10 • Objective: Achilles reflex present at 1+ (was absent), lumbar extension nearly full, SLR + left at 35 degrees, skin showed no signs of reaction to tape.	• Repeat of session 2 • Body mechanics and posture during ADL's was reassessed and advice was given • Taping was used again at the end of treatment, and the patient was told he could keep tape on for 2-3 days
Session 4, Day 14	• Subjective: Had been feeling much better, in "minor" MVA that caused leg pain to return • NPRS: 4/10 • Objective: Marked limitation of flexion and left rotation with peripheralization of symptoms, left Achilles reflex 1+, SLR + at 25 degrees	• Left sidelying Right rotation mobs f/b prone left unilateral P-A's at L4/5 grade III and IV • Prone EIL 2x10 reps • Inititation of independent activation and tonic hold of transversus abdominis and lumbar multifidus 10x10 seconds
Session 5, Day 16	• Subjective: Leg pain and back pain better, some intermittent numbness in leg since last visit. • NPRS: 3-4/10 • Objective: Flexion to 16" from floor, full extension and rotation, SLR 35 degrees, contralateral SLR 47 degrees, mild restriction left unilateral P-A at L4/5	• Rotation mobilizations discontinued, still had mild restriction and pain with left unilateral P-A's , grade IV mobilizations were performed at L4/5 for 3x30 seconds • EIL 2x10 reps • Progressed to co-contraction of transversus and multifidus in supine, sitting and prone • Lumbar taping
Session 6, Day 23	• Subjective: Not much back and leg pain, mild tingling in foot with driving, able to centralize. Able to sit through class and perform ADL's with no back pain • NPRS: 0/10 at rest, 3/10 at worst • Objective: Flexion to 12" from floor limited by hamstrings, full symmetrical sidebending, Achiles DTR 1+, SLR to 30 degrees, contralateral SLR to 55 degrees	• Progressed to dynamic activation of the transversus and multifidus by superimposing leg movements in supine, sidelying and prone. • Flexion in lying introduced to be followed by immediately by extension in lying 10 reps 3x/day • Tape was discontinued
Session 7, Day 37	• Subjective: No pain currently in leg or back • NPRS: 0/10 at rest, 2-3/10 if he performs ADL's incorrectly • Modified Oswestry score: 16 • Objective: Full lumbar ROM, FHL, EHL and hamstrings on the left 5/5, SLR to 40 degrees, positive slump test on the left.	• Progressed transversus and multifidus exercises to functional activities (contraction while standing, lifting a box, etc.) • Initiated seated nerve glides (neutral spine with knee extension f/b dorsiflexion) 3x10 reps to onset of discomfort • Initiated supine hamstring stretches 30 seconds 2x/day
Phone follow up day 67	• Doing well, no recurrence of back pain.	• Reassurance, encouraged to continue home program
Phone follow up 12 months	• No recurrence in 12 months, did have minor bouts of low back pain (2-3/10), but these never limited his function.	• Reassurance, encouraged to continue home program

Table 2. Actual interventions.

Motion tested	Findings
Side Glide in standing to the right (shifting the trunk sideward and over the pelvis in the direction indicated)	Decreased pain left lower back and leg.
Repeated Side Glide in standing to the right	Decreased pain left lower back and leg.
Side Glide in standing to the left	Increased left low back pain and pain in posterior thigh.
Repeated Side Glide in standing to the left	Increased pain in back and leg down to foot
Repeated Extension in Standing	Increased left low back pain, pain centralized out of leg into back.
Flexion in Lying (bringing the knees to the sides of the chest in supine)	Increased low back and posterior thigh pain.
Repeated Flexion in Lying	Increased low back and posterior thigh pain.
Extension in Lying (pressups in prone, like pushups only the pelvis stays in contact with the supporting surface)	Pain at L4/5, mild buttock pain.
Repeated Extension in Lying	Pain moved entirely into back, no leg or buttock pain. Back pain diminished with each repetition until 10 reps.

there have been no controlled studies evaluating the effect of tape on low back pain, taping has long been used in the treatment of musculoskeletal disorders [28,29,31-40,92,103]. Taping has been shown to be effective in improving ankle and knee proprioception and preventing ankle sprains [36,38,39,104-108]. Simoneau *et al.* [107] concluded that strips of athletic tape applied across the ankle joint of healthy individuals improved ankle joint position perception in nonweightbearing. Refshauge *et al.* [109] did not find that ankle taping enhanced proprioception in the sagittal plane. Allison *et al.* [110] reported that ankle taping did not alter neurophysiological responses

Table 3. Tests and measures utilized for re-examination.

Test/Measure	Initial Visit	Discharge Visit
Posture	Kyphotic lumbar spine in standing and sitting	Able to maintain a neutral spine with sitting and function.
Flexion Active Range of Motion	To 24" from floor with peripheralization of pain to left foot	Full range of motion with only mild pain at end range flexion.
Extension Active Range of Motion	Limited 50% with centralization	Full and painfree
Passive Accessory Intervertebral Motions (PAIVMs)	Back and leg pain with grade III central and unilateral posterior-anterior forces at L4 and L5 (deemed hypomobile by therapist)	Painfree except mild pain with left unilateral P-A at L4/5
DTR	Achilles reflex absent Left	1+ Bilaterally
SLR (left leg)	Positive at 20 degrees for left low back and left leg pain below the knee	Positive at 40 degrees with mild low back pain
Crossed SLR (right leg)	Positive at 45 degrees for left low back pain and left buttock pain	Limited by hamstring stretch at 55 degrees
Sensation	Impaired L5 dermatome	Normal
Manual Muscle Testing	Left extensor hallucis longus 4/5, flexor hallucis longus and hamstrings graded 4+/5	Full Strength
Sitting	1 minute	Able to sit for two hours with minimal back pain, no leg pain
ADL's	Unable to do dishes and brush teeth	No problems with ADL's
Recreation	Unable to participate	Able to ski
Oswestry Score	46	16

Table 4. Outcome measures (standard clinic outcome measure).

Question	Scale Utilized	Response at Initial Visit	Response at Discharge Visit
Do you have difficulty sleeping?	No difficulty=5 My sleep is completely disturbed=1	2	5
Do you have difficulty with personal care (dressing, washing, grooming, etc.)?	No difficulty=5 I am completely dependent on others for my personal care=1	3	5
Do you have difficulty with school or work activities?	No difficulty=5 I am unable to perform any school or work activities=1	3	5
Are you able to engage in recreational/sport activities as you did prior to your injury?	Able to fully participate in pre-injury recreational/sport activities=5 Unable to fully participate in pre-injury recreational/sport activities=1	1	5
Please rate your current level of overall functioning.	I am functioning at my pre-injury level=5 I am at the worst level of functioning since my injury=1	2	4
Please rate your worst pain in the last 48 hours.	Worst pain imaginable=10 No pain=0	8	2-3
Please rate the amount of stress currently in your life.	Worst stress imaginable=10 No stress=0	3	5
Please rate the amount of improvement in your condition since the beginning of your physical therapy treatment. (*Assessed only at discharge)	Complete recovery=5 No improvement=1	*	4
Please rate your adherence with the home program given to you by your physical therapist. (*Assessed only at discharge)	I performed my home program regularly as instructed=5 I never performed my home program=1	*	4

to sudden inversion in normal subjects. Zanella *et al.* [111] reported that scapular taping had no effect on joint repositioning during active shoulder flexion or abduction.

The low back pain episode described in this case had started one year prior to the initiation of treatment. While it is unknown whether the treatments had an effect on the pathology, the improvement of the patient's symptoms, physical impairments and functional limitations coincided with the initiation of classification based physical therapy treatments. The patient was contacted 12 months after discontinuing therapy, and he reported no recurrence up to that point. It has been reported that most episodes of low back pain typically resolve within 6 weeks, and that only 5% of individuals have symptoms lasting longer than 3 months [112], however, a recent study by Tubach *et al.* [113] found that of 622 patients with sciatica, 53% reported continued pain four years after the onset of pain, and of the patients that had recovered from sciatica, 61% continued to have low back pain 2 years later. This data would seem to imply that recovery from low back pain and sciatica is not as common as was once thought.

Further research is needed to determine the effects of the treatments outlined above. To the author's knowledge, there have been no studies examining the effects of taping on low back pain. Does the tape actually improve lumbar spine proprioception? Does it provide any kind of structural support? Does it actually improve a patient's resting posture? Does it change muscle recruitment or firing patterns? Future controlled trials need to be conducted to establish the efficacy of the above treatments alone and in combination.

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