SPECIAL SECTION

Treatment of Low Back Pain Using the MyoRack™ System: Description of the Treatment and Preliminary Findings

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Recent research suggests that surface electromyography (SEMG) abnormalities during flexion are highly associated with low back pain, and specific treatments that target these abnormalities are beginning to emerge in the literature. This article describes one such treatment that uses a device called the MyoRack™ to decrease muscle tension in the low back and improve strength and flexibility in the trunk. Preliminary evidence suggests that the treatment is beneficial in terms of decreasing pain and work interference. In addition, SEMG measures of flexion-relaxation significantly distinguish between persons with and without pain at posttreatment.

Introduction

Historically, biofeedback for the treatment of back pain has focused on training patients to decrease their level of muscle activity in the affected area, and several studies support the efficacy of this approach (Flor, Haag, & Turk, 1986; Keefe, Schapira, Williams, Brown, & Surwit, 1981; Nigl & Fischer-Williams, 1980; Nouwen & Solinger, 1979). In a randomized controlled study, Flor and Birbaumer (1993) found biofeedback to be superior to cognitive-behavioral therapy and conservative medical treatment (primarily physical therapy) among patients with musculoskeletal back pain. Despite these promising results, it is unclear what types of approaches or surface electromyography (SEMG) training are most appropriate for treating back pain or whether treatment should be tailored to the individual needs of the patient based on an evaluation of SEMG activity in the back.

Recent research has suggested that a common abnormality observed in persons with low back pain (LBP) is the absence of a flexion-relaxation response (Geisser et al., 2005). In persons without back pain, SEMG signals from the lumbar paraspinal muscles are generally low while standing. As one bends forward, SEMG activity increases as the lumbar paraspinal muscles support the trunk at a greater angle and then declines as the ligaments begin to bear the brunt of supporting the trunk. When a person reaches terminal flexion, SEMG activity is comparable to, or lower than SEMG levels when standing. In the majority of persons with LBP, SEMG activity tends to remain high when a person is in full flexion.

Neblett et al. (Neblett, 2007; Neblett, Gatchel, & Mayer, 2003; Neblett, Mayer, & Gatchel, 2003) published a treatment protocol for stretching and training subjects with chronic LBP to relax their lumbar paraspinal muscles. This technique has been incorporated into a functional restoration treatment program, and preliminary data indicated that 20 of 22 patients with an abnormal flexion-relaxation pattern prior to treatment demonstrated normalization of this response at the completion of the treatment program (Neblett, Mayer, 2003).

Figure 1. Patient in full flexion on Myorack™ system.
These findings suggest that restoration of flexion-relaxation is associated with successful treatment of chronic LBP.

This article presents another treatment technique designed to increase flexion-relaxation in persons with LBP. Donaldson and Hodgetts (2007) outlined a treatment protocol for LBP with the MyoRack™ system, which is designed to decrease muscle tension and increase trunk strength and flexibility. The authors indicate that an advantage of this system is that it decreases the stress and strain placed on the low back and other muscles as patients are supported through various therapeutic movements. This article describes the treatment protocol followed by a presentation of preliminary data on outcomes associated with this treatment in a group of patients who completed treatment using this technique.

**MyoRack™ Treatment Protocol**

The LBP treatment using the MyoRack™ system consists of a clinically based protocol of facilitated movements using the MyoRack™ to guide a series of forward bends, side bends, extension, and stretches for pelvic asymmetry. The MyoRack™ is designed to allow the patient to reduce strain in the low back muscles during both forward flexion and the return to the upright position. Second, a home-based exercise program is prescribed based on the clinical assessment of each patient undergoing treatment.

**Forward Bends**

The individual places his or her arms over the bolster (the arm sticking out from the body of the MyoRack™) and engages the abdominal muscles. As the patient moves into flexion, the bolster moves through an arc. The bolster is weighted in a manner that allows for the strengthening of
the abdominals and core muscles while allowing the erector spinae and other muscles in the back to stay relaxed and gently lengthen and stretch during flexion.

The patient moves into flexion until it first becomes painful and then stops and relaxes in that position (Figure 1). The individual performs a series of repetitions to relax the muscles and spine while also engaging in breathing techniques until lengthening is felt through the muscles in the low back. The Myorack™ has a carefully counterbalanced weight system, which allows the bolster to return the individual to the upright position while keeping all of the length and space gained in the muscles and spine during flexion.

**Side Bends**

The side bend procedure is identical to the procedure for flexion. The purpose of side bends is to strengthen one side while gently stretching the other. The arm can be positioned in various positions to create further stretching of the latissimus dorsi, thoracic erectors, and abdominals (Figures 2 and 3).

Side bends are always done in both directions, with the purpose of restoring the body to its natural balance and alignment. Left-right imbalances in SEMG activity are commonly observed and often serve as a source of pain (Wolf, Nacht, & Kelly, 1982). It is believed that these
exercises restore symmetry to the muscle function on both sides of the back.

**Extension**

As we age, our posture may become progressively stooped, and the knees and hips become more flexed (U.S. National Library of Medicine and the National Institutes of Health, 2002). Modern lifestyle and the design of the human body result in most activities being focused in front of the body, bent over and/or looking down. The forces from such activities pull the posture of the body forward, creating such abnormalities as head-forward posture and rounded shoulders. The extension exercise allows for the stretching of the torso in the opposite direction, aiding in the alignment and decompression of the spine (Figures 4 and 5). Subjectively, most patients comment that this is their favorite exercise.

**Pelvic Symmetry**

Muscles in the low back, such as the gluteals, hip extensors, and hip flexors, attach along the iliac crest. These muscles frequently contribute to pelvic asymmetry, which is contributory to low back pain (Greenman, 1989). These muscles can be assessed using SEMG, as well as range-of-motion techniques designed in conjunction with the MyoRack™. The stretches pictured in Figures 6 to 9 demonstrate four stretches using the MyoRack™ that address pelvic asymmetry.

**Home Exercise Program**

Clinical treatments using the MyoRack™ are conducted on a triweekly basis and are combined with a home exercise program that is tailored specifically to the patient based on SEMG assessments. This home exercise program is completed between treatment sessions on a daily basis to facilitate the speed of recovery and is important for the balancing, strengthening, and increasing flexibility in the low back.

**Results and Discussion**

Outcomes of the treatment intervention have been examined preliminarily in 101 patients with LBP who completed the treatment program. The mean age of the sample was 42.7 years (SD = 12.6), and patients were seen on average for a total of 22.1 treatment visits (SD = 12.7). Seventy-nine patients were male, and 22 were female. The majority of patients had LBP for more than 6 months (62.4%). All subjects were working at their regular jobs or in a modified job with restrictions. The treatment program was advertised throughout various plants in the Calgary, Alberta, area, and the plant managers suggested to workers that they consider obtaining treatment. The vast majority of patients had their treatments administered at work, whereas a minority were seen at a clinic because scheduling a visit at their workplace was not possible.

Pain and interference with work activities were assessed before and after treatment using an 11-point numerical rating scale (NRS), with 0 indicating no pain or interference and 10 indicating extreme pain or work interference. Among persons completing treatment, the average decline in NRS ratings of pain was 3.7 (SD = 2.6; *p* < .001) and 2.9 (SD = 3.0; *p* < .001) for interference with work activities. At posttreatment, 55 patients reported having no pain and 87 persons reported that pain did not interfere at all with their work activities. Applying Farrar, Young, La Moreaux, Werth, and Poole’s (2001) criteria for assessing clinically significant change in pain following treatment (an NRS decline of 2 points or 30%), 82% of persons who completed the program demonstrated clinically significant reductions in pain.

SEMG was assessed before and after treatment using the Thought Technology Infiniti ProComp MyoScan. The sampling rate was 2048/second, and the signals were passed through a band pass filter of 20 to 500 Hz and a notch filter at 60 Hz. Silver silver/chloride single-use triodes were placed along the L1/L3 lumbar paraspinals at the level of the iliac crest. Triodes were placed vertically along the paraspinals with the reference position distal to the spine and 5 cm between contacts on the left and right paraspinals (Figure 10).
During the assessment, each subject was told to stand still in a relaxed position (Phase 1), forward flex as far as comfortably possible (Phase 2), pause at the fully flexed position (Phase 3), return to standing on command (Phase 4), and then remain standing still in a relaxed position (Phase 5). This procedure was repeated three times. The recording program was initialized, and a 5-second baseline was recorded. The subject was then asked to complete the three cycles upon verbal command, with each portion of the cycle lasting at least 3 seconds.

The SEMG measures that were examined included the average SEMG signal from both the left and right sides in each position (standing, flexion, full flexion, return to standing, and standing after bending), the difference between left and right (asymmetry in the SEMG signal) at each point in time, maximum EMG during flexion and extension (return to standing), and two flexion-relaxation ratios, as absence of paraspinal relaxation in terminal flexion has been reported to be highly characteristic of persons with LBP (Geisser et al., 2005). The first ratio was calculated by dividing the maximum SEMG in flexion by the average SEMG in full flexion (Watson, Booker, Main, & Chen, 1997). The second was calculated by dividing the average SEMG while standing by the average SEMG in full flexion. In each instance, a higher ratio is felt to be reflective of greater paraspinal relaxation in terminal flexion, which is generally characteristic of persons who do not have LBP.

Examining persons at posttreatment who reported pain compared with those reporting no pain, there was a nonsignificant trend for persons who reported no pain to have a higher flexion-relaxation ratio calculated using the maximum SEMG in flexion and average SEMG in full flexion. In addition, persons reporting no pain at posttreatment had a significantly higher flexion-relaxation ratio calculated using average SEMG while standing and in terminal flexion compared with persons who reported having pain at posttreatment (p = .02).

Because composite scores may predict a greater proportion of the variance in pain and interference outcomes, an exploratory analysis was conducted to examine the association between composite SEMG measures and pain and interference. Because SEMG measures may be difficult to combine in a logical fashion, an empirical approach using factor analysis was conducted to group the SEMG measures. A three-factor solution best fit the data. The first factor represented SEMG activity while standing (before and after bending). The resulting factor scores were entered into a discriminant analysis to examine whether the composites significantly predicted whether or not a person had pain or work interference at posttreatment. For presence or absence of pain at posttreatment, the flexion-relaxation factor was the only variable that significantly predicted group membership (p = .05). None of the composites significantly predicted the presence or absence of work interference.

To summarize, these data suggest that the MyoRack™ system is beneficial in reducing LBP and improving work-related function among persons who complete the treatment program. In addition, SEMG measures of flexion-relaxation significantly predicted the presence or absence of LBP at posttreatment, consistent with prior research examining flexion-relaxation differences in persons with LBP and healthy control subjects. Of the two flexion-relaxation ratios examined, the ratio comparing SEMG in terminal flexion to SEMG while standing appeared to be more sensitive to the presence or absence of pain. This may be due to the fact that when comparing SEMG in terminal flexion to maximum SEMG in flexion, the ratio is influenced disproportionately by the larger number (maximum SEMG in flexion). Comparing values that are more similar in magnitude may make the ratio sensitive to actual changes in paraspinal relaxation in full flexion. This latter issue deserves further study.

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References


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