REFLEX AMPLITUDES INCREASED POST A 10-WEEK STABILIZATION EXERCISE PROGRAM IN SUBJECTS WITH RECURRENT LOW BACK PAIN

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SUMMARY
Patients with recurrent low back pain (LBP) demonstrated delayed and dampened trunk muscle reflexes compared to matched healthy control subjects (CNTL) during a sudden loading perturbation test. After a 10-week stabilization exercise (SE) program, the onset times of the trunk muscle reflexes remained delayed in the patients with LBP but reflex amplitudes increased.

INTRODUCTION
Delayed muscle onsets have been observed in patients with LBP in experiments involving sudden loading of the trunk [1,2]. Altered muscle responses contribute to impaired postural control and instability that may be a contributing factor to the recurrence of LBP [1]. SE programs have been shown to decrease the risk of LBP recurrence in a select group of patients with acute, first episode LBP [3]. It is not known if SE programs influence the trunk muscle response patterns to sudden perturbations. It was hypothesized that patients with LBP would have delayed and dampened trunk extensor muscle reflex responses compared to the CNTL subjects and a 10-week SE program would improve the reflexes in the patients with LBP. A perturbation test was used to study the trunk muscle reflexes in 13 patients with subacute, recurrent LBP, before and after a 10 week trunk SE program and in 13 CNTL subjects.

METHODS
13 subjects (6 female; Age: 32.3±18.2, Weight: 81.2±19.6 kg, Height: 1.75±0.08 m) with a primary complaint of subacute, recurrent LBP, and 13 matched subjects (6 female; Age: 35 ±10.1, Weight: 84.5±19.9 kg, Height: 1.75±0.12 m) with no history of significant LBP in the past 2 years volunteered for the study. Subjects with LBP were included if the duration of pain in the current episode was less than or equal to 8 weeks, and had experienced at least 1 separate episode in the past year. Informed consent was obtained from each subject following procedures approved by the Biomedical Institutional Review Board at the University. Subjects with LBP were tested before and after the SE therapy and the CNTL group subjects were tested once. The SE intervention was modeled using the program by Richardson and colleagues [4] and included 10 visits, each lasting 45 minutes, which were scheduled twice per week for 2 weeks (weeks 1 and 2), once per week for four weeks (weeks 3-6), and then once every 2 weeks (weeks 8 and 10). In between visits, the subjects with LBP completed the exercises at home.

To elicit the trunk reflexes, subjects kneeled in a frame while connected via a harness and cable system to a servomotor (Figure 1). The cable tension applied a series of quick, repeated flexion loads at approximately the T6-T7 level of the trunk. Surface and fine wire electromyograms were recorded bilaterally from the L5 multifidus (Mult S, Mult FW), and surface electromyograms only from the L3 erector spinae (ES S). Reflex latencies and amplitudes for the M2 reflex were calculated as shown in Figure 2. A mixed effect regression-modeling framework (SAS, Cary, NC) was used to model the reflex latency and reflex amplitude computed for each muscle. Significance was set at p≤0.05.

Figure 1: Subject’s position in the reflex perturbation device.

Figure 2: Reflex responses in the individual low back muscles to the perturbations for A) a CNTL subject; B) a LBP subject at PRE therapy; C) and the same LBP subject at POST therapy.
RESULTS AND DISCUSSION
The analysis for comparing the PRE LBP group and CNTL group included all 13 subjects whereas 9 were available for the comparison between the PRE and POST therapy LBP group. The LBP group at PRE therapy had delayed reflex responses in all the three measurements of Mult FW (p = 0.017), Mult S (p = 0.016) and ES S (p = 0.001) compared to the CNTL group. Reflex amplitudes for the LBP group at PRE therapy compared to the CNTL group for Mult FW were lower (p = 0.030) but for Mult S (p = 0.071) or ES S (0.098) (Figure 3A). POST therapy reflex latencies did not change but reflex amplitudes increased. There was no change in the reflex latencies for Mult FW (p = 0.915), Mult S (p = 0.561) and ES S (p = 0.549), between the two sessions at PRE and POST therapy. A significant increase was observed in the reflex gains for Mult FW (p = <0.0001), Mult S (p = 0.0056) and ES S (p = 0.0018) at POST therapy for the LBP group (Figure 3B).

Figure 3 Comparing mean and standard deviations for reflex latencies and reflex gains for the low back muscles between A) CNTL group subjects and LBP subjects at PRE therapy; and between B) LBP subjects at PRE therapy and POST therapy.

Trunk exercise programs such as the SE program are directed towards recruitment of muscle groups and restoring the cross-sectional area, particularly in the Mult [4], which is considered to be one of the important stabilizers for the intersegmental control of the spine [5]. The subjects with LBP after completing the SE program demonstrated stronger reflexes with higher reflex amplitudes but no changes in the reflex latencies. Increased reflex amplitudes after the 10-week SE program in patients with LBP could limit excessive movement of the spine when perturbed; potentially reducing strain on the ligaments, providing a protective benefit [6]. However, a persistent delay in the reflexes may alter the motor control and increases the risk of recurrent LBP [1]. The limitations of this study include the small sample size, the number of subjects who did not complete the SE program, and the lack of a group of subjects with LBP who did not receive the intervention. The impact of the SE program on a cohort of CNTL subjects was not evaluated and may be worth exploring in the future. These factors limit the ability to translate the findings to a larger population.

CONCLUSIONS
Longer muscle reflex latencies were observed in subjects with LBP at PRE therapy compared to CNTL subjects. A 10-week SE rehabilitation program increased the amplitudes of the long latency reflexes however did not influence the reflex latencies.

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