Preliminary study

Impact of Specific Muscular Strength Therapy on Patients with Chronic Lower Back Pain.

BY

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Abstract

Objectives: To measure the impact of a specific isolated lumber extension exercise protocol for patients with chronic lower back pain

Design, setting and participants: Prospective cohort study of 55 patients with chronic low back pain who were referred for muscular strength testing and therapy at a Muscular Strength Therapy [MST] clinic in Melbourne, Australia.

Interventions: A specialised clinical joint testing and exercise therapy machine isolated the lumbar spine of patients who attended over 6 weeks with bi-weekly exercise therapy sessions. The isolated lumbar spine was exercised to exhaustion.

Main Outcome Measures: Changes in strength measurements of the lower back in males and females from pre to post treatment and evaluation of changes in perceptions of back pain and disability

Results: After 12 specific isolated and exhaustive lumbar exercise therapy sessions both the males and females showed significant increases in strength at all angles of back extension across the measured range of movement ($P \leq .05$). The mean percentage increase in lumbar strength was 41.1 % for the males and 48.8% for the females.
Accompanying these improvements in strength was a mean 48.8% reduction in the Oswestry Low Back Pain Disability Questionnaire score recorded for the group ($P \leq .05$).

Conclusion: These results demonstrate that specific isolated lumbar testing and accompanying muscular strength therapy can target and quantify beneficial clinical changes in patients with chronic lower back pain.

Disability from chronic low back pain [LBP] is an ongoing public health concern in Australia. Researchers have identified that LBP is associated with specific muscle impairment of the deep muscles of the trunk which are responsible for the stability of the lumbar spine.[1] This stability being provided by the articular, muscular and neural systems integrating to control intervertebral movement. A focus of considerable research has been to examine the trunk muscle activity with a view to restoring, enhancing and optimising these stabilising muscle in subjects with LBP. [2,3]

A recent Cochrane Review clearly states that exercise is effective at reducing pain and functional limitations in the treatment of chronic LBP.[4] Several researchers have identified and advocate that the deep spinal muscles should be specifically targeted in rehabilitation for LBP.[5,6,7] Specific stabilisation exercise for low back pain have typically been conducted in a clinical situation requiring considerable clinician expertise and cooperation from the patient where by the patient is instructed to recruit the deep muscles of the spine while reducing unnecessary over activity of other muscles.[8] Hayden et al.[9] after conducting a systematic review of exercise therapy for LBP recommended that research should investigate specific exercise interventions rather than general ”exercise therapy” in LBP. In light of the calls from the most recent Cochrane Review [4] for highly targeted and specific exercise protocols: a controlled and systematic testing and training device is now available which permits specific, isolated joint function for controlled exercise intervention. The purpose of this study was to assess the effectiveness of intensive, progressive resistance exercise of the isolated lumbar spine as muscular strength therapy (MST) for back strength development and reductions in pain and disability.

Methods

A total of 55 patients comprising 28 males, [mean age 47.0 years, range 25-80 yrs] and 27 females, [mean age 46.9 years, range 26-73 yrs] supplied written informed consent to participate in this study. The study cohort was recruited from patients who had been suffering from chronic low back pain and had been referred to the Muscular Strength Therapy [MST] Clinic. The average duration of the chronic LBP was 1.65 years. This research was supported by the Human Ethics Research Committee of Victoria University.

Intervention:

Lower back strength was measured by using specialised testing and training equipment: MedX Lumbar Machine. This device is designed to isolate the muscles of the lumbar spine and to ensure that the gluteal and leg muscles are immobilised by securing the pelvis, thus only permitting flexion and extension of the lumbar spine to a range of seventy two degrees. [Figure 1]. With this device a computerised output records muscular isometric strength torque at up to seven specific joint angles throughout the range of lumbar extension and flexion. The measurements give a reading in foot lbs of torque and the angle is recorded in degrees of flexion with zero being full extension and 72 degrees full flexion of the lumbar spine. Under the guidance of trained physiotherapists and exercise specialists, a controlled intensive and progressive resistance-based strength therapy exercised the specific lumbar musculature. The protocol is strenuous and requires the patients to exercise to volitional fatigue throughout the total range of motion. This is accomplished by having the patient work against an individually prescribed resistance and to move slowly into

a position of maximal extension within 4 seconds, hold the fully contracted position for 2 seconds and then 4 seconds to return to the fully flexed position. These movements are repeated until the lumbar extensors experience local fatigue, which typically will take between 6-9 repetitions.

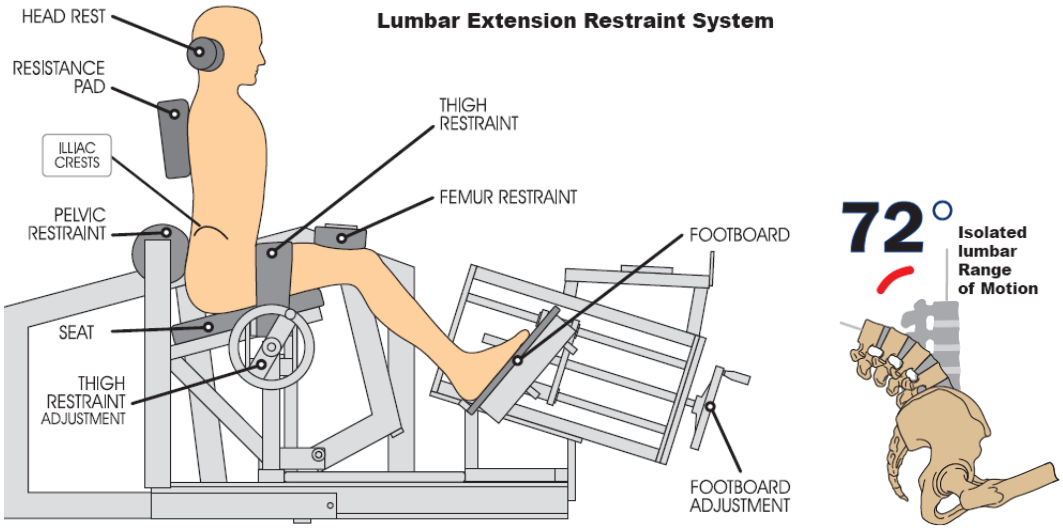
Outcome Measurement

Pre testing of muscular strength was conducted prior to the commencement of the muscular strength therapy and post testing at the completion of 12 sessions [6 weeks bi- weekly]. In addition, pre and post completion of the exercise therapy patients were administered the Oswestry Low Back Pain Disability Questionnaire, which is scored to a 50 point scale with 50 being the highest level of disability, to zero for absence of low back pain disability.

Statistical Analysis

Statistical significance was set at an alpha level of $p \leq 0.05$. All statistical calculations were completed using SPSS statistical software, version 14.0 (SPSS Inc, Chicago, Ill). A series of paired t tests were used to determine whether the mean of the differences between pre and post intervention measurements were different from zero for the whole group and within each gender. Differences were determined for absolute changes and changes expressed as a percentage of baseline.

Figure 1 Limiting flexion and extension of Lumbar spine.



Results:

Figure 2 presents the pre and post MST measurements of lumbar strength curves of both males and females. Both males and females achieved significant increases ($P<.05$) in strength at all the measured angles of lumbar flexion and extension. The mean percentage increases in strength for the males and females across the measured angles of lumbar function are presented in Table.1. The mean percentage of strength increase in the total group across the range of movement was 44.8%. There were no differences in the percentage gains between the males and females with an overall mean percentage increase for the males and females of 41.1% and

48.8%, respectively. The range of motion of the Lumbar spine was also improved in 31 of the 55 patients as a result of the therapy.
The degree of change reported in the Modified Oswestry Low Back Pain Disability Questionnaire (Table 2) revealed comparable significant improvement in both the male and female scores with mean score percentage changes of 46.9 and 55.0%, (P<.05) respectively. Of the fifty five patients tested there was only one who reported no change in the Oswestry Score every other report was of positive nature.

Discussion and Conclusion

This research demonstrated the effectiveness in developing strength through isolated joint specific lumbar exercise in both male and female subjects suffering from chronic lower back joint and muscular pain. These results address the call made in the Cochrane Review [4] in which the authors state quite categorically "trials should investigate specific exercise intervention strategies". Our results indicate that this specific exercise intervention increased both muscular strength and functional range in a cohort of patients with chronic lower back pain. The results demonstrate that the MST offers a viable and specific exercise intervention which has a defined outcome measure with known explicit exercise form, prescription and function.
Many rehabilitation exercises which are intended to strengthen the lower back, actually strengthen the gluteal and hamstring muscles, and have much less effect upon strengthening the muscles of the lumbar spine. Specific stabilisation exercise for low back pain have shown to be successful for low back pain reduction [10,11] but there are difficult methodological issues when attempting to teach and implement the isolation of the required muscles. [6 11] Further extensive research has identified that low back pain is related to direct impairment in the deep muscles of the lumbar spine, namely the Multifidus and Transversus Abdominis muscles.[5,7,12] Even more recently Kjaer et al [13] and MacDonald et al [14] support the role that these deep trunk muscles play in spinal stability and the importance of targeted therapeutic exercise.

In summary this is the first Australian study to use this device and therapy protocol to examine specific strength exercise designed to target the lumbar spine. We have provided objective and quantifiable data to reveal weakness and limit to range of motion for progress in therapy motivation and quantification for the clinician as an intervention for patients with chronic lower back pain.

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Figure Two. Pre and Post Isometric Strength in Males and Females with Chronic Low Back Pain. [Mean, 95%CI]

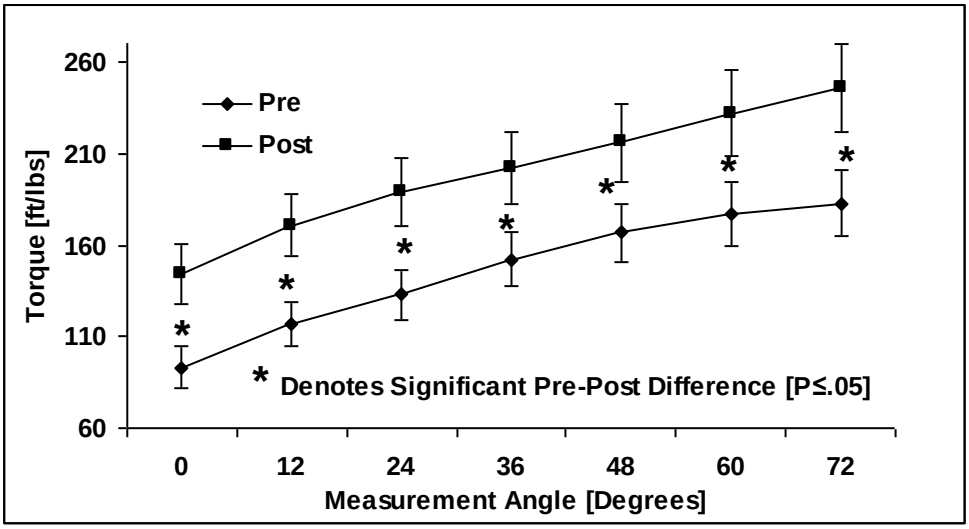

Table 1. Percentage Increases in Strength of Males and Females following 12 sessions of Muscular Strength Therapy

	Lumbar Spine Angle Measurement [Degrees] (% Change Pre-Post)						
Group	0^0 Full Extension	12^0	24^0	36^0	48^0	60^0	72^0 Full Flexion
All N=55	70.9 [51.8-90.0]	54.5 [42.3-66.7]	45.6 [36.8-58.6]	35.8 [27.2-44.4]	32.3 [25.0-39.6]	34.0 [25.8-42.1]]	38.5 [30.0-46.8]
Males N=28	67.9 [39.2-95.0]	48.4 [31.9-64.9]	46.1 [29.2-63.0]	30.9 [18.5-43.3]	28.1 [18.1-38.1]	29.7 [20.3-39.0]	34.6 [24.3-44.9]
Females N=27	73.9 [47.0-98.1]	60.7 [41.9-76.6]	49.4 [34.5-64.2]	40.9 [28.4-53.3]	36.5 [25.6-47.6]	38.5 [24.5-52.4]	42.3 [28.4-56.3]
Mean [95%CI]							

Table 2 Changes in Modified Oswestry Low Back Pain Disability Scale following Muscular Strength Therapy.

Modified Oswestry Low Back Pain Disability Scale*			
	Pre score	Post Score	Absolute Change
ALL	19.8 [17.5-22.1]	9.9 [7.7-12.1]	9.9 [A] [8.4-11.7]
Males	20.1 [16.9-23.3]	11.1 [7.6-14.5]	9.1 [A] [6.5-11.6]
Females	19.5 [15.9-23.1]	8.7 [6.0-11.4]	10.8 [A] [8.1-13.5]
* Score of 50 optimal disability Mean [95%CI] [A] Significance Pre-Post scores (P≤.05)			