Asian Journal of Health and Medical Research (AJHMR)
Volume 1, Issue 1, December, Page No.9-13, 2015
DOI:

ORIGINAL ARTICLE

EFFECT OF MOTOR CONTROL EXCERCISES ON ELECTROMYOGRAPH-IC RESPONSES IN BACK MUSCLES IN PATIENTS WITH LOW BACK PAIN. A PILOT STUDY

E. S. Prathyush[1]

[1]Physiotherapy Internee, SIMS College of Physiotherapy, Mangaldas Nagar, Guntur, Andhra Pradesh, India.

ABSTRACT

Background & Purpose: *Low back ache is one of common disorder experienced by all the individuals in their lives. Muscle strength and flexibility essential for maintaining the spine in neutral. The main muscle of the back is the erector spine which is commonly affected. To improve the function of erector spine muscles there are so many protocols available. Now a days the importance of motor control exercises was increased in improving muscle activity and Electro-myographic application to the back muscle is limited so, the purpose of the study is to record the activity of the erector spine muscle after motor control exercise.* ***Objectives:*** *The objective of this study was to know the electro-myographic changes of the erector spine after motor control exercise in low back pain patients and comparing the test results with pain levels and strength gained.* ***Methodology:*** *20 subjects are included in the study, 10 in each group. Experimental group received motor control exercises and interferential therapy, conventional group received flexion and extension exercises and interferential therapy for a duration of 6 weeks. Exercises were given for 30 minutes and IFT for 15 minutes per day. Muscle activity is recorded before and after the intervention. The EMG amplitude and fiber density were used as outcome measures. The outcome was measure before the treatment and after 6 weeks.* ***Result:*** *After 6 weeks the EMG amplitudes of erector spine muscles in experimental and conventional group were compared. P value is 0.0002, considered extremely significant with t = 4.660. The comparison between post treatment values of fiber density of erector spine muscles in experimental and conventional group considered extremely significant with P value is < 0.0001, t = 5.680.* ***Conclusion:*** *Motor control exercises are showing positive changes in EMG activity of erector spine muscles than conventional exercises while treating patients with chronic low back ache .this can conclude that motor control exercises are more specific in treating patients with chronic low back ache.*

Key words: *Motor control exercises, low back ache, electromyography.*

INTRODUCTION

Low back pain (or) lumbago is a common disorder involving the muscles and bones of the back. It is the common complaint experienced by most of the people in the world once during their lives. Around 60–80% of the population will at some time exhibit low back pain [1-4] and of these 70 to 80% will have at least one recurrence. The information technology (IT) industry boom in India, since the last two decades, has led to an increased use of computer devices and peripheral. Approximately 76% of computer professionals from India reported musculoskeletal discomfort in various epidemiology studies[5]. It is assumed that obesity, smoking, weight gain during pregnancy stress, poor physical condition; poor posture & poor sleeping position contribute to low back pain, if not treated within 3 months it leads to chronic low back pain[6]. The nature of these impairments in patients with LBP are still unknown and have been speculatively associated with de conditioning, abnormal fiber type composition, spasm, "protective" inhibition of muscle[7-11]. Some Studies have found the incidence of low back pain is highest in the third decade and over all prevalence increases with age until the 60-65 year age group and then gradually declines[12, 13].

Muscle strength & flexibility are essential for maintaining the neutral spine. As age increases the degenerative changes in the spine increases weakness of the trunk flexors and extensor are associated with low back pain. It has been suggested that the prolonged sitting could be a risk factor for the development of LBP (Corlett, 2006; pope et al., 2002). Disuse atrophy (muscle wasting), and subsequent weakening, which in turn causes more back pain because the muscle are less able to help hold up the spine. The extensor muscle of the spine help in standing & lifting objects (i.e. erector spine). The flexor muscles of spine helps in bending forward, lifting & arching the lower back (i.e. abdom-inal muscles) oblique muscle spine help to rotate the spine & maintain proper posture.

The lower back consists of several muscle, most of which cannot be seen superficially. In other words, the muscles lie deep and cannot be seen on the outside under the skin. The main muscle group of the lower back is the erector spine, which consists of three muscle groups Iliocostalis, longissimus and spinalis. The other muscles of the lower back include the quadrates labarum & the multifidus. Among this muscle transverse abdominals & extensor spine are more commonly affected.

Motor control exercises use a motor learning approach to optimize control of the spine & pelvis via rehabilitation of the posture, movement and the coordination of the muscle involved in the control &movement of the spine. Muscle strength and en-durance may be influenced directly by the patient's motivation & willingness to risk discomfort as well as by socio economic factor & secondary gain. Indices of the muscle performance that are based on parameter of the surface electromyography signal may provide more objective measures of muscle performance than purely mechanical indices. The earliest application of the electromyography techniques to back muscle are limited by the of only a few electromyography electrodes the failure to properly isolate the trunk extensors muscles & the relevance upon cumbersome method of spectral analysis. The current study in based on the individual Para spinal muscle activity (i.e. transverse abdominal & erector spinae) after the motor control exercises[13-15].

METHODOLOGY

Subjects with low back ache a randomly selected into experimen-tal group (n=10) and control group (n=10).inclusive criterion is patients between 15 to 35 years of age, pain severity of 07 on VAS scale, primary symptoms with or without leg pain. Patients with serious spinal pathologies and severe disc extrusions, history of previous spinal surgeries and patients with uncontrolled mental health were excluded from the study. Experimental group re-ceived Motor control exercises along with interferential therapy where, control group received flexion exercises with interferen-tial therapy for a period of 6 week, 30 mins of exercises and 15 mins of interferential therapy daily. Before staring the study and after 6 weeks the outcomes like EMG amplitude and fiber density were measured.

EXERCISES IN CONVENTIONAL THERAPY GROUP

1. Pelvic Tilt: Patient has also placed his hand under the small of his back and is told to "squash his hand by pushing the back downwards". The gluteal muscles (backside muscles) should also be squeezed simultaneously and the pelvis tilted drawing in the abdomen.

2. Pelvic Presses: Ask patient to bring his feet back, with knees bent. Then ask to push his abdomen upwards, keeping shoulders on the ground, and back straight. Ask him to Hold for 10 sec-onds, and then return the pelvis to the ground. Repeat 3 times.

3. Belly-button retraction: Place the blunt end of a pencil on pa-tient's umbilicus. Draw the pencil inwards toward the floor and ask him to feel the contraction of muscles as he do so.

4. Single knee to chest: First ask the patient to raise one knee toward your chest, by actively contracting hip muscles. Ask him to Hold for at least 3 seconds and then ask him to grasp his knee with both hands and pull toward chest. Hold for 5 seconds. The other leg should lies flat on the floor.

5. Both knees to chest: Ask the patient to raise both knees toward chest, by actively contracting hip muscles. Hold for 5 seconds. Now ask him to grasp both knees with his hands and pull toward his chest.

6. Curl-ups: Start by tucking patients chin and lifting the head upwards. Ask him to bring one heel towards his buttock for an extra stretch. Then ask him to bring both knees toward chest, while he is squeezing his abdominal muscles.

7. Hamstring and Gluteal stretches, Forward lunges, Quadriceps Stretches, abductor strengthening programs are also included in this protocol.

EXERCISES IN MOTOR CONTROL GROUP

1. Initial non-weight bearing motor control training strategies:
Starting position
- Assess in standing
- Generally commence treatment in side lying

Establish adequate relation (soft end feel on palpation): Ask the patient to relax and let the tummy flop out. Ensure that patient is completely relaxed and let him feel his breathing pattern and instruct him to breathe in and out slowly. Now ask him to draw his lower abdomen towards his spine. Ask patient to palpate his abdomen and concentrate on the changes occurring in the ab-dominal wall. The feel changes from spongy to tough and then the tone will be increased.

2. Activation and facilitation of transverses abdominis, lumbar multifidus and pelvic floor motor control
Starting position
- generally commence treatment in side lying
- consider other starting position if non-responsive to facili-tation described below

Pelvic floor as facilitation strategy

Ensure neutral spine with adequate relaxation. Instruct the pa-tient to "imagine a sling of muscle starting between two ischi-al tuberosities and extending forwards between the legs". While standing, ask the patient to slowly and gently lift the sling up towards your head. Therapist should observe and palpate for co-contraction of transverse abdominis and multifidus

Multifidus as a facilitation strategy

Ensure neutral spine position with adequate relaxation. Palpate between L3 and S1 adjacent to the spinous processes. Instruct the patient to"slowly and gently swell the muscles under thera-pist's fingers without moving his spine or pelvis". Further facili-tate multifidus (if required) by instructing to "tilt the tailbone up towards the back of the skull" or "tip the buttocks into the air".

Both groups received interferential therapy for back pain. The parameters used are same in both groups. Outcomes were evalu-ated before starting the procedure and after 6 weeks.

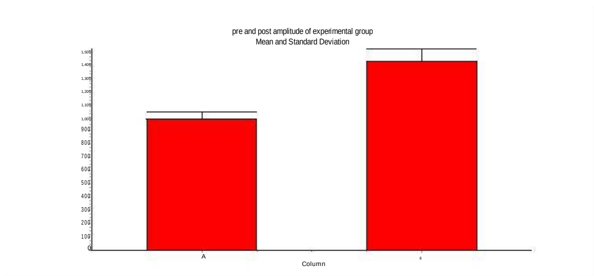
DATA ANALYSIS

1. COMPARISION OF EMG AMPLITUDES OF EXPERI-MENTAL GROUP

S.NO	PRE AMPLITUDE	POST AMPLITUDE
1	900	1325
2	950	1401
3	940	1509
4	1001	1280
5	1050	1490
6	990	1360
7	1000	1440
8	1090	1550
9	930	1490
10	1000	1350

	PRE AMPLITUDE	POST AMPLITUDE
MEAN	985.1	1414.5
STANDARD DEVIATION	57.23	82.801
SAMPLE SIZE	10	10

Table.1 Comparison of EMG amplitudes before and after in Experimental Group



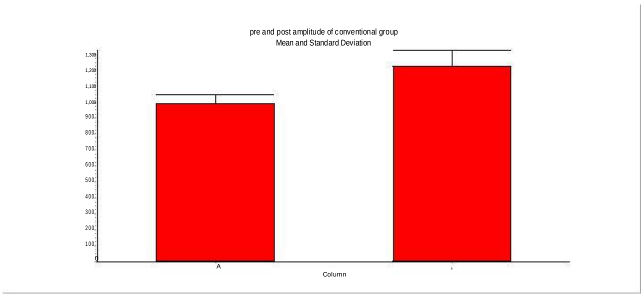
Graph.1: Comparison of EMG amplitudes before and after in Experimental Group

2. COMPARISION OF EMG AMPLITUDES OF CONVENTIONAL GROUP

S.NO	PRE AMPLITUDE	POST AMPLITUDE
1	900	1300
2	940	1290
3	950	1299
4	1010	1250
5	1040	1200
6	1000	1260
7	1010	1100
8	1080	1250
9	940	1000
10	1020	1290

	PRE AMPLITUDE	POST AMPLITEUDE
MEAN	989	1223.9
STANDARD DEVIATION	54.863	99.381
SAMPLE SIZE	10	10

Table.2 Comparison of EMG amplitudes before and after in conventional Group.



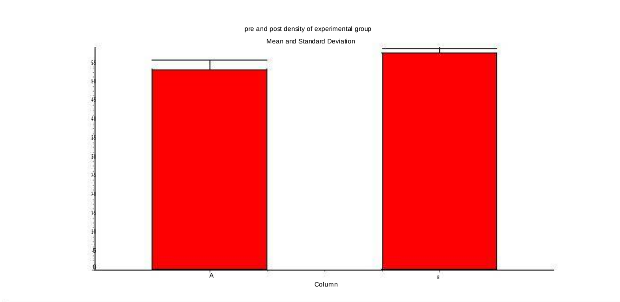
Graph.2: Comparison of EMG amplitudes before and after in conventional Group.

3. COMPARISION OF FIBER DENSITY OF EXPERIMENTAL GROUP.

S.NO	PRE DENSITY	POST DENSITY
1	54	59
2	53	58
3	59	58
4	52	57
5	51	56
6	50	55
7	54	56
8	53	59
9	53	58
10	54	59

	PRE DENSITY	POST DENSITY
MEAN	53.3	57.5
STANDARD DEVIATION	2.406	1.434
SAMPLE SIZE	10	10

Table.3: Comparison of fiber density before and after in Exper-imental Group.



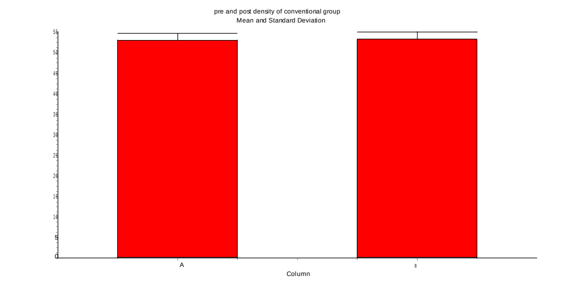
Graph.3: Comparison of fiber density before and after in Ex-perimental Group.

4. COMPARISION OF FIBER DENSITY OF CONVENTIIONAL GROUP

S.NO	PRE DENSITY	POST DENSITY
1	53	55
2	54	54
3	55	54
4	51	56
5	52	53
6	54	52
7	53	53
8	54	55
9	55	50
10	50	52

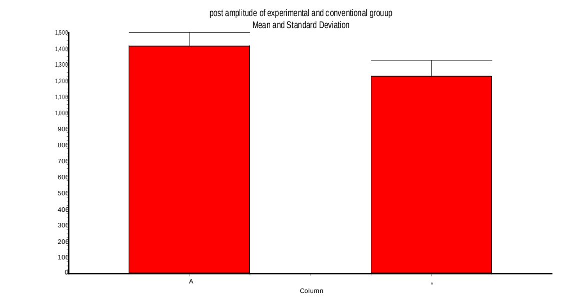
	PRE DENSITY	POST DENSITY
MEAN	53.1	53.4
STANDARD DEVIATION	1.663	1.776
SAMPLE SIZE	10	10

Table.4: Comparison of fiber density before and after in con-ventional Group.



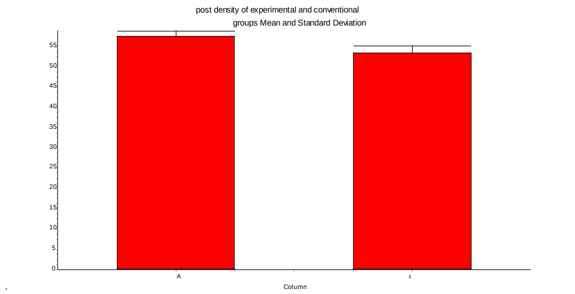
Graph.4: Comparison of fiber density before and after in con-ventional Group.

5. COMPARISION OF EMG AMPLITUDES BETWEEN TWO GROUPS



Graph.5: Comparison of post treatment values of EMG ampli-tudes between both groups.

6. COMPARISION OF FIBER DENSITIES BETWEEN TWO GROUPS



Graph.6: Comparison of post treatment values of fiber densities between both groups

RESULTS

Before and after treatment mean EMG amplitudes of erector spine muscles in experimental group were compared. The P val-ue is < 0.0001, considered extremely significant with t = 15.388. Before and after treatment mean EMG amplitudes of erector spine muscles in control group were compared. The P value is < 0.0001, considered extremely significant with t = 6.520. Before and after treatment the fiber density of erector spine muscles in experimental group were compared. The P value is < 0.0001, considered extremely significant with t = 6.332. Before and af-ter treatment fiber densities of erector spine muscles in control group were compared. The P value is 0.7304, considered not sig-nificant, with t = 0.3555. After 6 weeks the EMG amplitudes of erector spine muscles in experimental and conventional group were compared. P value is 0.0002, considered extremely signif-icant with t = 4.660. The comparison between post treatment values of fiber density of erector spine muscles in experimental and conventional group considered extremely significant with P value is < 0.0001, t = 5.680.

DISCUSSION

Muscle unloading reduces electromyographic activity and causes muscle atrophy and significant decreases in capillarization and oxidative enzymes activity. It is well known that acute or chronic increases in physical activity result in structural, metabolic, hormonal, neural, and molecular adaptations that increase the level of force or power that can be sustained by a muscle. These adaptations depend on the type, intensity, and volume of the exercise stimulus, but recent studies have highlighted the role of high intensity, short-duration exercise as a time-efficient method to achieve both anaerobic and aerobic/endurance type adaptations.

The factors that determine the fatigue profile of a muscle during intense exercise include muscle fiber composition, neuromuscu-lar characteristics, and high energy metabolite stores, buffering capacity, ionic regulation, capillarization, and mitochondrial density. Muscle fiber-type transformation during exercise train-ing is usually toward the intermediate type IIA at the expense of both type I and IIx myosin heavy-chain is forms. High-intensity training results in increases of both glycolytic and oxidative en-zymes, muscle capillarization, improved phosphocreatine resyn-thesis and regulation of K^+, H^+, and lactate ions.

Decreases of the habitual activity level due to injury or sedentary lifestyle result in partial or even compete reversal of the adaptations due to previous training, manifested by reductions in fiber cross-sectional area, decreased oxidative capacity, and capillarization. Complete immobilization due to injury results in markedly decreased force output and fatigue resistance.

Studies have reported that patients with chronic low back ache have reduced muscle strength and greater atrophy of the muscles compared with healthy persons. Increase in muscle strength and the cross sectional area of the back muscles has been demonstrated after the lumbar fusion. In a study analyses showed trunk strength means to be below 50% of gender specific “normal” values obtained by evaluating a normative sample.

Extensor strength assessment demonstrated psoas and erector spinae atrophy through significant decrease in muscle density, with only a trend towards decreased cross sectional area. Findings also indicated that there was a significant correlation between increased mechanical trunk strength performance and greater muscle density on CT scan[16].

In patients with chronic low back pain, medical imaging studies show paraspinal muscle wasting with reductions in cross-sectional surface area and fiber density. In healthy individuals, the paraspinal muscles contain a high proportion of slow-twitch fibers (Type I), reflecting their role in maintaining posture. The proportion of Type I fibers is higher in females, leading to better adaptation to aerobic exertion compared to males.

Abnormalities seen in paraspinal muscles from patients with chronic low back pain include marked Type II fiber atrophy, conversion of Type I to Type II fibers, and an increased number of nonspecific abnormalities. Limited data are available from magnetic resonance spectroscopy used to investigate muscle me-tabolism and from near infrared spectroscopy used to measure oxygen uptake by the paraspinal muscles. Surface electromyog-raphy in patients with chronic low back pain shows increased paraspinal muscle fatigability, often with abolition of the flex-ion-relaxation phenomenon.[17,18]

CONCLUSION

Motor control exercises are showing positive changes in EMG activity of erector spine muscles than conventional exercises while treating patients with chronic low back ache. This can conclude that motor control exercises are more specific in treating patients with chronic low back ache due to its effect on muscle activity.

REFERENCES

1. Waddell G: A new clinical model for the treatment of low back pain. Spine 1987, 12:632-644.
2. Hicks GE, Fritz JM, Delitto A, and S.M. MG: Preliminary development of a clinical prediction rule for determining which patients with low back pain will respond to a stabilization exercise program. Arch Phys Med Rehab 2005, 86:1753-1762.
3. Kasai R: Current trends in exercise management for chronic low back pain: comparison between strengthening exercise and spinal segmental stabilization exercise. J Phys Med Sci 2006, 18:97-105.
4. Freburger JK, Carey TS, Holmes GM: Effectiveness of physical therapy for the management of chronic spine disorders: a propensity score approach. Phys Ther 2006, 86:381-394.
5. Talwar R et al.,2009; Bhanderi D et al.,2007., Sharma A et al., 2006 and Bakhtia CS et al., 2003.
6. The prevalence and correlation of low back pain in adults: A cross sectional study from southern India. Ijmedph.org.vol 3. 2013: Anil Chankarmangalam Mathew.
7. Anderson GBJ, Bongduk N, De Luca CJ, et al. Muscle: clini-cal perspective. In: Frymoyer JW, Gordon SL, Eds. New per-spective on low back pain. Park rider, IL: American academy of orthopedic surgeons, 1989:293-334.
8. Biering-Sorensen F. Physical measurements as risk indica-

tion for low back trouble over a one year period. Since 1984; 9:106-19.
9. Garret W, Bradley W, Byrd S, Edgerton VR, Gollnick P. Basic science perspective.In:Frymoyer JW, Gordon SL,eds. New perspective on low back pain. Park Ridge, IL: American academy of orthopedic surgeons, 1989;335-72.
10. Lund JP, Revers D, Widmer CG, Stohler CS.the pain adaptation model. A discussion of the relation between chronic musculoskeletal pain and motor activity. Can J physiol phar-mocol 1991; 69:683-94.
11. Mayer TG, Gatchel R, Kishion N, et al. A prospective short-term study of chronic low back pain patients utilizing novel objective functional measurement. Pain 1986;25;53-68.
12. Low Back Pain in Young and Middle-Aged People JMAJ Toshihiko TAGUCHI Associate Professor, Department of Orthopedic Surgery, and Yamaguchi University School of Medicine 46(10): 417–423, 2003.
13. Merletti R, Sabbahi M, De Leuca CJ. Median frequency of the myoelectric signal: Effects of muscle ischemia and cool-ing. Eur J Appl Physio 1984; 52; 258-65.
14. Roy SH, De Luca CJ, Casavant DA. Lumbar muscle fatigue and chronic lower back pain. Spine 1989; 14; 992-1001.
15. Merletti R, Knafiltz M, De Luca CJ. Myoelectric manifesta-tion of fatigue in voluntary and electrically elicited contrac-tions. Eur J Appl Physio 1990;69:1810-20.
16. Mayer, Tom G. Md; Vanharanta, Heikki Md; Gatchel, Robert J. Phd; Mooney, Vert Md; Barnes, Dennis Ma; Judge, Linda Md; Smith, Sue Ms, Pt; Terry, Arthur Md. Comparison of CT Scan Muscle Measurements and Isokinetic Trunk Strength in Postoperative Patients. Spine (Phila Pa 1976). 1989 Jan; 14(1):33-6.
17. Demoulin C[1], Crielaard JM, and Vanderthommen M. Spinal muscle evaluation in healthy individuals and low-back-pain patients: a literature review. Joint Bone Spine. 2007 Jan; 74(1):9-13. Epub 2006 Nov 13.
18. Crisco JJ, 3rd, Panjabi MM. The intersegmental and multisegmental muscles of the lumbar spine. A bio-mechanical model comparing lateral stabilizing poten-tial. Spine.1991;16:793–799.