ORIGINAL RESEARCH

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TO STUDY THE EFFECT OF PROPRIOCEPTIVE NEUROMUSCULAR FACILITATION ON BACK MUSCLE STRENGTH, PAIN AND QUALITY OF LIFE IN SUBJECTS WITH CHRONIC LOW BACK PAIN – AN EXPERIMENTAL STUDY

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ABSTRACT

Background: Back pain is a prevalent and expensive problem in society. 60-80% of people will suffer at least one episode of low back pain sometime in their lives and 30-40% of these will experience low back pain each year. Therefore the need of the following study is to see the effect of proprioceptive neuromuscular facilitation on back muscle strength, pain and QOL in subjects with Chronic Low Back Pain.

Methods: Ethical approval was taken before study. Forty patients with chronic low back pain (28 male, 12 female) were included in the study and divided into two groups each containing 20 subjects. All the participants were signed written consent after being informed in detail about the study. Group A has been given the proprioceptive neuromuscular facilitation exercises including Rhythmic Stabilization (RST) and Combination of Isotonics (COI) and Conventional back exercises. Group B was given conventional back exercises only. Outcome measures were taken at the end of one month i.e. after the treatment protocol. VAS, SF-36Questionnaire and Core stability gradation were taken in both groups.

Results: There is significant improvement in VAS score in both groups but Group A was having more significant improvement than Group B. Also there is significant improvement in core stability grading and SF 36 score in Group A.

Conclusion: It is concluded that proprioceptive neuromuscular facilitation exercises on back is effective in reducing pain and improving core muscle strength in subjects with Chronic Low Back Pain.

Keywords: Chronic low back pain, Proprioceptive neuromuscular facilitation, Quality of life, Core stability, Back muscle strength, Rhythmic Stabilization, Combination of Isotonics

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INTRODUCTION

Back pain is a prevalent and expensive problem in society.[1] Low back pain is a significant public health problem in all industrialized nations. It is associated with considerable disability, health care use and societal costs.[2]

Low back pain is among the leading cause of occupational injury and disability in both developed and developing countries. Repetitive or static awkward body postures resulting from excessive bending and twisting will increase spinal stress and disproportionate loading to spinal structures.[3] 60-80% of people will suffer at least one episode of low back pain sometime in their lives and 30-40% of these will experience low back pain each year.

The majority of these patients most probably have a multifactorial cause for back pain, which includes functional instability, deconditioning, abnormal posture, poor muscle recruitment, emotional stress and changes associated with aging and injury such as disk degeneration, arthritis and ligamentous hypertrophy. This type of pain is called as mechanical low back pain.[1]

The biological model for the treatment of mechanical low back pain that movement patterns which are altered because of faulty strength and flexibility, fatigue, from poor endurance, or abnormal neural control can eventually cause tissue damage. This damage can also lead to abnormal movement patterns and further damage, which is the basis for the Kirkaldy-Willis degenerative cascade.[4]

During past few years, it has been observed that a new class of young sedentary back pain sufferers is emerging who are becoming more frequent visitors of Orthopaedic clinics. They usually are in a profession where prolonged sitting on chairs is essential like computer/visual display unit users, bank clerks, accountants, stock exchange workers, industrial workers, architects, etc. Prolonged continuous sitting in an inactive posture is a common feature among computer/visual display unit users as technology and its use is becoming more and more common.[5]

The consequences of low back pain are far reaching with sufferers experiencing high levels of disability, reduced quality of life and physical and psychological distress. These factors are associated with increase in absence from work, lost productivity and resulting economic costs.[6]

Low back pain and problems associated with lumbar spine have become increasing health problems despite considerable growth in knowledge and technology over decades. The muscular system provides major support to loaded spine during normal function.[7] So injury would be more likely in presence of poor muscular protection. Lack of support by trunk musculature can occur with general weakness associated with sedentary lifestyle.

Physical factors which are associated with Chronic Low Back Pain (CLBP) are segmental instability, lumbar para spinal abnormality, muscular imbalances and neural processing problems.[1]

Physical therapists are among the health care professionals most involved in the management of these problems. The primary goal of physical exercise in the management of CLBP is to gain muscle strength (force generating capacity), flexibility and endurance, to restore injured tissue and to contribute to the ability to sustain normal life activities such as those at work.[8] Following interventions are used by majority of physical therapists in management of low back pain i.e. stretching exercises, strengthening exercises, spinal mobilization, soft tissue mobilization and massage, manual traction, posture correction, interferential therapy, short wave diathermy, ultrasound. In the chronic phases of low back pain, tailored exercise programs have been shown to have positive effects on physical impairments and limitations.[9]

Some studies support the use of stabilization exercise programs for improving cross sectional area of muscles. However the effect of stabilization exercises on muscle strength and pain reduction is unclear. The aim is to correct imbalance of activity between deeply placed stability muscles and more superficially placed mobility muscles. The use of spinal manipulation for CLBP was given by Europeans, but the use of these modalities as a sole treatment is not recommended.[10]

Patients with CLBP have impaired psychomotor speed and impaired postural control. So nowadays in rehabilitation of CLBP, strategies improving psychomotor back care are also included.[11]

Neurophysiologic studies have linked pain development in the lumbar spine region of the vertebral column with disturbances in the mechanoreceptors and probably with impairment of the superior proprioception centers.[12] Thus, exercise programs that enhance proprioception may be beneficial for managing CLBP. Therefore the need of the following study is to see the effect of proprioceptive neuromuscular facilitation on back muscle strength, pain and QOL in subjects with Chronic Low Back Pain.

METHODS

This study is the experimental and randomized controlled trial. Ethical approval was taken before study. Forty patients who were having chronic low back pain (28 male, 12 female) were included in the study and were randomly divided into two groups each containing 20 subjects. All the participants were signed written consent after being informed in detail about the study. All participants met the following inclusion criteria: (1) Age: 20-40 years, (2) Both male and female, (3) Subjects with the clinical diagnosis of postural low back pain, (4) Subjects having low back pain since more than 6 months, (5) Subjects willing to participate, (6) Subjects who were able to comprehend the commands. Individual with the following conditions were excluded from the study: (1) Lumbar Spondylolysis, (2) Lumbar Spondylolisthesis, (3) Acute Disc Prolapse, (4) Any Neurological Disorders, (5) Any Other Musculoskeletal Disorders, (6) Hypertension and ischemic heart disease. Outcome measures were Visual Analog Scale and Core Stability Gradation. Data was collected from Physiotherapy OPD, V.S. General Hospital, Ahmedabad. Duration of the study was 4 weeks. Visual Analog scale, Core stability gradation and SF-36 were taken as outcome measure

PROCEDURE

Demographic data and Baseline vitals were taken prior to test including BP, RR, and PR. Starting the procedure, pain intensity was measured using VAS. Strength of core muscles was measured using a Core Stability Gradation. All the subjects were then asked to fill the Short Form – 36 to document their health –related QOL.

Then the 40 subjects were randomly divided into 2 groups: Group A (Experimental group) and Group B (Control group), each group containing 20 subjects. Both groups were treated with IFT for 15 min with a small sweep, 90-100Hz[13] and conventional back exercises. Along with it PNF exercises were given in Group A and Group B was given only conventional back exercises. It was seen to that all the patients were not taking any kind of medications.

FOR GROUP A:

Group A has been given the following proprioceptive neuromuscular facilitation exercises.

(1)RHYTHMIC STABILIZATION (RST): The RST program consisted of alternating (trunk flexion-extension) isometric contractions against resistance for 10 seconds, with no motion intended. Subjects performed 3 sets of 15 repetitions at maximal resistance provided by the physical therapist. Rest intervals of 30 seconds and 60 seconds were provided after the completion of 15 repetitions for each pattern and between sets, respectively.

(2) COMBINATION OF ISOTONICS (COI): The COI program consisted of alternating concentric and eccentric contractions of agonists without relaxation, resisted active concentric contraction for 5 seconds (trunk flexion), resisted eccentric contraction for 5 seconds (trunk flexion), and resisted maintained contraction for 5 seconds(trunk flexion-extension). Three sets of 15 repetitions against maximal resistance were performed. Rest intervals were the same as those described above.

FOR GROUP B:

Group B was regarded as the control group which was given conventional back exercises.Group B has been given the following circuit training protocol given by American Academy of Orthopaedic Surgeons in 2007: Abdominal Contraction, Single Knee to Chest Stretch, Abdominal curl ups, Prone on elbows, Prone on hands, Bridging, Straight Leg Raises, Postural advise. Subject was asking to perform 10 repetition of each above exercise with 5 second hold.[14]

The training frequency for both groups was 5 times per week. A typical weekly schedule included training sessions on Monday, Tuesday, Thursday, Friday, and Saturday, with no training sessions on Wednesday and Sunday. All training sessions were controlled by the same physical therapist and had a total duration of 30 to 45 minutes.

Outcome measures were taken at the end of one month i.e. after the treatment protocol. VAS, SF-36Questionnaire and Core stability gradation were taken in both groups.

RESULTS

Graph pad was used for data analysis. Level of significance was kept at 5%.

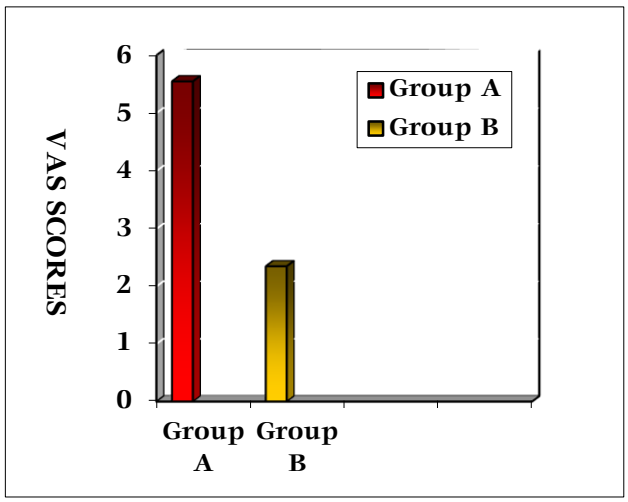
- Comparison of Difference in VAS score between Group A and Group B:

Table 1: Mean Difference in visual analog score between Group A & B.

	Group A	Group B	u-value	P-value
Mean	5.55	2.35	39.500	< 0.0001
Standard deviation	1.762	1.954		

Here, Mann Whitney test was performed with Graph Pad software for analysis. U = 39.500 and P value < 0.0001 was found extremely significant.

This shows that difference in mean VAS score between Group A and Group B is significant



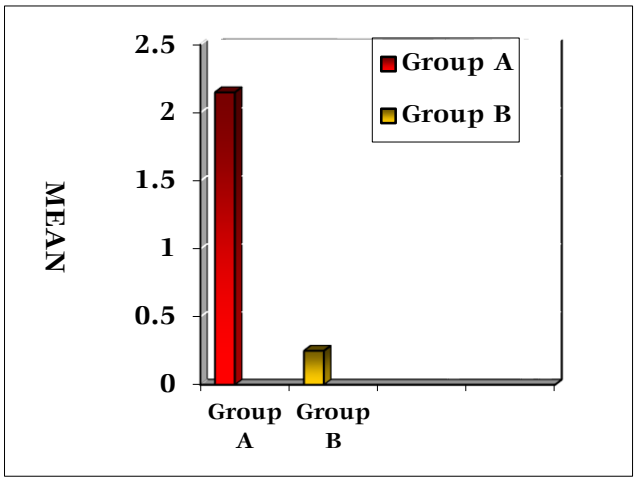
Graph 1: Mean Difference in visual analog score between Group A & B.

- Comparison of Difference in core stability grading between Group A and Group B:

Table 2: Mean Difference in core stability grading between Group A & B.

	Group A	Group B	u-value	P-value
Mean	2.15	0.25	27.500	< 0.0001
Standard deviation	1.182	0.4443		

Here, Mann Whitney test was performed with Graph Pad software for analysis. U = 27.500 and P < 0.0001 was extremely significant. This shows that the difference in core stability grading in Group A is more significant than the difference in grading in Group B.



Graph 2: Mean Difference in core stability grading between Group A & B.

- Comparison of Difference in PCS and MCS score in Group A and Group B:

Table 3 shows the difference found in PCS and MCS scores in SF-36 as below.

Table 3(a): Mean Difference in SF-36 – PCS in Group A

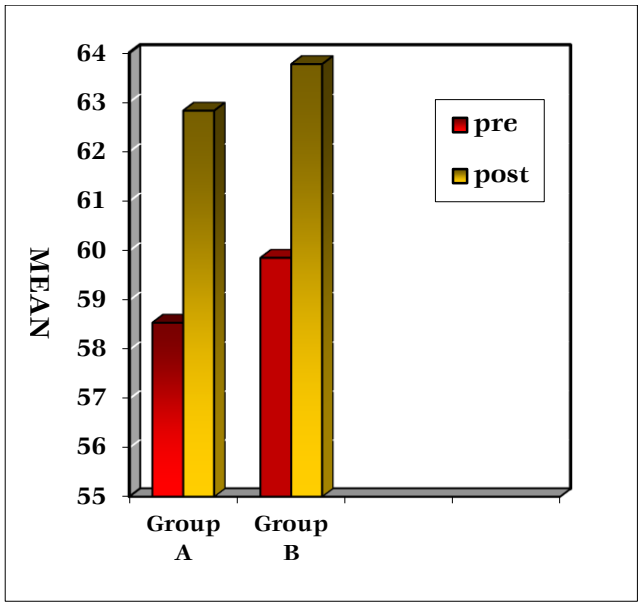
	Pre treatment	Post treatment	W value	P-value
Mean	58.55	62.83	-178.00	0.0003
Standard Deviation	4.841	3.849		

Here, Wilcoxon matched Pairs test was performed with Graph Pad software for analysis. W = -178.00 and P = 0.0003 was found extremely significant in Group A.

Table 3(b): Mean Difference in SF-36- PCS in Group B

	Pre treatment	Post treatment	P-value	t-value
Mean	59.86	63.77	0.0713	1.910
Standard deviation	8.348	6.843		

Here, paired t test was performed with Graph Pad software for analysis. t = 1.910 and P = 1.910 with df 19 was found not significant in Group B.

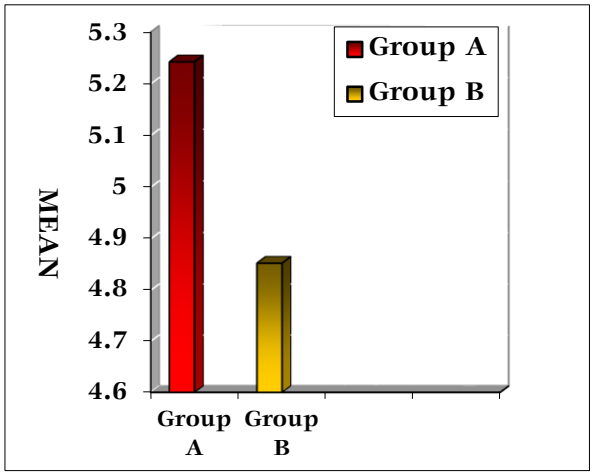


Graph 3: Mean Difference in SF-36 – PCS in Group A &Group B.

Table 4: Mean Difference in SF-36– PCS between Group A & B.

	Group A	Group B	P-value	t-Value
Mean	5.2425	4.853	0.6769	0.4200
Standard deviation	3.157	2.690		

Here, unpaired t test was performed with Graph Pad software for analysis. P-value 0.6769 and t-value 0.4200 with df 38 was found not significant

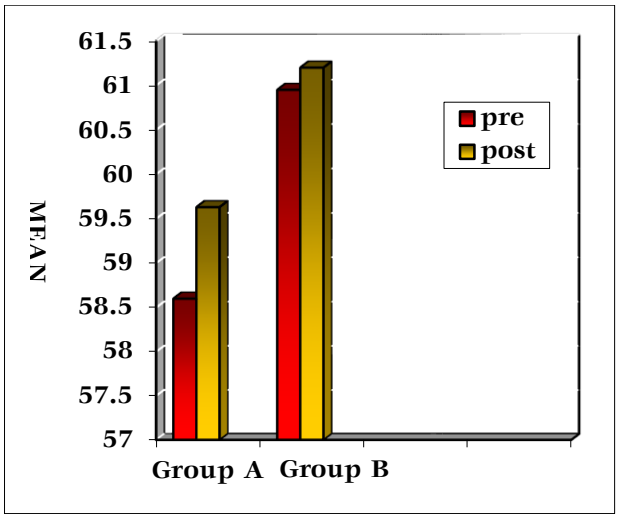


Graph 4: Mean Difference in SF-36 – PCS between Group A & B.

Table 5: Mean Difference in SF-36 – MCS in Group A and Group B.

Groups	Pre treatment		Post treatment		W value	P value
	Mean	SD	Mean	SD		
Group A	58.60	8.194	59.63	8.473	-28.00	0.4954
Group B	60.95	9.104	61.20	9.013	-19.00	0.5830

Here, Wilcoxon matched Pairs test was performed for analysis. For group A, P-value 0.4954 was not significant. For group B, P value = 0.5830 was not significant.

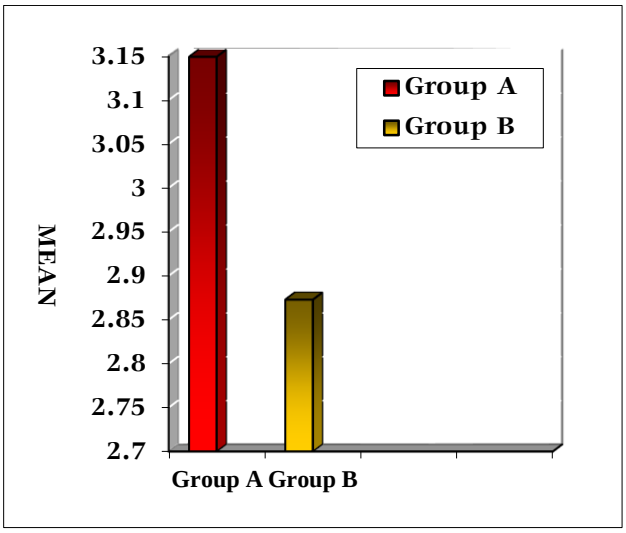


Graph 5: Mean Difference in SF-36 – MCS in Group A & Group B.

Table 6: Mean Difference in SF-36– MCS between Group A & B.

	Group A	Group B	P-value	t-Value
Mean	3.1492	2.873	0.6564	0.4900
Standard deviation	2.109	2.120		

Here, unpaired t test was performed with Graph Pad software for analysis. P-value 0.6564 and t-value 0.4900 with df 38 was found not significant.



Graph 6: Mean Difference in SF-36 – MCS between Group A & B.

DISCUSSION AND CONCLUSION

The present study was done to see the effect of proprioceptive neuromuscular facilitation on back muscle strength, pain and QOL in subjects with Chronic Low Back Pain. The main findings of the present study are that 4 weeks of PNF exercises significantly decreases the pain and increases spinal muscle strength in people with CLBP, without showing any improvement in QOL.

Comparing VAS score measures taken after 4 weeks, the value of U = 39.500 for $p < 0.0001$ between Group A and Group B showed that the results were extremely significant at 5% level of significance.

The Study showed a considerable decrease in VAS score in Group A. This is in accordance with the study done by Nick Kofotolis and Eleftherios Kellis; (2006) where significant reduction in back pain was seen in Oswestry Index. To explain this, trunk muscle strength and endurance has been identified as a potential risk factor for the development of back pain.[15] Also pain is an inhibitor of effective and coordinated muscular performance and is a sign of potential harm (Hislop 1960, Fisher 1967). Back pain can cause back muscle weakness and weak muscle can cause back pain. So it can be concluded that pain and strength have a negative correlation. Also Anne Keller (2007), in her study, emphasizes the central role of pain and treatment for improvements in muscle strength in patients with chronic low back pain. Here, the improvement of core muscle strength gradation was very significant.[16] So, the reduction in pain can be believed to be obtained by an increase in muscle strength.

According to Yamashita T et al (1990) neurophysiologic studies have linked pain

development in the lumbar spine region of the vertebral column with disturbances in the mechanoreceptors and probably with impairment of the superior proprioception centers.[12] Therefore, exercise programs that enhance proprioception may be beneficial for managing CLBP. Here proprioceptive exercises provide mechanoreceptor loading to the spine which might be reflected in decreased pain.

The present study showed a considerable decrease in VAS score in Group B also, where intervention was given in the form of conventional back exercises. This is supported by the Systematic Review based on Exercise Therapy for Low Back Pain, done by Maurits van Tulder, which shows significant reduction of pain after conventional exercises in chronic low back pain.[17]

Now for strength as an outcome measure which was taken after 4 weeks, the value of U = 27.500 for p < 0.0001 between Group A and Group B showed that the results were extremely significant at 5% level of significance.

In the present study, significant gains in core muscle strength were observed in Group A. This is in accordance with the study done by N Kofotolis et at (2004) where significant gains in the mean percentage area of type IIA fibre was seen ($p < 0.05$). This type IIA fibres are fast twitch (FT) fibres which play significant role in high intensity exercise, hence improves strength of muscle.[18] The result of above study is also in accordance with the study done by Nick Kofotolis and Eleftherios Kellis in 2006 which found significant gains in both dynamic and static muscle endurance by PNF exercises.[15] In the present study, the RST and COI exercise programs were based on the performance of static and dynamic muscle actions, respectively. This finding could be attributed to the fact that both exercise techniques involve muscle work at significant intensity levels that result in muscle strength and endurance improvement.

The positive effects of the present training programs could be attributed to the nature of PNF exercises, which are designed primarily to maximize improvements in flexibility and strength. (Dr. Kabat and Margaret Knott) [19]

In the present study, core muscle strength increased after both RST and COI programs. RST involves isometric contractions of agonist and antagonist whereas COI used all muscle action types (eccentric, concentric, and isometric) through a progressively increased range of motion. Here additional manual resistance is the basic component of PNF exercise,[19] whereas in conventional back exercise resistance is not given. These features also may explain the greater strength adaptations observed in experimental group.

Gellhorn and Loofbourrow in 1948 showed that when a muscle contraction is resisted that muscle's response to cortical stimulation increases. The active muscle tension produced by resistance is the most effective proprioceptive facilitation. The proprioceptive reflexes from contracting muscles increase the response of synergistic muscles at the same joint and associated neighbouring joints. This increases strength of contracting muscle. This theory can also be applied to the present study to explain results regarding increase in core muscle strength.

RST also works to increase the patient's ability to stabilize or hold a position as well. So this exercise also helps to improve stability of spine.

SF 36 was taken at the beginning of the 1st week and at the end of the 4th week and it consisted of PCS and MCS scores. Here for PCS difference in the scores at the end of 4th week in Group A, value of W = -178.00 for p = 0. 0003 showed that the results were extremely significant. For PCS difference in the scores at the end of 4th week in Group B, value of t =1.910 for p = 0.0713 showed that the results were insignificant. Thus, the results showed that PCS scores in SF 36 improved in Group A which received PNF training.

These improvements in physical ability (as registered by the SF-36) could be seen as a direct result of pain reduction, thus improving physical activity. Thereby the result provides further support for the effectiveness of PNF exercises for CLBP treatment.

Similarly for MCS difference in the scores at the end of 4th week in Group A, value of W = -28.00 for p = 0.4954 showed that the results were not significant. For MCS difference in the scores at the end of 4th week in Group B, value of W = -19.00 for p = 0.5830 showed that the results were insignificant. The study showed no significant change in PCS and MCS scores between the Group A and Group B.

This can be explained in accordance with a recent study done by Horng YS (2005), who has found that the Health Related Quality Of Life (HRQOL) of patients with low back pain depended on functional status and psychological factors more than simple physical impairment.[20] Thus, in this respect it seems that the PNF program is a not relevant regimen to improve both patients' physical and psychological status. Study done by Sedigheh Sadat Tavafian et at (2007) showed that

the 'Back School Programme' is an effective intervention and could play an important role in improving quality of life in patients who suffer from the chronic low back pain. In this study the 'Back School Programme' intervention was given for 3 months and was included with psychological therapy. This finding could be attributed to the fact that the HRQOL of patients with low back pain depended on functional status and psychological factors more than simple physical impairment. This shows that improvement also depends on aided behavioral programs which were not given in this present study and this might explain the comparatively less improvement which was obtained in SF-36 scores. The exercise programs applied in the present study were short-term intensive programs.

Studies also suggest that QOL takes more than 4 weeks to improve. Study done by Sedigheh Sadat Tavafian et al in 2007 showed The 'Back School Programme' is an effective intervention and might improve the quality of life over a period of 3 months in patients who experience chronic low back pain.[21] In the present study the back intervention was given only for 4 weeks which is very short term intervention to get improvement in QOL.

Thus, above results shows that proprioceptive neuromuscular facilitation exercises on back increases back muscle strength, reduces pain, but there is no significant change in quality of life in subjects with Chronic Low Back Pain.

CONCLUSION

Null Hypothesis of the study is rejected, hence Experimental Hypothesis is accepted. So it can be concluded that proprioceptive neuromuscular facilitation exercises on back is effective in reducing pain and improving core muscle strength in subjects with Chronic Low Back Pain.

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