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RESEARCH ARTICLE

EFFECT OF HIP EXTENSOR STRENGTH TRAINING ON PAIN AND FUNCTIONS IN PATIENTS WITH CHRONIC NONSPECIFIC LOW BACK PAIN: EXPERIMENTAL STUDY

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ABSTRACT

Chronic nonspecific low back pain accounts for a significant percentage of all the back injuries encountered in young adults. Symptomatic treatment interventions have resulted in recurring pain. Pain avoidance behavior and Deconditioning of the gluteus maximus affects ADL's. Hence this study was carried out to see the effect of hip extensor strength training on pain and functions in chronic nonspecific low back pain. The aim of this study was to find out if Hip extensors strength training had an effect on pain and functions. The study objective was to evaluate pre and post pain intensity, functional status, strength and endurance of hip extensors using VAS, ODI, 1RM and time in seconds respectively. Comparison of pre and post outcome measures was performed to see effect of hip extensor strength training. 40 participants with chronic nonspecific low back pain meeting the inclusion criteria were enrolled in the study after taking their informed consent. Each Participant's Visual Analogue Scale (VAS) Oswestry Disability Index (ODI) score, bilateral Hip Extensor muscle strength (1RM) and endurance time (in seconds) was noted. They were then allocated in two groups by means of a computer generated randomized table where one group received general trunk exercises and hip extensor strength training while the other group received only general trunk exercises. Intervention was given for 6 weeks, thrice a week. Outcome measures were assessed at the end of 6 weeks.

Results and Conclusion: Hip extensor strength training had added improvements in functional status with no significant difference in pain.

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INTRODUCTION

Chronic non specific low back pain is the pain lasting for more than 12 weeks, exceeding the normal healing time of tissues and causing frequent recurrences (Elders and Burdorf; Sang *et al.,* 2015). Symptomatic relief in pain is always achieved but there have been a significant increase in the recurrence of this chronic pain on resumption of daily activities. One reason contributing to these recurrences is the inability to understand the interaction between muscles surrounding the hip and back pain. Altered lumbopelvic rhythm and Deconditioning of muscles around the hip due to long standing back pain has been a major cause of affected functions according to the growing literature (Reiman *et al.,* 2009). This Deconditioning of hip muscles create a vicious cycle of pain, disuse, Deconditioning and affected functions (Leinonen *et al.,* 2000; Nelson *et al.,* 1995). Daily activities require adequate strength in antigravity muscles and hence Deconditioning of hip extensors mainly the gluteus maximus which is a prime antigravity muscle needs to be addressed in chronic pain.

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Deconditioning of gluteus maximus affects the efficient load transfer to the lower extremities thereby affecting the daily functions (Kankaanpa *et al.,* 1998; Wilson *et al.,* 2005). Considering the significant contribution of gluteus maximus in daily functions and the fact that there is evidence showing Deconditioning of hip muscles in chronic nonspecific low back pain patients (Kankaanpa *et al.,* 1998), a need was felt to see the effect of hip extensor strength training along with general trunk exercises in these patients.

METHODS

Design: Prospective experimental comparative study of 18 months using computer generated randomization procedure.
Participants: Patients with chronic nonspecific low back pain according to inclusion criteria consisting of:

- Patients suffering from low back pain for more than 12 weeks.
- Age group 18-41[(16)].
- Both sexes.
- Patient's with an ability to understand the purpose of the study and give a voluntary consent for the same.

- Patient's voluntary consent to follow up for 6 weeks.

Participant's exclusion criteria consisting of:

- Radicular pain
- Spondylolisthesis
- Vertebral or pelvic fractures
- Post trauma back pain
- Any arthritic disorder
- SI joint dysfunction
- Spinal lesions or infections
- Any neurological or cardiopulmonary problems
- Participation in any physical training activities
- Pregnant females.

Intervention and outcome measures: Each Participant's Visual Analogue Scale (VAS), Oswestry Disability Index (ODI) score (Fairbank *et al.,* 2000), bilateral Hip Extensor muscle strength (1RM) and bilateral Hip Extensor muscle endurance time (in seconds) was noted. They were then allocated in two groups by means of a computer generated randomized table where they were assigned to one of the protocols.

Group A: Hip Extensor Strength Training along with General trunk Exercises.
Group B: General Trunk Exercises only.

Both the Groups were treated with Hot Pack Application for 15 minutes (Scott *et al.,* 2003) before training with either of the two protocols for 6 weeks thrice a week. The VAS, ODI Scores, 1RM and Endurance time in seconds was collected for the Participants pre and post 6 weeks of intervention. The data was analyzed using SPSS 16 software. To check the strength- Patients were positioned in prone lying with pelvis stabilized using a belt across the plinth and hands held to the plinth. Knee was flexed to 70-90 degree and patients were asked to exert maximum voluntary force against the resistance applied by the dynamometer 5cm proximal to knee joint line. Command given was to 'push push push and relax'. After 5 sec of MVC 1min rest period was given before the next set to avoid fatigue. Best of three values was considered as 1 RM (Thorborg *et al.,* 2010; Belmin Freitas de salles *et al.,*). To check endurance time- 70% of 1RM was calculated and patients were asked to hold against the calculated force which was applied using the dynamometer. The time of hold without causing fatigue and pelvis movement was recorded as endurance time in seconds (Thorborg *et al.,* 2010; Scott *et al.,* 2003).

The protocols are as followed:

1. General trunk exercises (George *et al.*, 2005)

Weeks	Protocol
	1.Exercises for the RA in Dorsal Decubitus with flexed knees: trunk flexion. 2.Exercises for the RA, IO and EO in Dorsal Decubitus and flexed knees: trunk flexion and rotation. 3.Exercises for the RA in Dorsal Decubitus and semi-flexed knees: hip flexion. 4.Exercises for the ES in Ventral Decubitus: trunk extension.
1 – 2 weeks	Training the participants to perform 3 sets of these exercises for 10 Repetitions with Grade 3 strengthening
3 – 5 weeks	Training the participants to perform 3 sets of these exercises for 10 Repetitions with Grade 4 strengthening
6 week	Training the participants to achieve 3 sets of these exercises for 10 Repetitions with Grade 5 strengthening

RA- Rectus Abdominus , IO – Internal oblique , EO – external oblique , ES – Erector Spinae.

Participants were progressed to higher grading only if previous grading was achieved.

2. HIP extensor strengthening protocol (Mose Monday Omoniyi *et al.*, 2014).

Weeks	Protocol
	Participants were trained using Delorme's strength training methods in prone lying with pelvic stabilization by belt and using weight cuffs after calculating 10RM.
1 -2 weeks	10 repetitions with 50% of 10 RM.
3-5 weeks	10 repetitions with 75% of 10 RM
6 week	10 repetitions with 100% of 10 RM

Participants comfort was given first priority during entire treatment regime. Data summary sheet was prepared and statistical analysis was done.

Data Analysis

Data was analyzed using SPSS 16.0 software. Descriptive analysis of data was done. Normality was tested using the Shapiro - Wilk test. Data passing the normality, Parametric tests like Paired t test and unpaired t test were used within the Group and between the Groups respectively. Between groups the difference between pre and post values were calculated and the data were analyzed using Mann-Whitney U test. For Bilateral strength and endurance of hip extensors normality testing was performed within the group and between the groups depending on the difference between pre and post values. Data passing the normality, Parametric tests like the paired t test and unpaired t test were used within the group and between the groups respectively. Data not passing the normality, non parametric tests like Wilcoxin signed rank test and Mann-Whitney u test were used within the group and between the groups respectively. The level of significance was set at 0.05.

RESULTS

The mean age in Group A was 31.10 ± 6.820 years and Group was B 32.90 ± 6.601 years. On applying the parametric and nonparametric test after normality testing using Shapiro-wilk test, results showed significant difference between ODI, 1RM and endurance time between the groups and in the patients within the group. Whereas VAS showed significant difference within the group but no significant difference was seen between the groups. The results indicate that both the protocols were effective in reducing pain but added improvements were seen in functions among the patients receiving hip extensor strength training.

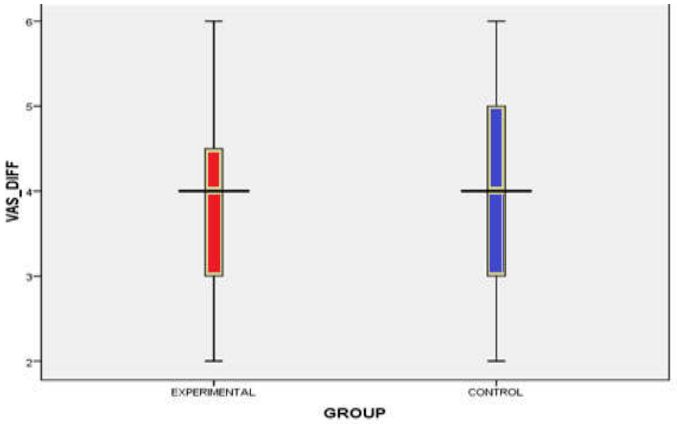

Fig 1. Pain comparision

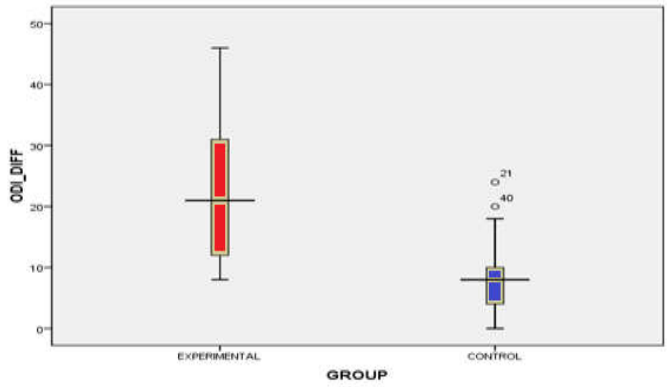

Fig. 2. Functions comparision

Table 1.

Outcome Mesures	Pre-post Group a	Pre-post Group b	Between groups
VAS	<0.05	<0.05	>0.05
ODI	<0.05	<0.05	<0.05
RT-STRENGTH	<0.05	<0.05	<0.05
LT-STRENGTH	<0.05	<0.05	<0.05
RT-ENDURANCE	<0.05	<0.05	<0.05
LT-ENDURANCE	<0.05	<0.05	<0.05

DISCUSSION

Our findings suggest that both protocols are effective in reduction of pain in chronic low back pain. It has been suggested in previous studies that a central widespread inhibitory mechanism is activated with muscle contractions. The central mechanisms include increased secretion of β-endorphins, attenuation mechanisms, activation of diffuse noxious inhibitory controls, or an interaction of the cardiovascular and pain regulatory systems causing hypo analgesia post exercise. In our study also exercises can be a reason to reduce pain. Therefore, after exercising, the muscles relax and there is a release in the spasm of hypertonic muscles along with release of neurotransmitters. These mechanisms of the central nervous system lead to alleviation in pain (Naugle *et al.,* 2012). Mann Whitney u test for comparison of ODI scores between the groups, indicate Hip Extensor Strength training had an added effect as compared to General Trunk exercises in improving the functional ability of patients with chronic low back pain. Significant difference within the groups can be the result of pain relief and exercise regime for both the groups whereas significant difference between the Groups can be explained by the effect of strength training for Hip Extensors given to Group A causing efficient load transfer and adequately improved activation time enabling activities along with providing lumbar support, thus improving their daily functions. Many previous studies have shown improvements in ODI scores after resistance training in low back pain (Mose Monday Omoniyi *et al.,* 2013). Results of functional status in chronic low back pain patients match with the fact that Gluteus Maximus is the important muscle in lumbar pelvic region for load transfer from low back to lower extremity as required for activities of daily living (Rochenda Rydeard *et al.,*). Activities of daily living in healthy individuals show proper activation pattern of Gluteus Maximus in trunk flexion extension movements, thus providing bracing and support to the back through its attachments to thoracolumbar fascia (Leinonen *et al.,* 2000). Proper activation patterns and effective load transfer achieved by training of Gluteus Maximus hence show improvements on ODI scores. According to a Finnish study, pain intensity (measured by VAS) and Lumbar disability (measured by ODI) show moderate correlation. Hence, pain relief caused by general exercises can improve functional ability to some extent (Ferrin *et al.,* 2014). Despite of this pain relief, recurrence of functional disability and pain on resuming activities of daily living have been a major concern. Many studies conducted in the past failed to show complete long term correlation between pain relief and functional status of patients with chronic pain (Ferrin *et al.,* 2014). Results of our study relate well to the findings of Andry *et al.* showing the advantageous effect on the posterior layer of thoracolumbar fascia by giving strength training to the Gluteus Maximus along with specific trunk training which helps in avoiding pain on resuming activities of daily living (Andry Vleeming *et al.,* 1995). Study by Andry Vleeming *et al.* describes the influence of Gluteus Maximus training on the posterior layer of thoracolumbar fascia. This study shows the contra lateral relationship between Gluteus Maximus and Latissimus Dorsii enabling uninterrupted mechanical load transfer between the pelvis and trunk (Andry Vleeming *et al.,* 1995). Delorme and Watkins progressive resistance training in low back pain has shown resolution of symptoms along with effective load transfer (Mose Monday Omoniyi *et al.,*). N. Shakoor *et al.* stated pain to be a factor which is known to affect strength. Temporary reduction in pain improves the maximum voluntary contraction with a decrease in abnormal involuntary muscle activation (Shakoor *et al.,* 2008). Many studies conducted in the past suggest that pain influences maximum voluntary muscle strength and activation (Shakoor *et al.,* 2008). Significantly increased muscle endurance time within and between both the groups seen could be a result of strength training causing short term improvements in muscle endurance as stated by Hickson *et al.* for Group A and pain relief caused in both groups with hot pack and General Trunk exercises which nullifies the consequences of pain avoidance behavior or fear of pain on movement thus showing strength and endurance gains. Findings of our study indicating improvements in endurance time with strength training are supported by Hickson RC *et al.* as they show the effect of resistance training in increasing short term muscle endurance (Hickson *et al.,* 1980). Thus, study shows that Hip Extensor strength training exercises and General trunk exercises both were equally effective in reducing pain on VAS, but added improvements were seen in functional status on ODI, Hip Extensor Strength and Endurance gains by including Hip Extensor strength training exercises to General Trunk exercises as compared to giving General Trunk exercises alone.

Conclusion

Hip extensor strength training had added improvements in functional status with no significant difference in pain.

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Conflict of interest: Nil

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