Research Article

Effect Of Pressure Biofeedback Training Versus Swiss Ball Training On Pressure Pain Threshold, Core Endurance and Disability in Chronic Non-Specific Low Back Pain

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Abstract

Introduction
Chronic nonspecific low back pain (CLBP) is defined as pain in the lumbosacral spine that persists for more than 3 consecutive months 4 without an identifiable anatomical or neurophysiological cause and may be of mechanical, musculoskeletal, or multifactorial origin.

Aims & Objective: To compare the effect of pressure biofeedback training and Swiss ball exercise training on Pressure pain threshold, Core endurance, Core strength, and Disability in chronic NSLBP.

Methods: In present comparative study, thirty-four patients with non-specific low back pain with age group of 30-45 years were included on basis of inclusion criteria. The participants were randomly assigned to a 4-week intervention protocol and allocated randomly to Group A and Group B with 17 participants in each. Group A received pressure biofeedback training with conservative treatment and Group B received Swiss ball exercise with conservative treatment. The examiner measured PPT, Core strength, Core endurance and disability before the intervention on the first day of the treatment & then again after 2-week all the outcomes measured in both groups. Post assessment data of all the outcomes was taken at the end of 4 week. Same Conventional treatment was given to both the groups. The level of significance was set at α =0.05 and Confidence Interval was set at 95%.

Result: The data were ensured for their normal distribution using Shapiro-Wilk Test. So, the parametric test was used for within group analysis for the data which were normally distributed and non-parametric test was for the data which were not normally distributed. Repeated measures ANOVA test as a parametric test and Friedman test as a non-parametric test have been used to analyze the variables pre-intervention, to intermediate-intervention, to post-intervention with calculation of change.

Conclusion: in both groups significant changes were found in the intra-group comparison in PPT, core endurance, core strength and ODI. on comparing mean difference of both groups pressure biofeedback training along with conservative management was found to be more effective in improvement of, core endurance than the swiss ball exercise group. although swiss ball exercise training along with conservative management was found to be more effective in improvement of core strength than the pressure biofeedback training group and there was no significant change were found in pressure pain threshold and Oswestry disabiltity index between both groups.

Introduction

Over 50% of elderly people experience musculoskeletal pain, with low back pain being the most prevalent type, which up to 80% of people experience at least once in their life.[1]

Non-specific low back pain is defined as low back pain not attributable to a recognizable, known specific pathology (eg, infection, tumour, osteoporosis, lumbar spine fracture, structural deformity, inflammatory disorder, radicular syndrome, or cauda-equina syndrome).[4] it is defined as "pain, tension and/or local rigidity below the marginal ribs and above the lower gluteal fold.[5]

A recent focus in the management of chronic low back pain patients has been the specific training of the deep abdominal (internal oblique and TrA) and lumbar multifidus muscles. The primary role of these muscles is considered to be the provision of dynamic stability and segmental control of the spine.[6]

The Pressure biofeedback has come into general use in physiotherapy practice in assessing the abdominal drawing-in action, and is also frequently used as an aid in stabilization, re-education for all parts of the body. Pressure biofeedback is used to identify the presence or absence of low back pain and transversus abdominis muscle dysfunction.[2]

Swiss-ball core training programs are among the most popular trends in physiotherapy and strength and conditioning programs. Benefits of Swiss-ball core training exercises that facilitate spinal stability and balance have often been emphasized by researchers to develop strength, endurance, flexibility, and neuromuscular control as a cost effective and enjoyable way to prevent lower back injury and lower back pain.

Both pressure biofeedback exercise and Swiss ball exercise have been given to chronic nonspecific low back pain patient but till date no comparison has been done to see the effect of both these exercise on chronic nonspecific LBP patients. In Author's Knowledge, There Is Lack of Evidence on Pressure pain threshold in nonspecific LBP Patient, So This Study Will Provide Information about Which of These exercises Is More Effective In decreasing PPT and disability and improving core endurance in patients with nonspecific LBP.[3]

Also, less studies have been done on Effect of these exercises on pressure pain threshold in nonspecific low back pain patients and hence this study will significantly contribute for an effective intervention protocol to improve the pressure pain threshold, lumbar functions and core endurance and hence improve the functions and quality of life in patients with Chronic Nonspecific low back pain.

Aims and objective - To check the effect of Pressure biofeedback training versus Swiss ball training on pressure pain threshold, core endurance and disability in chronic non-specific low back pain

Methodology

Study design was Pre-Post experimental study. Study Population consisted of Patients of Chronic nonspecific low back pain . Sampling technique was convenient sampling Study duration: 1 Year . The sample size was calculated using G POWER 3.1.9.7 version, in which α was set at 0.05, power at 0.80and effect size at on the basis of pilot study. Hence the sample size obtained was 32 and with calculating 5% dropout rate, sample size obtained was 34 which was taken for analysis. Study setting: Various Physiotherapy OPD'S from SURAT.

Inclusion criteria: Patients willing to participate in the study were included if they met the following criteria: Either gender between 30 to 45 years of age group. Patients with clinically diagnosed chronic mechanical low back pain.[12] Patient having complain about chronic nonspecific LBP for more than 3 months.[7] Subjects with minimum to moderate disability (up to 40%) ODI [12]Exclusion criteria: Any previous or current experience in core strengthening in last 6 months. Subjects who were on regular fitness program[12] No current musculoskeletal degenerative, neurological condition, Severe or excruciating pain[6]

Any constitutional symptoms (fever), History of fracture in past 6 months, History of abdominal surgery in past 6 months, Any inflammatory condition, Pregnancy ,Any psychological illness or cognitive impairment, Other clear causes of LBP such as spinal stenosis, ankylosing spondylitis, sciatica, PIVD. Materials and Tools included Pressure biofeedback unit[14], Swiss ball size = 45-55 cm [8],Oswestry low back pain disability questionnaire sheets.[10] Pressure algometer[15]

Outcome Measures: 1. Pressure pain threshold was measured using Pressure Algometer[7] 2. Disability score was measured using Oswestry Low Back Pain Disability Questionnaire.[19] 3. Core endurance measurement pre and post exercise program was taken using pressure biofeedback unit[16,17] 4. Core strength was measured using Double leg lowering test[9]

Evaluation of PPT- Pressure pain threshold was measured using a Pressure Algometer (Wagner algometer, Force dial FDK 20, Wagner instruments, Greenwich connceticut) with a 1cm2 probe area was used as an analogue algometer. There was 30-s interval between measurements and a 10-s rest period was given between each test. Three measurements were taken for each point and the mean of the three measurements were used for data analysis. Previous studies with comparable hand-held analogue algometers showed ICC values for [6]intrarater reliability ranging from 0.79 to 0.91 in healthy participants.[22]Pressure pain threshold values of Erector spine and Transverse Abdominis muscles data were collected by pressure algometer. Location for PPT measurement [7] Erector spine-horizontal fifth lumbar vertebrae para spinous Transversus abdominis- the intersection of the vertical line of the iliospinale posterior height and the horizontal line of the transverse process of the third lumbar vertebra.

Evaluation of core endurance: - On the first day of the first week, core endurance of the patient was checked with PBU unit. Then pressure biofeedback training started after conventional exercise. After 2 weeks to measure core endurance with pressure biofeedback unit. Post assessment was taken at the end of 4 week. Testing for Transverse Abdominis muscle: The participant lay in a prone.The aim was to measure the ability of each subject to perform abdominal hollowing, holding the contraction for 4 seconds within a 10-second period, and monitored using a watch. If the participants demonstrated a decrease in pressure of at least 1 mmHg for 4 consecutive seconds within a 10-second period (pressure criterion), this was recorded as a positive test result for the Prone test (i.e. a positive result for

the complete criterion). Otherwise, the participant attained a negative result for the complete criterion[16]

Testing for Multifidus muscle: - the participant lay in a side lying position, then place a PBU under the lateral to the spinous processes of the lumbar spine. then Inflate to 70 mm Hg and instruct the patient to perform the drawing-in maneuver. If done properly, the pressure drops 6 to 10 mm Hg. Have the patient maintain the gentle contraction while resuming relaxed breathing. if the patient can maintain the pressure drop for up to 10 second, Muscle endurance (holding or tonic capacity) of the Multifidus is measured by the number of 10-second holds (up to 10)[17]

Evaluation of core strength: - A test presumed to characterize abdominal strength is the double leg-lowering test. [29]. On first day core strength was taken by DLLT. After 2 weeks again core strength was taken. Post assessment was taken at the end of 4 week. Grading scheme was used for the double-leg-lowering test.

Functional disability was assessed via Oswestry Disability Index.it is considered the 'gold standard' of low back functional outcome tools.[18]On first day, after 2nd week and end of the 4 th week the ODI score was taken.

Procedure: - The participants were randomly assigned to a 4week intervention protocol and allocated randomly to Group A and Group B. The examiner measured PPT, Core strength, Core endurance and disability before the intervention on the first day of the treatment. The patients were screened on the basis of inclusion and exclusion criteria and their demographic data were taken by a patient screening form. Prior to the commencement of the study, detailed procedure of the study was explained to the patients and a signed informed consent form were taken from them. Then the subjects were allocated to any of the two groups by random allocation using coin method Description of the groups are given as follows: **Group-A:** Conventional treatment + Pressure biofeedback training

Group-B: Conventional treatment + Swiss ball training. On the first day of the first week, baseline measurements of Pressure Pain Threshold, core strength core endurance and disability were taken. Again after 2- week, measurement of pressure pain threshold with Algometer, core strength with Double leg lowering test and core endurance with pressure biofeedback and ODI Score were taken in both groups. Total treatment was of 4 weeks with 6 sessions per week. Post assessment data of PPT, Core strength, endurance and ODI score were taken at the end of 4 week.

Intervention- Same Conventional treatment was given to both the groups. Conventional treatment includes Conventional Treatment-Both A and B Group Both groups receive same conventional protocol as follows, Hot pack was given for 10 minutes, followed by Bridging exercise, Pelvic tilt, Back extension exercise (prone on elbow), Knee to chest exercise. These exercises given with 10 repetition, 6 days per week.[20] Group A= Conventional Exercise+Pressure Biofeedback Training In Group A total duration of each treatment was around 35-40 mins. Training for Transverses Abdominis muscle: Patient position and procedure:- Side lying, Place your palpating digits (thumbs or index fingers) immediately lateral to the spinous processes of the lumbar spine. Palpate each spinal level so comparisons in the activation of the Mf muscle can be made between each segment as well as from side-to-side. Instruct the patient to "swell the muscle" out against your digits. Palpate for consistency of muscle contraction at each level. In the side-lying position, facilitate by gently applying manual resistance to the thorax or pelvis to activate the rotation function of the Multifidus. Then place a PBU under the lateral to the spinous processes of the lumbar spine. then Inflate to 70 mm Hg and instruct the patient to perform the drawing-in maneuver. If done properly, the pressure drops 6 to 10 mm Hg. Have the patient maintain the gentle contraction while resuming relaxed breathing. if the patient can maintain the pressure drop for upto 10 second.[17]In first two week 10 repetitions were given .Next two week, 15 repetitions were given as progression.

Group B=Coventional Exercise +Swiss Ball Exercise In Group B total duration of both treatment was around 35-40 mins. In first two weeks 5 repetition of each exercise were given and then the core endurance was checked with pressure biofeedback unit. Next two week 15 repetitions were givenas progression. Four different types of exercise with Swiss ball were prescribed. 1. Swiss ball alternate arm and leg extension 2. Swiss ball wall squat3. Swiss ball Shoulder Bridge 4. Swiss ball back extension: [8]

Statistical analysis & Results : The Statistical software named statistical package of social sciences (SPSS) version 20 (SPSS 20.0) was used for the analysis of the data and Microsoft word 2013 and Excel 2013 was used to generate graphs and tables. Descriptive statistical analysis was carried out at 95% confidence interval. Outcome measurements analyzed were presented as mean ± SD. Significance was assessed at 5% level of significance with $p \leq 0.05$. Total sample size analyzed was 34 [11]. There were no dropouts. For checking the homogeneity of the data, the Levene's test for equality of variance was done. The data were ensured for their normal distribution using Shapiro-Wilk Test. The level of significance was set at $\alpha = 0.05$ and Confidence Interval was set at 95%.

Results

There is total 17 subjects in group A and 17 in group B and there was no dropout in any group. Table shows that PPTTA, PPTES, CETA, CEMF are normally distributed CORE STRENGTH and ODI are not normally distributed, parametric test were used for normally distributed data and non-parametric test were used for not normally distributed data for further analysis.

Table 1.For within group analysis of group A ANOVA test

Variables		Group A		
		Sum of squares	F value	P- value
PPT	TA	11176.118	728.501	0.000
	ES	1232.896	526.009	0.001
Core enduerace	TA	2863.059	223.522	0.000
	MF	2144.118	185.555	0.000

Table 2.Within group analysis of group A Friedman test

Variables	Group A		
	χ^2	df	P- value
Core strength	25.8	2	<0.001
ODI	38.0	2	<0.001

Table 3.Within group analysis of group B ANOVA test

Variables		Group B		
		Sum of squares	F value	P- value
PPT	TA	1265.018	879.823	0.000
	ES	1303.490	671.096	0.000
Core enduerace	TA	1284.735	231.576	0.000
	MF	942.382	160.205	0.000

Table 4.Within group analysis of group A Friedman test

Variables	Group B		
	χ^2	df	P- value
Core strength	31.6	2	<0.001
ODI	38.0	2	<0.001

Table 5.Independent sample t-test for mean difference of outcome measure of both groups

	t-Test For Equality Of Means				
	t	df	Sig.(2-tailed) p value	Mean difference	Std. Error difference
MEAN DIFF PPTTA	-0.728	32	0.472	-0.436	0.599
MEAN DIFF PPTES	-4.79	32	0.635	-0.34000	0.7101
MEAN DIFF CETA	-4.123	32	0.000	-6.058	1.469
MEAN DIFF CEMF	-3.737	32	0.001	-5.352	1.432

Table 6. For Mann-Whitney u test for mean difference of outcome measure of both groups

	t-Test For Equality Of Means				
	t	df	Sig.(2-tailed) p value	Mann-Whitney U test	Std. Error difference
MEAN DIFF CS	3.997	34	0.000	255.500	27.76
MEAN DIFF ODI	-1.062	34	0.306	114.00	28.73

Discussion

This study was determined to compare the effect of pressure biofeedback training and Swiss ball exercise. This study was conducted on 34 subjects with age group 30-45 years. In group A significant changes were found in the intra-group comparison of pain pressure threshold change signifying that the pain pressure threshold improved after intermediate and post-test intervention in transverse abdomen is muscle and erector spinae muscle. This shows that pressure biofeedback training along with conservative management is improving the PPT, these findings were supported by Changmingxu et al, who also reported that after transverse abdomen is training the blood circulation of the core muscles is activated which could promote the absorption of pain inflammatory factors.

In group B, also significant changes were seen in the intra group comparison of PPT changes. The PPT was improved in the intermediate and post-test. Signifying that Swiss ball exercise along with conservative management and increasing the PPT, these findings were supported by Rajan Balakrishnan et al who also reported that Swiss ball exercise is effective for reducing the pain in nonspecific low back pain.[12]

Both in In group Aand Group B, the result was significant in the intra group comparison of the core endurance changes., signifying that core endurance was improved after 4 week of intervention programme.

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As mean difference of group A was more than group B, this shows that Pressure biofeedback training was more effective in improvement of Core endurance. If we compare both the muscles, pre-test score of core endurance of Transverse abdominis was more than the multifidus muscle. The core endurance was improved in intermediate and post-test. On the basis of post-test mean, the core endurance was more improved comparatively intermediate test because the number ofrepetitionswasincreasedafter2nd week.

Both in In group A and Group B, the result was significant in the intra group comparison of the core strength changes., signifying that core strength was improved after 4 week of intervention programme.These findings were supported by, P.Pragya et al, who also found that combination of conventional exercise with pressure bio feedback training is more beneficial in increasing the efficiency of the deep abdominal function.[21]

These findings were supported by Betul Sekendiz et al, who also described that Swiss ball core strength training protocol providing the coactivation of global and local muscles of the core and significant improvements instrengthandenduranceofthelowerbackabdominals.[8]

On comparing both group's , As mean difference of group B was more than group A, this shows that Swiss ball exercise training was more effective in improvement of Core strength, which may be due to the following reasons: Reduction in contact area, Increase in perturbations, Control of center of gravity within limited base of support. Gregory J Lehman stated that, performing a bridge on the Swiss ball finds the participants in a more vertical position than floor. Therefore, more muscle activity is required to produce secondary spinal stabilization due to labile surfaces. The subjects were highly motivated during the training, probably due to the fun nature of this program and also their desire to tone up their core muscles to improve theirbodyshapes.[12]

In group A, significant change were found in the intra-group comparison of ODI, signifying that disability score was reduced after the intervention programme. In group B, the result was significant in the intra-group comparison of the ODI, signifying that disability score was reduced after the intervention programme. These findings were supported by Paul V.M. Marshall et al, who also describes that the Swiss ball exercise was effective in improving functional capacity and it may lead to positive results in rehabilitation programme.[13]On comparing both groups, there was no Significant Difference between Pressure Biofeedback Training and Swiss ball Training on Oswestry disability index in Subjects with Chronic Non-Specific LBP.

Limitations of the study and future recommendations

The study was limited to one geographical location. This study was carried for the specific age group hence, the result cannot be generalized for the overall population of chronic non-specific LBP. Intervention was only of 4-week duration, no follow-up was taken after that. Hence, the consistency of the result i.e. the long-term effect of the intervention, cannot be evaluated. In the future larger sample size can be taken and from different zones and cities. Further study can be carried out considering other age groups. Further study can be done by taking follow-up and evaluating the long-term effect of the intervention. Further study can also be done by evaluating the muscle recruitment of TA and multifidus and erector spinae muscles with the help of EMG in NSLBP patients.

Conclusion- Swiss ball exercise training along with conservative management was found to be more effective in improvement of core strength than the pressure biofeedback training group and no significant change was found in Pressure Pain Threshold and Oswestry Disability Index between both the groups.

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