Original Article

Physiotherapy and Occupational Therapy Journal
Volume 11 Number 1, January - March 2018
DOI: http://dx.doi.org/10.21088/potj.0974.5777.11118.2

Efficacy of Swiss Ball Exercises versus Floor Exercises in Mechanical Low Back Pain: A Comparitive Study

Uzma Khan[1], Shefali Pushp[2], R.K. Meena[3]

Abstract

Aim: The aim of study was to find out the efficacy of swiss ball exercises versus floor exercises in mechanical low back pain patients.

Methodology: The number of subjects was 30 (n=30) with both males and females and randomly divided into 2 groups (group A & group B). *Intervention*: Both the experimental groups (group A & group B) received a moist heat pack prior to the treatment with ergonomics care and strengthening exercises one group on swiss ball and another on floor for 4 weeks (3 days/week). *Outcome measures*: The pre & post readings of outcome measures Visual Analogue Scale (VAS), Oswestry Disabilty Index (ODI), Dynamic Extension Endurance Test (DEET), Dynamic Abdominal Endurance Test (DAET) & Multifidus Test (MT) was taken to find out the improvement in both the groups.

Result: Comparison of values of both the groups showed a highly significant improvement in low back pain, endurance and decreasing in disability but there is no significant difference between both the groups.

Conclusion: It is concluded that both the exercises (Swiss ball & Floor) are equally effective in reduction of low back pain, disability and increasing endurance.

Keywords: Mechanical Low Back Pain; Visual Analogue Scale (VAS); Oswestry Disability Index (ODI); Dynamic Abdominal Endurance Test (DAET); Dynamic Extension Endurance Test (DEET); Multifidus Test (MT).

Introduction

In this present scenario low back pain is a most frequent musculoskeletal problem that is seen in practices affect all range of population. The Low back pain is may be defined as a pain, discomfort, aching, localized below the area of costal margins and the gluteal folds with or without leg pain (sciatica) (Omokhodion et al 2002) [1] Or as pain limited to the region between the glutei fold with or without leg pain (Manek and Macgregor 2005) [2]. Although acute low back pain is very commoner but 10-15% of patient of acute low back pain develops into chronic low back pain.

"Mechanical or non-specific low back" pain may be defined as a unknown pathology or unknown cause or unilateral pain with no referral below the knee may be caused by injury to muscles(strain) or ligaments (sprain), the facet joint, or in some cases, the sacroiliac joints [3]. According to its duration, low back pain may be:-

a. Acute (less 6 weeks) – acute low back pain is usually define as a duration of an episode of low back pain persistent less than 6 weeks.
b. Sub-acute (6-12 weeks) - low back pain which persist for 6 to 12 weeks.
c. Chronic (12 weeks and more) - long term or low back pain which persisting for 12 weeks or more [4].

Whereas the Core stability plays an important part in rehabilitation of low back pain. Core included the

Author Affiliation: [1]Assistant Professor [2]Associate Professor [3]Professor & Principal, Subharti College of Physiotherapy, Swami Vivekanand Subharti University, Meerut, Uttar Pradesh 250005, India.

Reprint Request: Shefali Pushp, Associate Professor, Subharti College of Physiotherapy, Swami Vivekanand Subharti University, Meerut, Uttar Pradesh 250005, India.
E-mail: prasadsc1@gmail.com

Received on 05.02.2018, **Accepted on** 09.02.2018

abdominals, trunk, pelvic floor muscles. Core stability may also be defined as a strengthening of the corset muscles surrounding the back and abdomen. Non specific low back pain caused by the mechanical factors. The "Bradford Hill" criteria includes the occupational sitting, awkward postures, standing & walking, pushing & bending and twisting, lifting and carrying were independently causative for low back pain in the population of workers [5].

Need of Study

Back pain is a leading cause of disability interfering with quality of life and work performances. As many studies have been done to overcome the low back pain by mean of various physiotherapy intervention like heat therapy, electrical modalities & exercise therapy but none of the researcher have compared these two exercises to decease pain, disability & endurance so that the need of study is:-

- Own Interest of the Researcher
- For the further prevention/recurrence of the Low back pain.
- There is less empirical data available to support the efficacy of Swiss ball training.
- As lifestyle is changes, chances of low back pain may occur through the strengthening exercises and ergonomics we can decrease the chances.

Operational Definitions

Strengthening Excercises: Strength training or strengthening exercises is defined as a systematic procedure of a muscle or muscle group lifting, lowering or controlling heavy loads (resistance) for a relatively low number of repetitions or over a short period of time [6].

Swiss Ball: Swiss ball is an versatile piece of exercise equipment available to help people with back pain. swiss ball improves the strength of abs, back muscles, in balance, co-ordination & ROM of the joints [7].

Oswestry Disability Index: Oswestry disability index is a good functional scale because it deals with activity of daily living & therefore is based on the patient response and concerns affecting daily life. It is used to measured patient perceived functional disability. It is most commonly used functional back scale. It is calculated by dividing the total score (1-6) by number of section answered and multiplying by 100 [8].

Visual Analog Scale: The visual analog scale is one of the most basic pain measurement tools. It consists of a 10cm line. The clinician can measure the place on the line & convert into it a score between 0 to 10 where 0 is no pain at all and 10 is pain as bad as it could be [9].

Dynamic Abdominal Endurance Test: This test checks the endurance of the abdominals. The patient will be in crook lying position or in supine with hip 45 degree and knees is at 90 degree and hands at a side. This test may also be done as an isometrics test by assuming the end position & holding it. The grading for this isometrics abdominal test would be dividing into 5 grades [10].

Dynamic Extensors Endurance Test: The test is designed to test the strength of erector spinae & multifidus. The patient will be in prone lying with arm at a side .The test may also be done isometrically and the examiner note the times how long the patient can hold the contrctions without pelvis & spinal movements. The test would be divided into 5 grades [11].

Multifidus Test: Check the ability of lumbar rotators & multifidus to stabilize the trunk during dynamic extremity movement. The patients assume in quadrupeds position and is asked to hold the neutral pelvis position and breathe normally. This also be divided into 5 grades [12].

Materials and Methodology

Ethical approval was obtained from the board of studies of Jyoti Rao Phule Subharti College of Physiotherapy, Swami Vivekananda Subharti University, Meerut, Uttar-Pradesh (U.P), India.

A written informed consent was taken from all the participants and allocated into 2 groups on randomly selection. Both of experimental groups i.e., group A and group B have 15 participants in each. The pain, disability and endurance in mechanical low back pain were assessed with a help of Visual analog scale (VAS), Oswestry disability index (ODI), Dynamic abdominal endurance test (DAET), Dynamic extension endurance test (DEET) and Multifidus test (MT) respectively. All the patients were assessed using a similar assessment performa. Both males & females with mechanical low back pain of duration less than 6 weeks (acute) and age between 20 to 30 were included in the study. Subjects with any congenital causes, Traumatic causes,

Inflammatory causes, Neoplastic causes, any Radiculopathy, Any spinal surgery, Gynecological causes, Athletics & gymnastics were excluded for the study. A Swiss ball of 85cm in diameter was used in this study. An appropriate reading of VAS, ODI, DAET, DEET and MT was taken on first day (day 1) and last day (day 28th). The treatment plan of

Group A: Moist Heat Pack + Swiss ball exercises.

Group B: Moist Heat Pack + floor exercises.

Procedure

Group A:

Swiss ball used in this study were provided in size of 85cm in diameter according to the height of subjects, to provide a better grip on the ball.

Crunches

Position of Therapist: At the side of a patient.

Position of Patient: The patient is lie on the ball with hip and lower torso above the ball or your middle back resting on top, with hip is at 0 degree and knee is at 90 degree of flexion & arms straight at the side with feet flat on the ground. Then therapist is asked to lift your chest off the ball bringing your shoulder up or curl your upper body forwardly keep your arm straight throughout the exercise and focus straight up the ceiling instead of looking down would cause unnecessary sprain in your neck & return shoulder to ball. 2 to 3 sets of 8 to 12 repetitions [13].

Back Extension

Position of Therapist: At the side of a therapist.

Position of Patient: Put the exercise ball in the area. You should have plenty of space to move around, and all sharp/heavy objects should be removed so as to minimize the potential for the accidents. Lean forward so that your mid section rests on the ball. Straight your legs out behind you. Keep your feet's & toes on the contact of ground. Don't touch the ground with any other part of your body. Once you have fully extended your legs, the hands are placed on your lower back. Ask to inhale & lift your torso up or raise the chest/stomach from the waist up so that the chest from the waist up so that the entire body forms a straight line, imagine that someone holding a ruler next to your body and you are trying to align with it. Stop once you have reached a comfortable position and hold it for 10 to 15 seconds and 2 to 3 sets and 8 to 12 repetitions for each legs/arm [13].

Multifidus

Position of Therapist: At the side of patient.

Position of Patient: Firstly put the exercise ball in plenty of area, the patient is in prone kneeling position or in quadruped position above the ball so that the patient mid-section rests on the ball. The trunk is horizontal, supported under the shoulder by the arms and the pelvis by the thighs, and must be held vertical. The head is held in line with the trunk.

Instruction to Patient: Ask the patient that trunk is remain horizontal, supported under the ball & hands are under the shoulder.

Ask the patient to raise or lift the opposite arm and opposite leg (left arm and right leg) a hold then returning back to starting position and hold it for 10 to 15 sec.

Group- B (on floor)

Crunches

Position of Therapist: At the side of a couch.

Position of Patient: The patient is in crook lying or lying on back on feet flat on the ground with knee bent at 90 degree, the hip at 45 degree with arms at the side. Ask the patient raise the chest or to curl up with arm at the side or using your abdominal and by reaching both of your arms straight out in front of you and then return slowly to the start position.

Back Extension

Position of Therapist: At the side of a couch.

Position of Patient: The patient is lie in prone position with forearm and elbow supported on couch. Ask a patient to slowly raise your trunk in extension in a pain free range and your elbow joint and shoulder joint are lie in a same line by leaning on the forearm and curling of shoulders and upper back and hold it and then returning to a start position and 10 to 15 seconds hold.

Multifidus

Position of Therapist: At the side of a couch.

Position of Patient: The patient is in quadruped position, before you start the exercise make sure that your hands are under your shoulders and knees are under your hip, without arching back and keeping head in line with spine. Ask the patient to lift or raise the opposite arm and leg similar to superman, but they are executed from an all four positions. Steadily raise your left arm straight in front of your body, and extend your right leg straight behind you. After holding your arm and leg returning to starting position and repeat on your other side and hold for 10 to 15 sec.

Ergonomic Advices

The ergonomic advices are given in both the group A & group B.

Statistical Analysis

All result analysis were obtained using SPSS version 20.0. The dependent variables for the statistical analysis were VAS, ODI, DAET, DEET and MT. A base line data was taken at the beginning of the study (pre test values) and after the completion of the treatment (post test values). Results were summarized as mean± standard deviation and t-test. A level of 0.05 was used to determine the statistical significance.

Result

Table 1: Mean & Standard Deviation of Pre & Post Scores of ODI & VAS in Group A & Group B.

S. No.	Groups	Age (in Years)	Pre Scores (Mean ± S.D.) ODI	Pre Scores (Mean ± S.D.) VAS	Post Scores (Mean ± S.D.) ODI	Post Scores (Mean ± S.D.) VAS
1	Group A	23.13±2.10	45.67±4.17	5.67±.89	18.6±1.24	.2±.5606
2	Group B	21.8±2.04	43.2±2.81	5.33±.81	18.87±1.60	.6±.633

Table 2: Mean & Standard Deviation of Pre & Post Scores of Dynamic Abdominal Endurance Test, Dynamic Extensors Endurance Test and Multifidus Test in Group A & Group B.

S. No.	Groups	Dynamic Abdominal Endurance Test		Dynamic Extensors Endurance Test		Multifidus Test	
		Pre Scores	Post Scores	Pre Scores	Post Scores	Pre Scores	Post Scores
1	Group A	2±0	3.13±.3519	2.2±.414	3.2±.414	2.73±.458	3.87±.3519
2	Group B	2±0	3±0	2.33±.488	3.4±.507	2.8±.414	3.73±.458

Table 3: % Mean & Standard Deviation of difference b/w Pre to Post Scores of ODI & VAS in Group A & Group B

S. No.	Groups	% Mean difference b/w pre to post scores in ODI	VAS
1	Group A	58.6±3.52	96.22±10.90
2	Group B	56.2±4.54	89±11.44

Table 4: %Mean & Standard Deviation of difference b/w Pre to Post Scores of Dynamic Abdominal Endurance Test, Dynamic Extensors Endurance Test and Multifidus Test in Group A & Group B

S. No.	Groups	%Mean difference b/w pre to post scores in Dynamic Abdominal Endurance Test	Dynamic Extensors Endurance Test	Multifidus Test
1	Group A	35.56±5.86	30±16.90	28.89±12.94
2	Group B	33.33±0	31.67±6.46	24.44±11.98

Table 5: Comparsion b/w Pre to Post Scores for ODI & VAS in Group A & Group B (by paired "t" test)

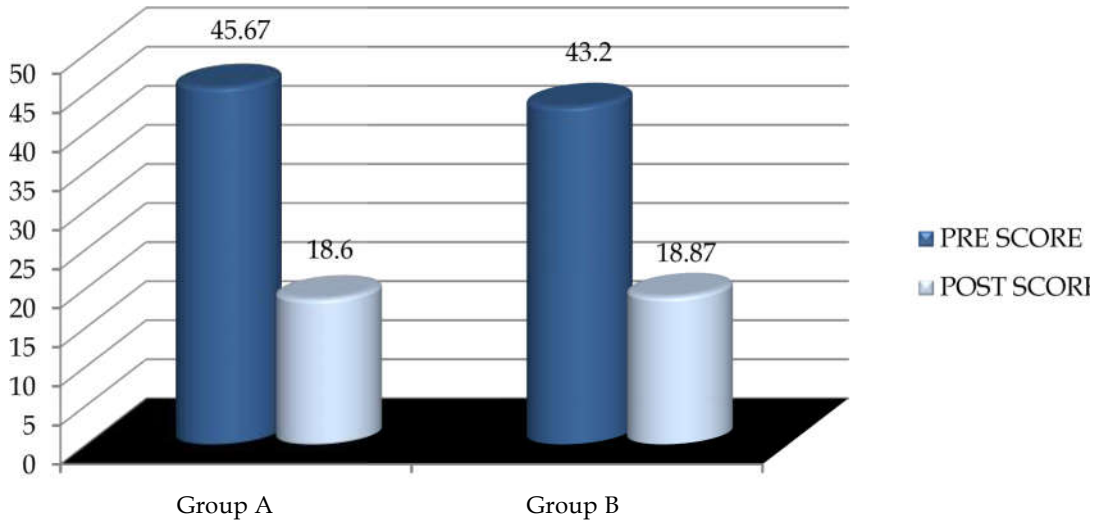
S. No.	Groups	Probability of paired't" test b/w pre to post scores for ODI	VAS
1	Group A	.0000* (P<.05) SIGNIFICANT	.0000* (P<.05) SIGNIFICANT
2	Group B	.0000* (P<.05) SIGNIFICANT	.0000* (P<.05) SIGNIFICANT

* Shows a significant difference AT .05 level of significance. I.E. P<.05

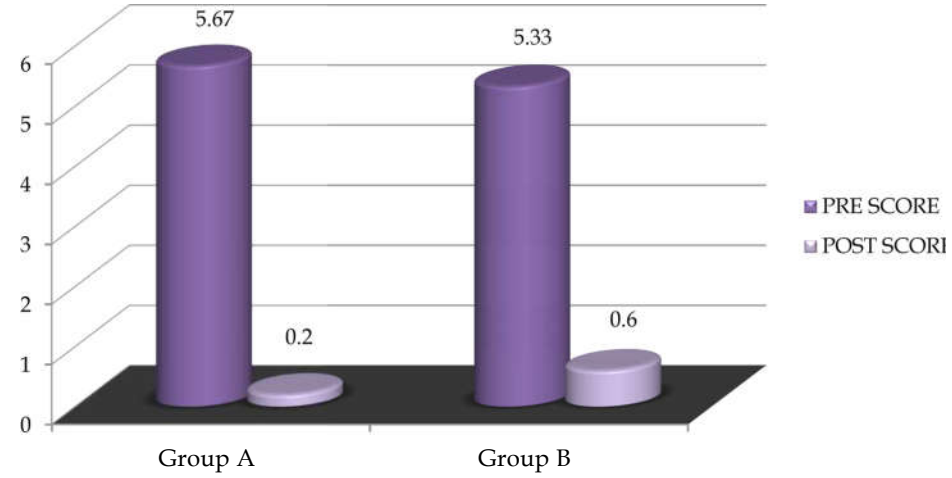
Table 6: Comparsion b/w Pre to Post Scores for Dynamic Abdominal Endurance Test, Dynamic Extensors Endurance Test and Multifidus Test in Group A & Group B (by paired"t" test)

S. No.	Groups	Probability of paired't" test b/w pre to post scores for Dynamic Abdominal Endurance Test	Dynamic Extensors Endurance Test	Multifidus Test
1	Group A	.0000* (P<.05) Significant	.0000* (P<.05) Significant	.0000* (P<.05) Significant
2	Group B	.0000* (P<.05) Significant	.0000* (P<.05) Significant	.0000* (P<.05) Significant

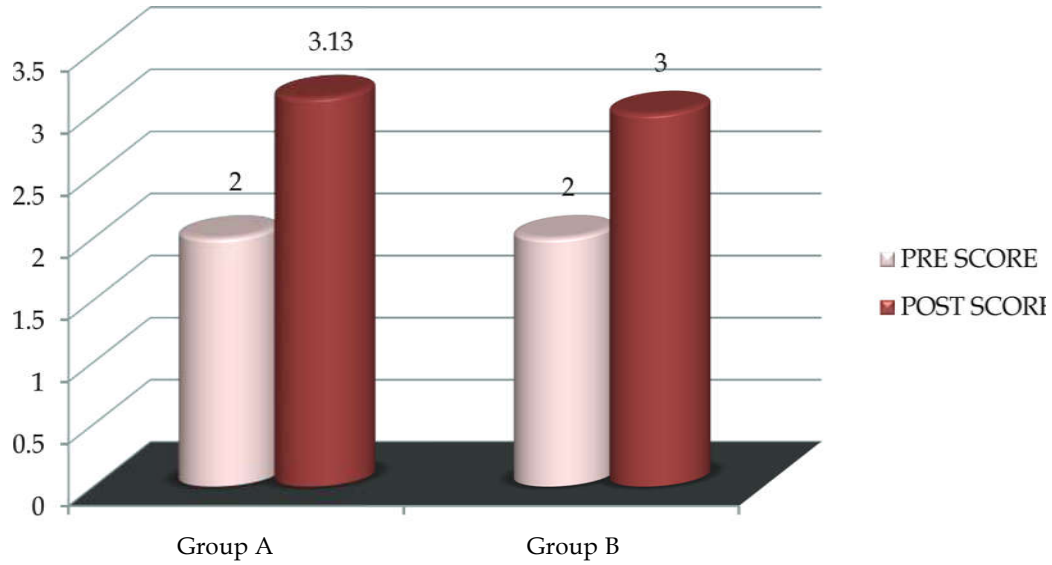
* Shows a significant difference at .05 level of significance .i.e. p<.05



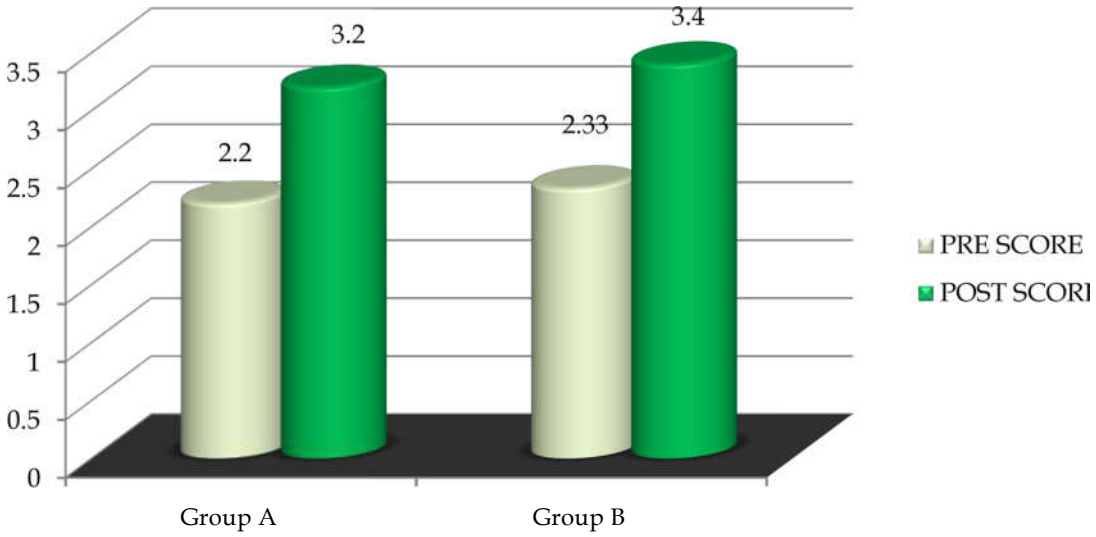
Graph 1: The Bar Chart of Average Pre ODI & Post ODI Scores in two Groups



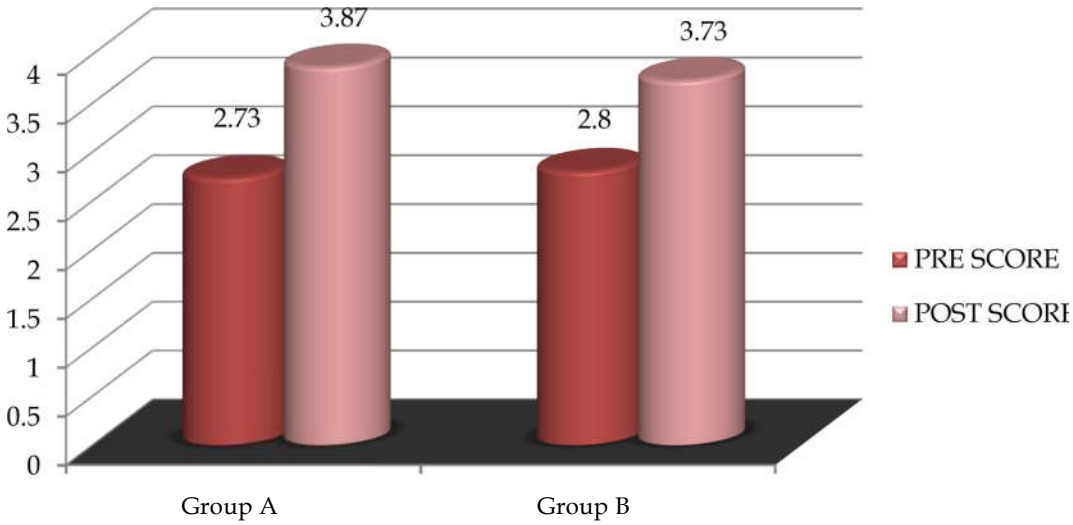
Graph 2: The Bar Chart Diagram of Average Pre VAS & Post VAS Scores in two Groups



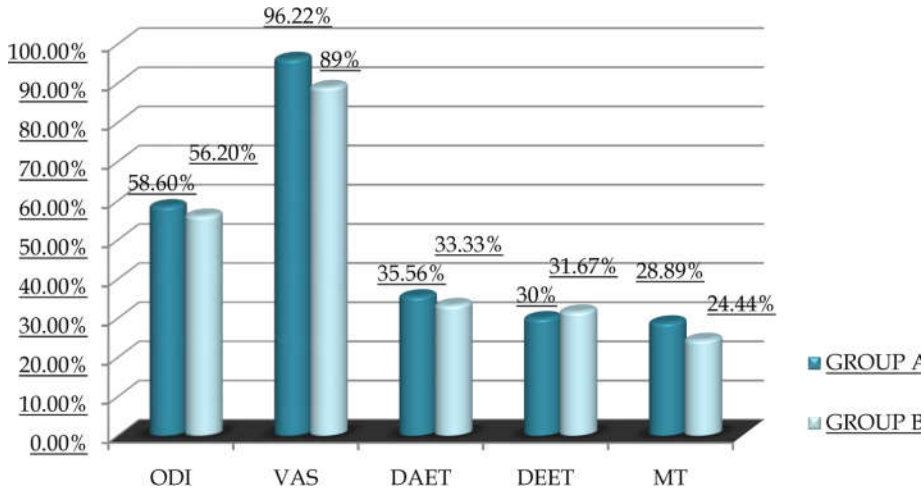
Graph 3: The Bar Chart of Average Pre DAET & Post DAET Scores in two Groups



Graph 4: The Bar Chart of Average Pre DEET & Post DEET Scores in two Groups



Graph 5: The Bar Chart of Average Pre MT & Post MT scores in two Groups



Graph 6: The Bar Chart of Average Percentage Difference in Pre to Post Scores in two Groups for ODI, VAS, DAET, DEET & MT respectively

The Paired t-test was applied to find out the significance difference between pre and post values of VAS, ODI, DAET, DEET and MT in group A and B respectively, which shows a significant difference in both the groups separately at 5% level of significance ($p<0.05$) (In Table 5 & 6).

Results were analyzed using student t- test (paired and unpaired) by using SPSS version 20.0. The entire group A and B completed all 12 training session for 4 weeks. Before the exercise protocol were started the pre-readings were measured, and post-readings were (day 28) also noted down.

The Table 3 & 4 shows a mean and SD values of VAS & ODI, DAET, DEET & MT, Table 5 & 6 shows a % mean & SD difference between the group A and B for VAS & ODI, DAET, DEET & MT.

The table 7 & 8 shows a pre to post scores of group A & B for ODI (0.0000), VAS (0.0000), DAET (0.0000), DEET (0.0000) & MT (0.0000), respectively and shows a significance difference of pre to post in each groups i.e., $p<0.05$ and shows a no significance difference between the groups.

The statistical analysis shows no significant difference for VAS, ODI, DAET, DEET and MT in group A and group B but shows a significant difference in pre to post values of VAS, ODI, DAET, DEET and MT.

The Barchart 1 shows a Average Pre & Post ODI scores for Group A and Group B (45.67 & 18.6) and (43.2 & 18.87) respectively.

The Barchart 2 shows a Average Pre & Post VAS scores for Group A and Group B (5.67& 0.2) and (5.33& 0.6) respectively.

The Barchart 3 shows a Average Pre & Post DAET scores for Group A and Group B (2 & 3.13) and (2& 3) repectively.

The Barchart 4 shows a Average Pre & Post DEET scores for Group A and Group B (2.2 & 3.2) and (2.33 & 3.4) respectively.

The Barchart 5 shows a Average Pre & Post MT scores for Group A and Group B (2.73 & 3.87) and (2.8 & 3.73) respectively whereas the percentile difference shown in Barchart 6 for group A and group B ODI (58.60% & 56.20%), VAS (96.22% & 89%), DAET (35.56% & 33.33%), DEET (30% & 31%) & MT (28.89% & 24.44%).

Disscussion

The result of this study revealed that Swiss ball exercises and Floor exercises are equally effective in increasing the endurance of muscles and improving the pain and decreasing the disability. This is in accordance with the study by *Bala K, Gakhar et al* which also stated that reduction of pain is may be due to increased endurance of abdominal muscles and Trunk muscles and the lumbar Multifidus.

The 4 weeks training programme on Swiss ball resulted in significance increase in endurance of abdominal muscles and in lumbar multifidus.

Thus the Swiss ball exercises resulting more increase in endurance, reduction of disability and pain are supported to *Behm G et al*, study showed that there is evidence exercises performed on unstable (Swiss Ball) surface stressed the musculature and activated the propioception activity & gain the Stability [14].

Many literatures also concluded that the exercises performed on Swiss ball have more muscles work or activity on Swiss ball compared than other [15,16].

The result of our study are in accordance with the previous study *Jorgensen K et al* studied in their studies that trunk endurance training has been recommended as means of increase fatigue threshold and improving performance and reducing disability [17].

Petersen et al concluded that reduction of pain is due to strengthening exercises in patient with Mechanical low back pain [18].

Future Scope

1. The strengthening of lower rectus abdominal muscles may be done for further study.
2. MMT or Sorensen test may be used as primary outcome measure to check the strength of abdominal and trunk muscles.
3. May be done on gender base.
4. Strengthening done on Swiss ball longer duration.

Conclusion

The study compared the efficacy of Swiss ball exercises & Floor exercises to decrease the pain, improves endurance (abdominals, trunk, Multifidus), and to decrease the functional disability in patients of mechanical low back pain. It is concluded that both Group A & Group B are equally effective in reduction of pain, increases the endurance and decreasing the disability. But the result revealed a significant difference in pre to post readings of dependent variables in both the groups i.e., Group A & Group B.

References

1. Omkhodion FO, Low back pain in rural community in south west Nigeria. West Afr J Med 2002 Apr – Jun; 21(2):87-90.
2. Manek and Mcgregor. Epidemiology of back pain disorders: prevalence, risk factors and prognosis. Curr opin Rheumatol 2005 Mar;17(2):134-40.
3. NICE Guideline. Low back pain : early management of persistent non-specific low back pain, may 2009.
4. Johnson Olubusola Esther. Therapeutic exercises for the management of non-specific low back pain.
5. Federico, Anne Mannion et al, Non-specific Low Back Pain. The lancet , 2012 Feb;379(9814): 482-49.
6. Carolyn kisner and Lynn Allen Colby, Therapeutic Exercise foundations and Techniques, Chapter-6, 5th edition page- 161-164.
7. Beate Carriere. The Swiss Ball Theory,Basic exercises and clinical application.
8. David J. Magee. Orthopedic physical assessment, chapter 9, 5th edition, Published by W.B. Saunders; page no 553-54.
9. Susan B O' Sullivan & Thomas J Schmitz: physical rehabilitation, chapter 11, 5th edition, published by Jaypee brother's medical publisher's ltd, page no. 381.
10. David J. Magee. Orthopedic physical assessment, chapter 9, 5th edition, Published by W.B. Saunders; page no 540-43.
11. David J. Magee. Orthopedic physical assessment, chapter 9, 5th edition, Published by W.B. Saunders; page no 543-44.
12. David J. Magee. Orthopedic physical assessment, chapter 9, 5th edition, Published by W.B. Saunders; page no 546-47.
13. Wener W.K. Hoeger, Sharon A. Hoeger. Principles and Labs for Fitness and Wellness. Muscular strength and endurance. Chapter-7. 2013.pp.270-84.
14. Behm et al. Trunk muscles activity with unstable and unilateral exercises, 1: J Strength Cond Res. 2005 Feb;19(1):193-201.
15. Panjabi M. The stabilizing system of the spine Part (1). J Spinal Disorders.
16. Panjabi M. The stabilizing system of the spine Part (2). J Spinal Disorders.
17. Jogersen K et al. Trunk extensor endurance: determination & relation to low back trouble, Ergonomics 1987;30:259-67.
18. Tom Petersen. Non-specific Low Back Pain-Classification and Treatment, 2003.