ORIGINAL ARTICLE

IJPHY

THE EFFECTS OF LUMBAR STABILIZATION EXERCISES ON A SWISS BALL IN PATIENTS WITH MECHANICAL LOW BACK PAIN

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ABSTRACT

Background: Mechanical low back pain is one of the most common causes of discomfort amongst people all over. There are various exercises to reduce low back pain. Swiss ball exercises are one of the dynamic exerciseswhich increase muscle strength, endurance, balance,and flexibility of the trunk while the individual leans on a swiss ball. Therefore the purpose of this study was to check the effects of lumbar stabilization exercises on a swiss ball in patients with mechanical low back pain.

Methods: Forty participants out of which 30 were females and 10 were males who were suffering from mechanical low back pain between the age group of 20 to 60 years were included. They were divided into two groups with each group having 20 subjects. One group was taught floor exercises,and the other was taught swiss ball exercises for two weeks thrice a week,i.e.,sixdays. The pain and disability were checked with the Numeric Rating Scale,and Roland Morris Questionnaire scores respectively pre and post-intervention.

Results: On comparison of the difference between both the groups the mean difference in the NRS and RMQ scores for floor group was one ± 1 and 0.75 ± 1.6($p<0.05$). The mean difference in the NRS and RMQ scores for swiss ball group was 2.6 ± 0.5 and 3.7 ± 1.26($p<0.05$).

Conclusion: We can conclude that lumbar stabilization exercises on a swiss ball are effective in reducing mechanical low back pain compared to exercises done on the static surface.

Keywords: Mechanical low back pain, swiss ball exercises, lumbar stabilization, exercises.

Received 24th October 2018, accepted 26th Januray 2019, published 09th February 2019

10.15621/ijphy/2019/v6i1/180068

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INTRODUCTION

Low back pain is the most frequent complaint amongst people these days. It not only affects a person medically but also socially [1].It often occurs in correlation with other musculoskeletal pain [2].It is described as pain occurring from 12th rib to the inferior gluteal fold generally localized; leg pain may or may not happen [3]. A person with mechanical low back pain avoids any physical activity which causes disuse atrophy of the lumbar muscles and decreased strength and hence increases pain [4,5].O'Sullivan et al.(2003)pointed out that the presence of spinal stability issues results in recurrence of low back pain as there is core muscle weakness [4,6].

Mechanical low back pain is also known as non-specific low back pain and is defined as low back pain not attributed to a recognizable, known, specific pathology, for example, an infection, a tumor, osteoporosis, lumbar spine fracture, structural deformity, radicular pain et cetera [7].The low back is a well-engineered structure of interconnecting joints, bones, nerves, ligaments, and muscles all of which work together to provide support, strength, and flexibility. However, the lower back is the most susceptible to pain and injury. Most acute low back pain occurs from damage to the muscles, ligaments, joints or discs. The body reacts to injury by initiating an inflammatory healing response. A dull ache is the most typical type of pain experienced by the patients during low back pain. Mechanical low back pain tends to be localized to the lower back, buttocks and sometimes the top of the legs. It is generally influenced by loading of the spine and may feel different based on various motions for example forward bending, backward bending, sitting, standing, rotating, etc. Low back pain may incorporate a wide variety of symptoms. It can be merely annoying, or it can be severe, it may start suddenly, or it may proceed gradually. Mechanical issues and soft tissue strain is the most common cause of mechanical low back pain. A muscular strain at the lower back can occur suddenly due to lifting a heavy load or develop over time due to repetitive movements [8]. Various interventions have been used to alleviate mechanical low back pain.

Lumbar stabilization exercises are in conjunction with the capacity to control the strength of movement when the posture is unstable and consciously and unconsciously control movement to maintain a neutral spine, a position of the spine that can best adapt to the load of the of the spine [9]. Lumbar stabilization exercises tend to cause thickening of the vertebra which includes a combination of activation of muscles while performing a task [10]. Lumbar stabilization is the stabilization that is achieved internally by isometric contraction of the core muscles [11].It is also called core strengthening, motor control learning, and dynamic stabilization [12].The motive of lumbar stabilization is to regain control of muscles and their movements [13]. Unstable training devices such as balls can be used to increase the difficulty of the exercises. Exercises that use the swiss ball use most of the regions of the body so that activities can occur on a more extensive basis than with exercises on the floor. The purpose of balls can improve the dynamic balance ability, the flexibility, and stability of the spine, and the sense of balance as ways to prevent damage (Marshall and Murphy, 2005) [14]. The ball exercises also help in improving strength, endurance, and coordination [15]. Swiss ball exercises are one of the dynamic exercises,and the main principle is to reduce low back pain by increasing muscle strength, endurance, balance, and flexibility of the trunk while the individual leans on the Swiss ball [16]. The Exercises can also improve the functions of the nervous and muscular system thereby protect and control the spine. Instability training is shown to facilitate neural adaptations of trunk stabilizing musculature thus resulting in an improvement in trunk stability [17].Stabilization exercises aim to improve the activation pattern of trunk muscles so that low back pain can be relieved.

Therefore, the purpose of this study was to find out the effects of lumbar stabilization exercises on a swiss ball on mechanical low back pain.

METHODS

Study design

This study was an experimental type of research with a convenient sampling method. Forty participants between the age group of 20 to 60 years suffering from low back pain were included in this study and the study period was for six months.

Methodology

Forty participants suffering from mechanical low back pain between the age group of 20 to 60 years were included in this study. Those having lumbar radiculopathy, spinal surgery, prolapsed lumbar intervertebral disc, and any other spinal pathology were excluded. Informed consent was obtained,and the protocol was explained to the participants, and they were ensured that confidentiality would be maintained. Two experimental groups, ie. Group A of 20 participants and Group B of 20 participants were made. Demographic data were collected, and assessment of pain using NRS and RMQ scales was done. Group A was taught lumbar stabilization exercises on the floor, and Group B was taught lumbar stabilization exercises on the swiss ball. The intervention was done thrice a week for two weeks, i.e., six sessions. The reassessmentwas done after two weeks, and the scores were noted. The analysis of pre and post scores of NRS and RMQ was done using mean, and standard deviation and the data was analyzed using SPSS software. The normality was tested using the Shapiro-Wilk test and as the data were not normally distributed the nonparametric tests were used. The pre and post scores of NRS of both the groups and RMQ scores of both the groups were analyzed using the Wilcoxon test, and the comparison of NRS and RMQ scores of Group A and Group B was done using the Mann Whitney U test. Graphical representation of the data was done.

INTERVENTIONS: Floor exercises

Curl-ups on the floor

The candidate was asked to lie down in crook lying posi-

tion with hands placed at the back of his/her head. From this position, the candidate was told to lift his/her head, and neck up such that the scapula was above the ground and tension was felt in the abdominals. This position was held for a second and the same was repeated ten times for three sets.

Bridging on the floor

The candidate was asked to lie down in crook lying position with hands placed at the side of his/her body. From this position, the candidate was told to weight bear on his/her legs and lift his/her pelvis. This position was held for a second and the same was repeated ten times for three sets.

Front plank on the floor

The candidate was asked to lie prone on his/her elbows. He/she was then told to lift his/her body such that the shoulder, the back, and the pelvis were in one straight line. This position was held for 10 seconds, and ten repetitions were performed of the same.

Cat and camel on the floor

The candidate was asked to go into quadruped position and arch his/her back up and head down such that they depict a camel. After that, the candidate was asked to relax his/her back and arch it downwards with his/her head facing upwards. Each position was held for 5 seconds, and the same was repeated ten times for three sets.

Straight leg raise on the floor

The candidate was asked to lie down in the supine position with hands at the side of the body. He/she was asked to lift one leg with the knee straight and heel facing forward. Thiswas repeated ten times for one leg, and then the same was done for the next leg. Thiswas done for three sets.

Swiss ball exercises

Curl-ups on a swiss ball

The candidate was asked to lie down on the swiss ball such that his/her back was supported on the ball and legs were supported on the floor with his/her hands behind the head. From this position, the candidate was asked to lift his/her upper body such that the scapula was above the ball and only the lower back was supported by the ball. This position was held for a second and the same was repeated ten times for three sets.

Bridging on a swiss ball

The candidate was asked to lie down on the swiss ball in the same position as was done for the curl up on the swiss ball. The candidate was asked to weight bear on his/her legs and lift the pelvis off the ball. This position was held for a second and the same was repeated ten times for three sets.

Front plank on a swiss ball

The candidate was asked to lie down prone on the swiss ball with his/her elbows supporting him/her on the swiss ball. The candidate was then asked to lift his/her body such that the shoulders, the back, and the pelvis are in a straight line. This position was held for 10 seconds, and the same was repeatedten times.

Wall squats using a swiss ball

The candidate was asked to lean against the wall with the swiss ball placed on the back with the hands extended forwards. From this position, the candidate was asked to perform a squat. This position was held for a second and the same was repeated ten times for three sets.

Pelvic rotations on a swiss ball

The candidate was asked to sit on the swiss ball with the spine in a neutral position with his/her hands and the side of the body. From this position, the candidate was told to perform a forward pelvic tilt and a backward pelvic tilt. Each positionwas held for a second and repeated ten times for three sets.

OUTCOME MEASURES

Numeric Rating Scale (NRS): The Numeric Rating Scale is a 10 point scale used to measure the pain intensity in patients with chronic pain. The standard format is a horizontal line with a score from 0 to 10; 0 indicating no pain and 10 indicating unbearable or worst imaginable pain

Roland Morris Questionnaire (RMQ): The Roland Morris Questionnaire is designed to assess self-rated physical disability caused by low back pain. A clinical improvement over time can be graded based on the analysis of serial questionnaire scores. This is a specific outcome measure designed to be completed by patients with a physical disability caused by LBP. It consists of 24 items, and the total score may vary from 0(no disability) to 24(maximum disability).

RESULTS

The data wereanalyzed using mean and standard deviation using the SPSS software. The normality was tested using the Shapiro-Wilk test and as the datawere not normally distributed the nonparametric tests were used.

The pre and post scores of NRS of both the groups and RMQ scores of both the groups were analyzed using the Wilcoxon test, and the comparison of NRS and RMQ scores of Group A and Group B was made using the Mann Whitney U test.

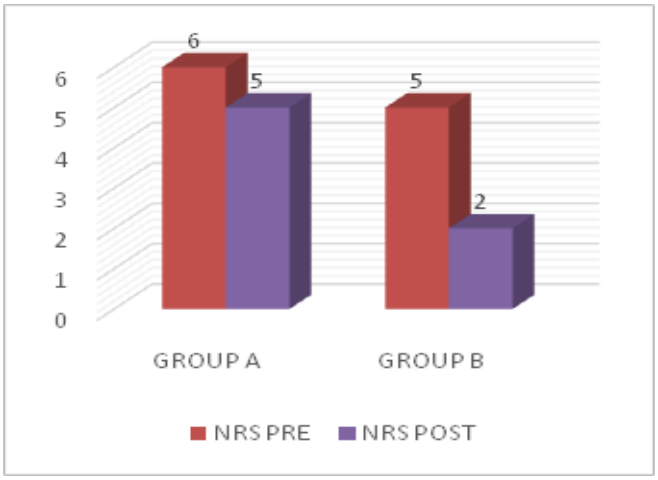
The mean age for group A was 30.20 (±9.09)whereas the mean age for group B was 23.95 (±7.64).There were 65% (n=13) females and 35% (n=7) males in the floor exercise group and 85% (n=17) females and 15% (n=3) males in the Swiss ball exercise group.(ref.Table1)

Table1: Demographic data

GROUP	MEAN AGE
A	30.20 ± 9.09(n=13) females and (n=7) males
B	23.95 ± 7.64(n=17) females and (n=3) males

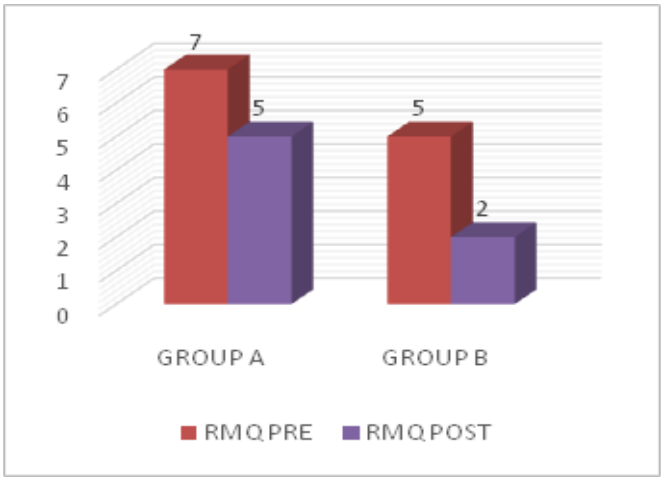
The NRS score for Group A changed from 6 to 5,and that of Group B changed from 5 to 2 (ref.Graph1). After analysis using the Wilcoxon test, there is a significant difference in the pre and post NRS scores of Group A and Group B with a p-value of 0.00* which is statistically significant.

Graph 1: Pre and post NRS scores of group A and group B



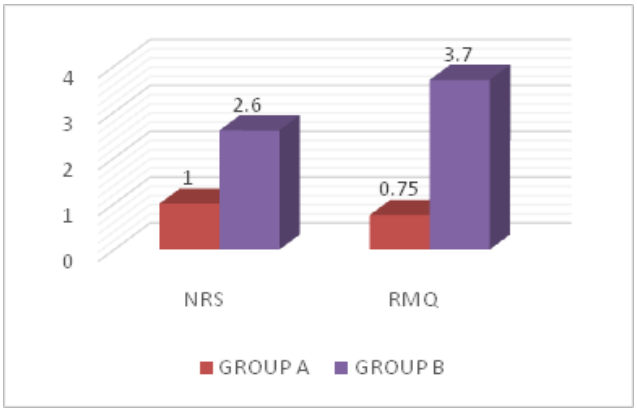
The RMQ score for Group A changed from 7 to 5, and that of Group B changed from 5 to 2 (ref.Graph2). After analysis using the Wilcoxon test, there is a significant difference in the pre and post RMQ scores of Group A and Group B with a p-value of 0.00* which is statistically significant.

Graph2: Pre and post RMQ scores for group A and group B



On comparison of the mean difference of both the groups using the Mann Whitney U the mean difference in the NRS and RMQ scores for floor group was 1 ± 1 and 0.75 ± 1.6 with p-value of 0.00 (<0.05) respectively and the mean difference in the NRS and RMQ scores for swiss ball group was 2.6 ± 0.5 and 3.7 ± 1.26 respectively with p-value of 0.00 (<0.05) (ref.Graph3).

Graph 3: Comparison of the mean difference between both groups.



There is a significant statistical difference in the effectiveness of both techniques since the mean difference in the NRS and RMQ scores and the Mann Whitney U test is significant with a p-Value of 0.00* (<0.05) (ref.Table2).

Table 2: Comparison of the mean difference between NRS and RMQ scores of both groups using the Mann Whitney U test

GROUP	NRS	RMQ	p VALUE
A	1 ± 1	0.75 ± 1.6	0.00*
B	2.6 ± 0.5	3.7 ± 1.26	0.00*

The effect size for Group B, ie. The swiss ball group is greater than that of Group A, ie. The floor exercise group, therefore, the swiss ball exercises are clinically useful (ref. Table3).

Table3: Effect size to check clinical effectiveness

GROUP	A	B
NRS	0.877	0.929
RMQ	0.57	0.907

DISCUSSION

The primary goal of this study was to study the effects of swiss ball exercises in comparison to floor exercises in patients with mechanical low back pain. The subjects of Group A were taught floor exercises, and that of Group B were taught Swiss ball exercises. After statistical analysis, it showed that both groups are capable of reducing mechanical low back pain, but the swiss ball exercises showed greater capability in reducing mechanical low back pain. This difference may be due to a reduction in contact area, control of the center of gravity. Gregory L Lehman stated that performing a bridge on a swiss ball finds the participants in a more vertical position than the floor. Therefore, more muscle activity is required to produce secondary spinal stabilization due to the liable surface [1]. Spinal stabilization is a relation between active and passive muscle and neural systems [18].

It can be considered that lumbar stabilization exercises reduce pain by reducing the stimulus delivered to pain sensation tissues such as ligaments and joint capsule through a reduction of load on the lumbar vertebra. As a result, they enhance muscle function of the stabilizer muscles that contribute to position control of the trunk [5]. Swiss ball exercises due to their unstable nature improve facilitation and activation of spinal stabilizers [19]. Exercises on an unstable surface provide stability to the spine due to the co-activation of global and local muscles at the beginning of motor control [14]. Exercises performed on an unstable surface show more muscular activation as compared to exercises performed on a stable surface [20].Instability training using a swiss ball mainly activates local stabilizers while the use of resistance to body mass increases the integration and recruitment of global and local muscles [14]. The local muscles have a contribution in enhancing the endurance of spinal musculature [21]. There is a significant

improvement in latissimus dorsi activity after performing a plank on the swiss ball (Escamilla RF. et al. 2016) [22]. The overall effect is an increase in muscle activation and improvement in motor control, which ultimately leads to an improvement in muscle strength [14]. Improvement in strength occurs due to increased neural activation of muscles and physiological variations, e.g., improved pain tolerance, well motivated, etc. [23,24].According to Emil Sundersturp strong abdominal musculature provides support for lumbar spine during everyday movements, hence strengthening the abdominal musculature on a swiss ball cause reduction in low back pain [25]. Due to the following reasons, the Swiss ball exercises are more effective in reducing low back pain as compared to floor exercises.

The effect size for Group B,i.e., the swiss ball group is larger as compared to that of Group A,i.e., the floor exercise group. This shows that swiss ball exercises are clinically effective as compared to floor exercises.

Hence we can conclude that both swiss ball and floor exercises are effective in reducing mechanical low back pain, but swiss ball exercises are more effective as compared to floor exercises.

CONCLUSION

From our study, we can conclude that lumbar stabilization exercises on a swiss ball are effective in reducing mechanical low back pain.

CLINICAL IMPLICATIONS

Swiss ball exercises are clinically significant and effective in reducing mechanical low back pain and can be used in clinical practices.

Acknowledgment

We express our gratitude towards those who participated in the study.

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Citation
Khokhawala, A. M., & Gaurav, R. (2019). THE EFFECTS OF LUMBAR STABILIZATION EXERCISES ON A SWISS BALL IN PATIENTS WITH MECHANICAL LOW BACK PAIN. *International Journal of Physiotherapy,* 6(1), 17-22.