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Effectiveness of the core stabilisation exercise on floor and Swiss ball on individual with non-Specific low back pain

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Abstract
Objective and Background: We all need the good core stability program to prevent low back pain, to initiate limb movement, for proper utilization of the muscle forces and to enhance performance. And also, there is lack of literature support in normal subject and the benefits of core endurance in everyday activities. To compare the effectiveness of core stability exercise on floor and core stability exercise on Swiss ball in reducing pain and disability.
Method: A group of 30 subjects were selected for the study and randomly divided into two equal groups of 15 each. All subjects were selected between the age group of 30-45 years. The groups A subjects were asked to perform core stability exercises on Swiss ball and group B performed same exercises on floor. Both groups were asked to perform 4 types of core stability exercises for 3 days in weeks, for 4 weeks. The pain the disability were compare assessed Pre and Post intervention using VAS and ODI respectively.
Result: Two groups were compared for the difference between the post test score of group A and group B were analysed by independent 't'test and the result showed that there was statistically significant difference between the post mean VAS scores values for Group A (Swiss ball) was 2.267 which was lesser than the post-test VAS mean value for Group B (floor mat) 2.933. The p value was > 0.05.Result for post mean ODI scores values between two group also showed statistically significant difference with value for Group A (Swiss ball) was 15.733 which was lesser than the post-test ODI mean value for Group B (floor mat) 24.067. The p value was > 0.05.
Conclusion: The Swiss ball exercise showed statistically significant improvement in reducing back pain and disability when compare to the core stability exercise on the floor. Thus, performing core stability exercise on a Swiss ball reduces pain and disability significantly compared to core stability exercise on floor among mechanical low back ache subjects.

Keywords: Core muscle; abdominal muscle; Trunk muscle; Core strengthening; Swiss ball; Low Back Pain Rehabilitation.

Introduction

Low back pain has been and continues to be, one of the enigmas of the modern medicine. The epidemic of low back pain and the disability associated with it has appeared to escalate, at the same time that the greatest technology advances related to diagnosis treatment and rehabilitation have been made. Back pain has now become not only a medical problem, but a social, legal and political one as well. In 1990, nearly 15 million office visits took place for mechanical Low Back Pain, ranking this problem as the second most common symptom related reason for seeing a physician. Survey suggested that the life time incidence of low back pain Rangers from 60% to 90% within 5% annual incidence. For persons younger than 45 years, mechanical low back pain represent the most common cause of disability than in person aged older than 45 years. Mechanical low back pain is described as a musculoskeletal pain which varies with physical activities and not involving root compression or serious spinal diseases.

Definition: unilateral pain with no referral below the knee may be caused by injury to the muscle (strain) or ligament (sprain), the facet joint, or in some cases, the sacroiliac joint. This is called mechanical low back pain [3].

Symptoms

1. Pain is usually cyclic.
2. Low back pain is often referred to buttock and tight.
3. Morning stiffness or pain is common at morning.
4. Start pain (i.e., when starting the movement) is common.
5. There is pain on forward flexion and often also in returning to erect position.
6. Pain is often produced and aggravated by extension, side flexion, rotation, standing, walking, sitting, and exercise in general.
7. Pain usually becomes worse over the course of the day.
8. Pain is relieved by change in position.
9. Pain is relieved by lying down especially in foetal position.

Risk factors for mechanical low back pain

1. Physical factors

- Heavy manual work
- Lifting and twisting
- Postural stress sitting and driving
- Whole body vibration

2. Psychosocial work factors

- Social influences
- Monotonous work
- Lack of personal control- tension, stress, anxiety, fear and depression
- Low job satisfaction

3. Physiological factors

- Low physical fitness
- Inadequate trunk strength

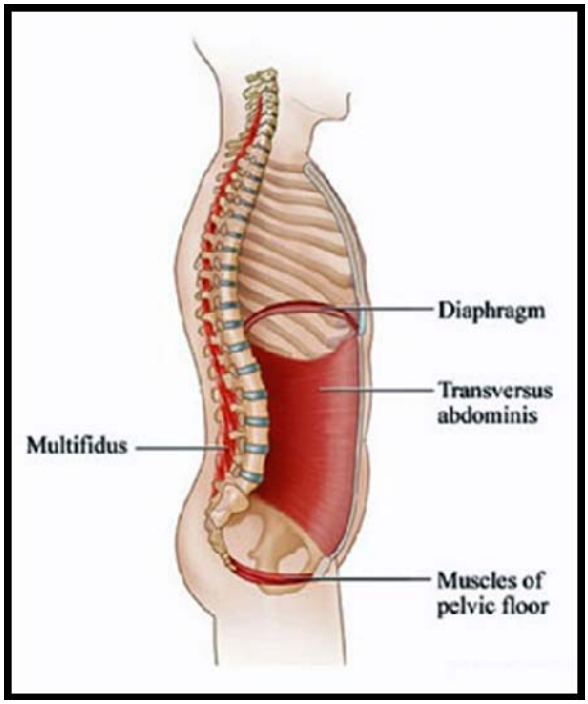
Definition of core: According to Merriam-Webster's dictionary core is "a central and often foundational part usually distinct from the enveloping part by a difference in nature". Stability is "the property of body that causes it when disturb from a condition of equilibrium or steady motion to develop forces or moments that restore the original condition. Paul W. Marshall says the term core stability is a generic description for training of abdominal and lumbopelvic region. To define core stability, the combination of global and local stability system has been used. The global; stability system refers to the larger, superficial muscle around the abdominal and lumbar region, such as rectus abdominus, paraspinal and external obliques. These muscles are the prime movers for trunk or hip flexion, extension and rotation. Local stability refer to the deep, intrinsic muscles of abdominal wall, such as transverses abdominus and multifidus. These muscles are associated with segmental stability of lumbar spine during gross whole body movements and where postural adjustments are required. There is a synergistic relation between the global and local stability system that elicit a satisfactory training effect.

History of core: Core stabilization dates back 50 years ago and was introduced in the U.S. during 1960s to treat neurological and spinal injuries. Today, using stability balls and balance boards develops core stabilization. According to Joseph Pilates, in 1920s core training is developing a girdle of strength by recruiting the deep trunk muscles. Today, Pilates has regained popularity and fame as authoring an effective way to train the core.

Core in life: We need to understand the benefits a good core conditioning programme will decrease the likelihood of back and neck pain, incontinence, rupture discs, muscle and ligamentous strains. Many problems and orthopaedic injuries are a result of poor core endurance. The body is designed to work at the most economic level thus saving energy future use. We spend more energy maintaining misalign posture thus creating a situation for muscular and joint pain to arise. The use of labile surface underneath the subject for stability training of injured low back demonstrate the importance of abdominal muscles in ensuring sufficient spine stability to prevent buckling and enhancing fuction. Trunk is a kinetic chain, connecting all the parts of body together as a whole. A problem or weakness in one part of the chain or injury can lead to pain or injury to other part. Anatomically speaking, the core is an integrated functional unit consisting of lumbo-pelvic-hip complex and the thoracic and cervical spine.it is a muscular corset that lends integrity and support to the body [4].

The core muscle

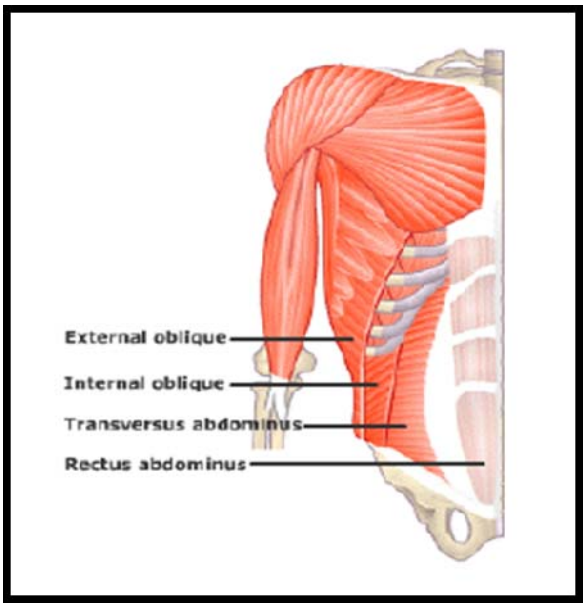
The "core" has been described as a box with the abdominal in front, paraspinals and gluteals in the back, the diaphragm as the roof, and the pelvic floor and hip girdle musculature as the bottom. The core serves as a muscular corset that works as a unit to stabilize the body and spine, with and without limb movement. The muscle involved are broken down into inner and outer units. A good core programme should coordinate all these muscles as one working unit [14].



Inner unit muscles

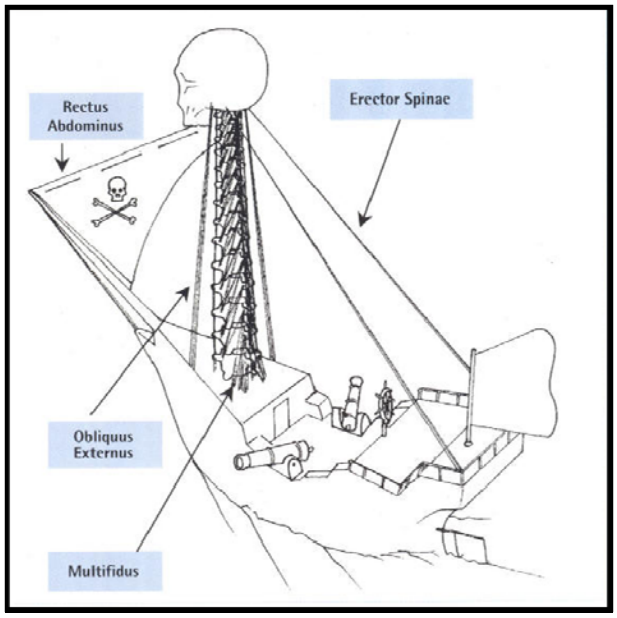
The inner unit provide the necessary joint stabilization for the spine. If the inner unit doesn't active properly our spine, pelvis, and joint structures are placed under undue stress. This stress creates an atmosphere that leads to many injuries. The basic inner unit consist of transverses abdominus, multifidus, pelvic floor and diaphragm. Transversus abdominus (TA) is the deepest, innermost layer of all abdominal muscle. Consider the TA as our body's personal weight belt. When the TA contracts it causes hoop tension around midsection like a girdle or corset. TA will, if working properly, contract before extremities will move, according to Diana Lee. It also provide support for the abdominal wall has vital role in maintenance of

posture, allows for trunk movement (flexion, extension, lateral flexion), responsible for raising intra-abdominal pressure. Multifidus lies deep in the spine spanning from three joint segments. The multifidus work to provide joint stabilization at each segmental level. Each vertebrae needs stiffness and stability to work effectively to reduce degeneration of joint structures. Pelvic floor is our next set of muscle which spans the area underneath the pelvis. It is important for the pelvic floor and the inner unit to work properly. By doing simple yet important exercise we can re-establish communication, tighten and tone the muscle group, prevent or diminish incontinence, leakage and pelvic dysfunction [10]. Diaphragm plus each of these three muscles, is the target of inner unit conditioning. The transverse abdominus forms the walls of cylinder while the muscle of pelvic floor and diaphragm forms the base and lid respectively [10].



The outer unit muscles

The outer unit musculature system aids in movement and function. The outer unit muscle are basically the prime movers of the core muscle and extremities such as the internal oblique, external oblique, rectus abdominus, back, legs, shoulder girdle and more. They each have vital function movement. An outer unit consist of exercise that allow for multi-joint-plane activities. The Rectus Abdominal, which is the most superficial muscle group of the core area and functions to the flex the spine. The Rectus Abdominus works with all of the other core muscles to stabilize the pelvis when walking. It originates from the public symphysis and public crest and inserts at the xyphoid process and 5th to 7th costal cartilages. The two muscles are separated by linea alba The internal and external oblique are located on the core area. When oblique are activated on only one side of the body they operate to rotate the trunk and laterally flex the body. When they contact on both sides concurrently, they aid in flexing the vertebral column and compressing the abdominal wall [1].



Relationship between inner and outer unit.

The big muscle (outer unit) becomes stronger and tighter, the delicate balances between the inner and outer units become disrupted. This concept is easier to understand using the pirate ship model. Although the larger guy wires (outermost) support the most of the pirate ship, it's functionally is completely dependent upon the support provided by small guy wires which represent the multifidus and inner unit muscles in the analogy. When the inner and outer unit works together as a cohesive unit we greatly improve our daily lives by reducing the risks of joint injuries, ligamentous and muscular strain and low back pain [10].

Principals of core training [17]

Stage1: Core stabilization
Stage 2: Core strengthening
Stage 3: Core power

Benefits of core training

- Improvement of posture, balance and peripheral mobility.
- Increased endurance, strength and agility.
- Less chance of injury.
- Decrease in or prevention of low back pain.
- Enhance performance.
- Allows doing more with less effort.
- Increase flexibility.

Importance of core training [4]

- A strong is the basis for all human movement.
- If the core is strong and stable, all other movement are more efficient and more effective.
- Poor core stability means that power is wasted. Instead of forces being applied by arms or legs to the movement, it is absorbed by a weak, sloppy trunk.
- A strong core reduces the stress on particular muscle groups and joints.
- Poor core stability increase the likelihood of injury in these areas. Excess stress is placed on these areas if the trunk is weak.

Swiss ball

The term "Swiss ball" was coined because one of the earliest noted uses of an exercise ball was 1965 in Switzerland where a group of physical therapist used it in their work with children with cerebral palsy. The exercise ball may be referred to as gymnast ball, stability ball, physio ball [18, 19]

The Swiss ball is widely used in the recreational training environment to be a training device for core stability exercise. The Swiss ball is a conservative treatment option for back pain sufferers and is designed to help prevent further episodes of low back pain as part of a rehabilitation programme [18].

Uses of Swiss ball

Improve muscle tone and endurance.
Shed unwanted pounds and post-baby weight.
Improve posture.
Improve balance.
Lessen the risk of osteoporosis.
Lessen low back pain.
Increase flexibility.
Experience greater self confidence.

The body responds naturally and automatically to this instability to keep balanced on the exercise ball. Over time, the muscle used to keep in balance on the Swiss ball become stronger. In essence, individuals build strength in important back muscles and abdominal muscles without knowing it.

Methods and Procedures

STUDY DESIGN: An Experimental study.
STUDY LOCATION: Fitness centre, Cheras Selangor.
STUDY DURATION: 4 weeks
SAMPLE SIZE: 30Subjects.
SAMPLING METHOD: Simple random sampling method

Inclusion Criteria

1. Both males and females
2. Age group of 30-45 years
3. Patients with diagnosed mechanical low back pain
4. Patients with minimum to moderate disability (up to 40%) on ODI
5. Patients with VAS grade of 5 and below.

Exclusion Criteria

1. Any previous or current experience in core strengthening.
2. Subjects who are on regular fitness program.
3. Past history of fracture (spine, rib) or injury.
4. Past history of abdominal surgery.
5. Any other systemic illness.
6. Spinal or disc pathologies

Orientation of subject: The proposal review committee for Bachelor of Physiotherapy approved this study. Prior to the study, the stretching procedure and core training perform on Swiss ball and floor mat procedures were explained verbally to the volunteers. A written consent was obtained from all the subjects and they were informed that they can dropout at any time without revealing any reason.

Procedure

After obtaining ethical clearance 30 subjects were selected on the basis of inclusion criteria and randomly allocated into 2 groups.

Subjects were assessed through proforma and informed consent was taken. Pre-test low back pain and disability was assessed by VAS and ODI respectively.

Group A – core stability exercises given on Swiss ball.
Group B – core stability exercises given on floor mat.

Subjects were instructed to do warm up exercises for 5 minute, which consisted of spot jogging, followed by some free exercises and light stretches held for 15 seconds. Both the groups were asked to perform 4 types of core stability exercises for 6 reps for 1st week and later on till 3rd week the reps were increased by 50% of 1st week performance. In week 4 exercises will be continued with addition of 5 seconds holding time i.e.

- 1st week – 6 reps
- 2nd week – 9 reps
- 3rd week – 12 reps
- 4rd week – 15 reps with 5-10 sec hold

Exercise Protocol:

Rest time: 2-3 minutes in between sets of exercise with appropriate stretch

At the end of each day exercise program, subjects were asked to do cool down exercises, which involve aerobic exercises followed by stretching exercises, again before starting the training for next session, the subjects were asked for any discomfort.

At the end of 4 weeks of core stability exercise program, post test scores were measured for both the groups using same measurement tools. At the end of the study, two groups were compared for the post test values.

Exercise for swiss ball group

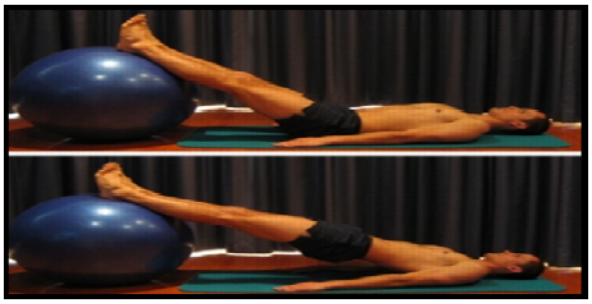
Curl-up on Swiss ball

Starting position: Start in supine position with lower back supported on the ball. Hands are clasped behind the head. Feet are shoulder width apart. Draw lower abdominal muscles towards the spine.

Procedure: Slowly flex the spine while keeping abdominal muscles draw in. Return to starting position.

Instruction: Keep cervical neutral by keeping the chin tucked.

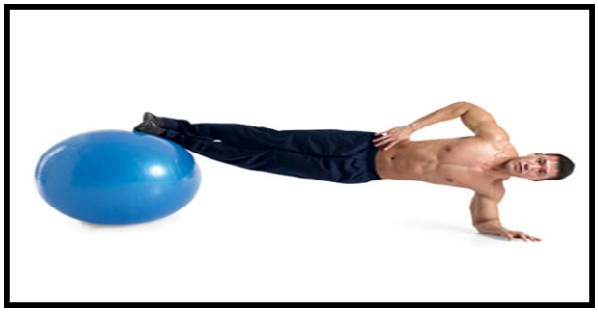
Bridging on Swiss ball



Starting position: Start in supine position with arms out to the side. Place feet on the ball toes pointed forward. Draw abdominal muscles in towards the spine.

Procedure: Contract the abs and gluteus and lift hips off the floor.
Instruction: Avoid rotating toes outwards.

Side plank on Swiss ball
Starting position: Lying on your side, keeping lateral surface of down leg on ball.

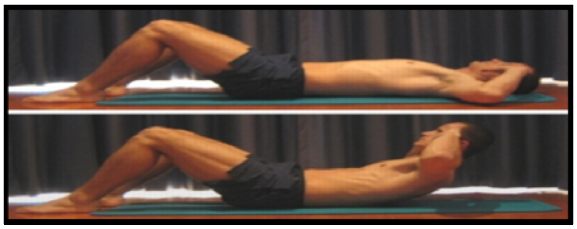


Procedure: Prop yourself on your right elbow placed directly under your shoulder. Lift yourself off the ground supporting your body on your right elbow and ball.
Instructions: Maintain neutral alignment of the hips, not allowing the top hip to roll front or back. Avoid laterally flexing the cervical spine or letting the head tip to the side. Let the supporting arm assist with balance, but avoid pushing the body up with the arm.

Front plank on Swiss ball

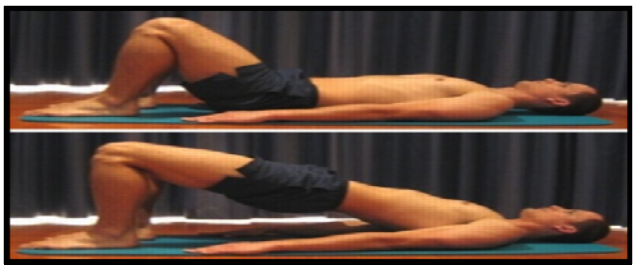
Starting position: Subject assumes a front plank position on the Swiss ball with elbow under the shoulder and upper arm perpendicular to the ground.
Procedure: Slowly lift the shoulder and pelvis off the ground, supporting points will be on elbow and feet.
Instructions: Balance the forearm under the shoulder and keeping your spine neutral and drawing in your lower stomach.

Exercise for Floor Group
Curl-up on floor



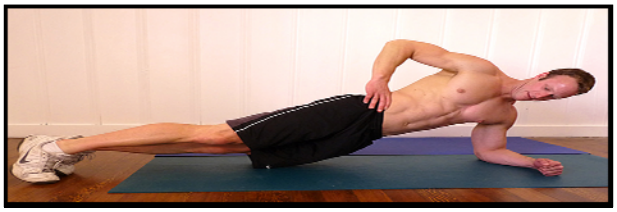
Starting position: Supine incline position with arms aver the head.
Procedure: Slowly curl your trunk, letting your shoulders and upper back lift off the ground. Return slowly to starting position.
Instruction: Avoid pulling on the head or neck. Return to neural posture between each repetition.

Bridging on floor



Starting position: Supine crook lying, with hands at the side of the body, palm facing downwards.
Procedure: Slowly raise the hips off the grounds so that only forearms and heels ate touching the ground.
Instruction: Weight is supported across the shoulder area. Avoid pressing the cervical spine into the floor. Maintain neutral posture in the lumbar and cervical spine throughout.

Side plank on floor



Starting position: Subject assume a side plank position with elbow under the shoulder and upper arm perpendicular to the ground.
Procedure: Slowly lift the shoulder and pelvis off the ground, supporting points will be on elbow and feet.
Instruction: Balance the forearm under the shoulder and the same side foot while attempting to keep the body aligned in a straight line.

Front plank on floor

Starting position: Subject assumes a front plank position with elbow under the shoulder and upper arm perpendicular to the ground.
Procedure: Slowly lift the shoulder and pelvis off the ground, supporting points will be on elbow and feet.
Instructions: Balance the forearm under the shoulder and keeping your spine neutral and drawing in your lower stomach.

Data Analysis

Data Analysis: Data analysis is the method by which the validity of research study is evaluated. It requires a number of closely related operations such as establishment of categories to raw data through coding, tabulation and then drawing statistical inferences.

Data Intepretation: Interpretation means, examining the results from data analysis, forming conclusions, exploring the significance of the findings and suggesting further studies. The test values for the group were obtained before and after intervention of 4 weeks. Mean, Paired't' test and independent 't' test were used to find out whether there is any significant difference on the magnitude on effect of both Swiss ball and the floor mat exercise. Paired't' test was used to interpret the results within the group and independent't' test was used to interpret the results between the groups. The collected data were analysed statistically using SPSS version 17.

Results: An experimental study consisting of 30 mechanical low back ache subjects randomized in two groups, 15 subjects in group A (Swiss ball exercise) and 15 subjects in groups B (floor exercise) is undertaken to the compare the magnitude of effect of both Swiss ball and the floor exercise.

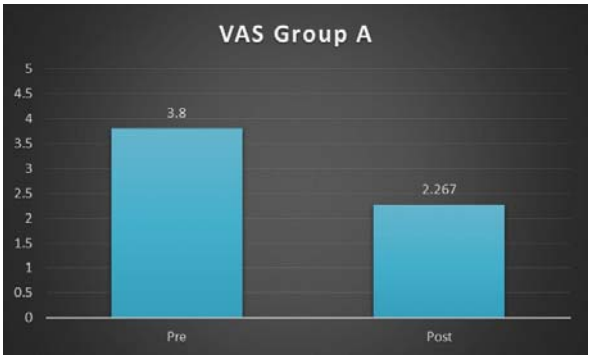
Comparison of Core Stability Exercise on Swiss Ball Between Group A Pre And Post Vas

		Mean	N	Std. Deviation	Std. Error Mean
VAS	Pre	3.8000	15	.86189	.22254
	Post	2.2667	15	.70373	.18170

Paired t-test was used to compare the pre and post test scores. Results showed the mean value of pre-test of 3.800 and post-test of 2.266 and standard deviation .8618 and .7037 respectively of VAS in group A.

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
VAS	Pre Post	1.53333	.91548	.23637	1.02636	2.04031	6.487	14	.000

Moreover, t= 6.487 and P=.000.Hence a statistically significant difference as reflected in table no: 1.



Group A: Core Stability Exercise on Swiss Ball Mean Value (Vas)

The mean value for core stability exercise of the group A VAS before intervention was 3.800which was higher than the mean after intervention, the value being 2.267.The p value was < 0.05. Hence there was a significant change in VAS score in core stability exercise on Swiss ball between pre and post.

Comparison of Core Stability Exercise on Swiss Ball between Group a Pre and Post Odi

		Mean	N	Std. Deviation	Std. Error Mean
ODI	Pre	18.8000	15	4.88730	1.26190
	Post	15.7333	15	3.99046	1.03033

Paired t-test was used to compare the pre and post test scores. Results showed the mean value of pre-test of 18.80 and post-test of 15.73and standard deviation 4.88 and 3.99 respectively and standard deviation of ODI in group A.

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
ODI	Pre Post	3.06667	1.83095	.47275	2.05272	4.08061	6.487	14	.000

Moreover, t= 6.487 and P=.000 Hence a statistically significant difference as reflected in table no: 2.

Group A: Core Stability Exercise on Swiss Ball Mean Value (Odi)

The mean value for core stability exercise of the group A ODI before intervention was 18.800 which were higher than the mean after intervention, the value being 15.733.The p value was < 0.05. Hence there was a significant change in ODI score in core stability exercise on Swiss ball between pre and post.

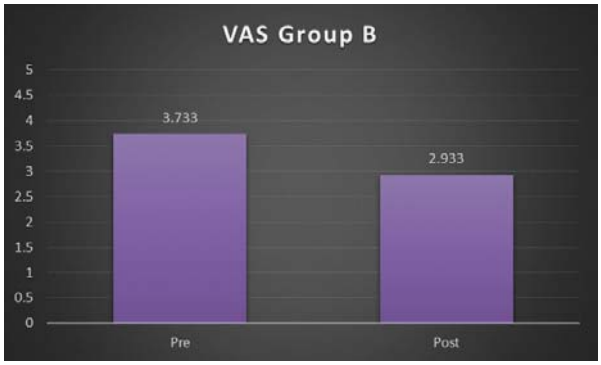
Comparison of Core Stability Exercise on Floor Mat between Group B Pre and Post Vas

		Mean	N	Std. Deviation	Std. Error Mean
VAS	Pre	3.7333	15	1.09978	.28396
	Post	2.9333	15	.70373	.18170

Paired t-test was used to compare the pre and post test scores. Results showed the mean value of pre-test of 3.73 and post-test of 2.93 and standard deviation 1.099 and .703 respectively of VAS score in group B.

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
VAS	Pre Post	.80000	.56061	.14475	.48954	1.11046	5.527	14	.000

Moreover, t= 5.527 and P= .000 .Hence a statistically significant difference as reflected in table no: 3.



Group B: Core Stability Exercise on Floor Mat Mean Value (Vas)

The mean value for core stability exercise of the group B VAS before intervention was 3.733 which were higher than the mean after intervention, the value being 2.933.The p value was < 0.05. Hence there was a significant change in VAS score in core stability exercise on floor mat between pre and post.

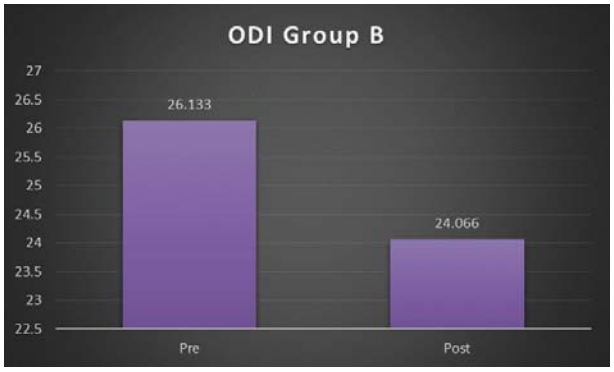
Comparison of Core Stability Exercise on Floor Mat between Group B Pre and Post Odi

		Mean	N	Std. Deviation	Std. Error Mean
ODI	Pre	26.1333	15	7.65195	1.97573
	Post	24.0667	15	7.07578	1.82696

Paired t-test was used to compare the pre and post test scores. Results showed the mean value of pre-test of 26.13 and post test of 24.06 and standard deviation 7.65 and 7.07 respectively of ODI score in group B.

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
ODI	Pre Post	2.06667	.96115	.24817	1.53440	2.59893	8.328	14	.000

Moreover, t=8.32 and P=.00 .Hence a statistically significant difference as reflected in table no: 4.



Group B: Core Stability Exercise on Floor Mat Mean Value (Odi)

The mean value for core stability exercise of the group B ODI before intervention was 26.133 which were higher than the mean after intervention, the value being 24.066.The p value was < 0.05. Hence there was a significant change in ODI score in core stability exercise on floor mat between pre and post.

Between Group Comparison for Vas Score Group A and Group B

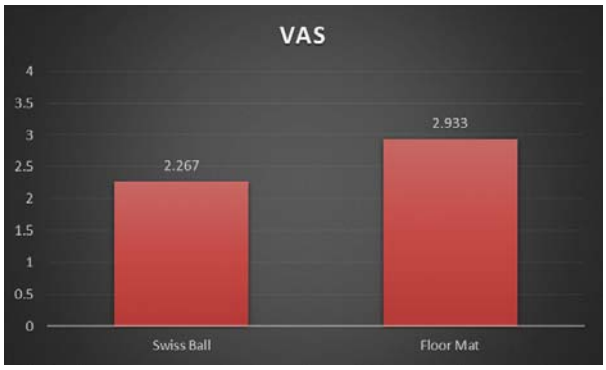
Group Statistics					
	Group	N	Mean	Std. Deviation	Std. Error Mean
VAS Post	Swissball	15	2.2667	.70373	.18170
	Floormat	15	2.9333	.70373	.18170

To compare the post-test values of VAS between the groups, independent t-test was used. Results showed the mean value of VAS score for Swiss ball (labile group A) as 2.26 and standard deviation of .703 and for Floor mat (stabile group B) mean value was 2.93 and standard deviation of .703

Independent Samples Test											
			Levene's Test for Equality of Variances		t-test for Equality of Means						
										95% Confidence Interval of the Difference	
			F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Swiss ball vs Floor mat VAS (Post)		Equal variances assumed	.333	.569	-2.594	28	.015	-.66667	.25697	-1.19304	-.14029
		Equal variances not assumed			-2.594	28.000	.015	-.66667	.25697	-1.19304	-.14029

Moreover, t= -2.594 and P= .15 .Hence a statistically significant difference as reflected in table no: 5.

Mean Comparison of Vas Scores between



Group A and Group B

Post test VAS scores values of Group A and Group B were analysed by independent 't'test. The post test VAS mean value for Group A (Swiss ball) was 2.267 which was lesser than the post test VAS mean value for Group B (floor mat) 2.933. The p value was > 0.05. Hence the null hypothesis was rejected. There was a significant difference in VAS scores between core stability exercise on Swiss ball and core stability exercise on floor mat.

Between Group Comparison Forodi Scores

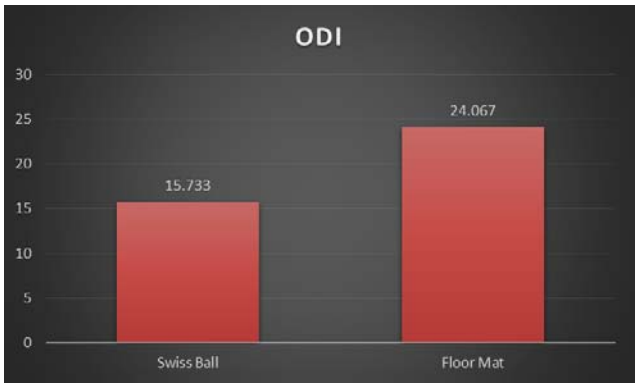
Group Statistics					
	Group	**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**
ODIpost	Swissball	15	15.7333	3.99046	1.03033
	Floormat	15	24.0667	7.07578	1.82696

To compare the post-test values of VAS between the groups, independent t-test was used. Results showed the mean value of ODI scores for Swiss ball as 15.73and standard deviation of 3.99 and for Floor mat group mean value of 24.06 and standard deviation of 7.07 for ODI.

Independent Samples Test											
			Levene's Test for Equality of Variances		t-test for Equality of Means						
										95% Confidence Interval of the Difference	
			F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Swiss ball vs Floor mat ODI (Post)		Equal variances assumed	4.417	.045	-3.973	28	.000	-8.33333	2.09747	-12.62980	-4.03687
		Equal variances not assumed			-3.973	22.087	.001	-8.33333	2.09747	-12.68221	-3.98445

Moreover, t= -3.973 and P=.00. Hence a statistically significant difference as reflected

Mean Value Comparison of Odi Scores between



Group A and Group B

Post test ODI score values of group A and group B were analysed by independent't' test. The post test ODI mean value for group A (Swiss ball) was 15.733 which was lesser than the post test ODI mean value for group B (floor mat) 24.067. The p value was > 0.05. Hence the null hypothesis was rejected. There was a significant difference in ODI scores between core stability exercise on Swiss ball and core stability exercise on floor mat.

Discussion: The primary aim of this study was to determine if performing core stability exercises on a Swiss ball rather than the floor resulted in reducing back pain and disability more effectively. The group A subjects were allowed to perform core stability exercises on Swiss ball and group B performed same exercises on floor. At the end of 4 weeks of core stability exercise program, post test of VAS and ODI scores were measured for the both groups Chattanooga (2002) stated that, core stabilization training involves the re-learning of co-activation of co-contraction patterns of transverse abdominis and lumbar multifidus to provide local segment support. When working normally the transverse abdominis and the lumbar multifidus act in concert, increasing tension on thoracolumbar fascia acting like a corset, providing stability to lumbar spine. The mean value for core stability exercise of the group A VAS before intervention was 3.80 which was higher than the mean after intervention, the value being 2.267.The p value was < 0.05. There was a significant change in VAS score in core stability exercise on Swiss ball between pre and post. The mean value for core stability exercise of the group A ODI before intervention was 18.8 which was higher than the mean after intervention, the value being 15.733.The p value was < 0.05. There was a significant change in ODI score in core stability exercise on Swiss ball between pre and post. The mean value for core stability exercise of the Group B ODI before intervention was 26.133 which was higher than the mean after intervention, the value being 24.066.The p value was < 0.05. There was a significant change in ODI score in core stability exercise on floor mat between pre and post. There was a significant improvement in Swiss ball group compared to floor, which may be due to the following reasons:

- Reduction in contact area
- Increase in perturbations
- Control of centre of gravity with in 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 their body shapes.
- The minimal changes could have been due to short duration exercise program i.e.., 4 weeks.

Paul W. Marshall, Bernadette A. Murphy (2005) on his study on 'core stability exercise on and off Swiss ball' on 8 healthy subjects with an intervention on 4 exercise on and off Swiss ball came with a result that the performance of task on the Swiss ball would lead to greater activation levels when compared with the stable surface. There was no evidence to suggest that specific exercise involve different synergistic relationships between the muscles and the muscles and the Swiss ball can directly influence those relationships.[32]The mean value for core stability exercise of the Group B VAS before intervention was 3.733 which was higher than the mean after intervention, the value being 2.933.The p value was < 0.05. There was a significant change in VAS score in core stability exercise on floor mat between pre and post. Post test VAS scores values of Group A and Group B were analysed by independent 't'test. The post test VAS mean value for Group A (Swiss ball) was 2.267 which was lesser than the post test VAS mean value for Group B (floor mat) 2.933. The p value was > 0.05. There was a significant difference betweencore stability exercise on Swiss ball and core stability exercise on floor mat. Post test ODI score values of Group A and Group B were analysed by independent 't'test. The post test ODI mean value for Group A (Swiss ball) was 15.733 which was lesser than the post test ODI mean value for Group B (floor mat) 24.067. The p value was > 0.05. There was a significant difference betweencore stability exercise on Swiss ball and core stability exercise on floor mat. In the current study some subjects in floor exercise group showed significant changes in outcome measures. It is possible that some subjects volitionally contracted their trunk muscles to provide stability. It is also possible that individuals may be able to influence through verbal encouragement. Additionally, the variability may have been due to slight variation in participant posture or task performance. While exercise standardization was sought through verbal correction, it is possible that difference between the subjects still occurs.

Effects of Exercise as a Whole

No single muscle can be identified as being more important for spinal stability than another during a range of trunk movement tasks. Therefore, current study assesses the group of muscles or the effect of exercises on pain disability as a whole and not done separately. The influence of surface stability on muscle activity depends on type of muscle and type of exercises. These results suggest that core stability exercise program can effectively reduce back pain and disability in mechanical low back ache subjects.

Conclusion: From the above analysis, it is clear that both core stabilisation exercise on Swiss ball and floor have an effect on reducing mechanical low back pain. There is significant difference on core stabilisation exercise on Swiss ball compared to core stabilisation exercise on floor between 2 groups. Hence our null hypothesis is rejected and alternate hypothesis is accepted. This result suggests that the core stabilisation exercise with Swiss ball is more effective than the core stabilisation exercise on floor in reducing pain and disability among mechanical low back ache subjects in a very short period of times.

Clinical Implication

- In a very short period of time there was a significant reduction in back pain and disability associated with it.
- It is an inexpensive method and helps in reducing pain and disability.
- It doesn't require any sophisticated tools.
- It is not a time-consuming program, individuals can take out the time conveniently even in their busy schedules.
- It is easy to learn and perform these exercises, once learned assistance is not required.

Limitations

1. In current study the sample size was small.
2. There is no separation between male and female.
3. Quantitative measures were not used to compare the effect of individual exercises on isolated muscles to know which exercise gives better effect in reducing pain and disability.
4. No measurements were made to determine the compressive or shear loading on the spine during task. This type of kinematics is optimal when determining the safety and tissue loading properties of various movements.

Recommendations

1. The confounding parameters like agility, speed, balance, motor control can be considered.
2. Further measures should be taken to check core muscle strength and endurance separately.
3. Further research may be done to determine the influence of the trunk muscle activation levels during resistance exercise.
4. EMG biofeedback can be used for quantifying muscles activity.

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