J Int Acad Phys Ther Res 2010; 1: 149-154
ISSN 2092-8475

The Effect of Swiss Ball Exercises and Taping Therapy on Back Muscle Strength of Healthy Subjects

The purpose of this study was to investigate the effects of swiss ball exercise and taping therapy on back muscle strength on normal college students. The aim of this study was to find effective method for back muscle strengthening. Subjects of 30 college students divided 3 groups(taping therapy group: 10, swiss ball group: 10, control group: 10). All subjects inquired physical conditions and normal exercise habits for data base. Back muscle strength measured before and after 3 weeks intervention. Taping therapy was displayed stable a growth curve in continuative a growth graph of back muscle strength better than swiss ball exercise, because it was taping therapy by periodic effect. The result of this study known to effective either taping therapy or swiss ball exercise, but both taping therapy and swiss ball exercise were effect to increase in back muscle strength.

Key words: *Back Muscle Strength; Swiss Ball; Taping Therapy*

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Received : 28 July 2010
Accepted : 13 September 2010

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INTRODUCTION

The recent progress in scientific civilization and its consequent conveniences have wrought many problems in maintaining proper physical balance due to abnormal physical developments. Such problems bring about imbalance in muscles, tendons and ligaments from weakening of the musculature and the disharmony in weight loads(1). According to McGill report, pain in the musculoskeletal system can lead to the reduction of muscle strength, flexibility and endurance that ultimately result in numerous disorders found in the modern society(2). According to Moon asserts that in order to prevent such pains in the musculoskeletal systems, the strengthening of the abdominal muscles and the increasing the flexibility of the body is of the utmost importance(3).

Muscles on the surface such as the erector spinae, oblique abdominal muscles and the external obliques are worked foremost in any movement. Without adequate stabilization in the spine, the contraction of the lower and upper limb muscles affect the proximal regions, resulting in movements that place excessive load on the structural and support soft tissues of the spine(4). Because the body's back region is, anatomically speaking, relatively weak, it is said that in overall, the body's motor abilities are reduced when the back muscle strength is less than optimal(5).

According to Yu, bodily movement is implemented through the contractile actions of the flexor and extensor muscles(6). Here, muscle strength of the extensor muscle is measured through the back muscles and the flexor muscle through the grasping power. While numerous devices have been developed to measure such muscle strength, most commonly, the Smedley or the Collin method dynamometer for grasping power and the K.Y.S method dynamometer for measuring back strength are in use. The purpose is to measure the extensor muscle strength at the trunk. Under the current K.Y.S method for measuring back strength, the subject is required to lean forward approximately 30° while standing with their back straight. Then with their arms straight grasping the handle of the device, the subject is required to pull, leaning back while keeping their back straight(7).

According to Wells, there are sacrospinalis, lumbar portions and semisoinalis dorsi for the primary acting muscles, and deep posterior and spinal muscles for the secondary acting muscles mobilized at the trunk during back muscle strength measurements(8).

According to Park et al. exercises trend of modern men are developing in a more scientific and objective direction, becoming more customized to each individual where the exercise forms and intensity are prescribed(9). For the purpose of its evaluation, tools such as treadmill, cycle ergometer and upper limb exercise ergometer are used. Furthermore, According to Stanton et al. has reported that for maintaining stability in the trunk muscles, swiss ball exercises have shown to be effective(10).

Swiss ball is a large rubber ball that was first produced by an Italian company in 1963 under the name "gymnastik". It was used by physical therapists in the 70's and was then distributed worldwide. Park et al. reported that today, the stretching exercises utilizing the swiss ball are widely employed by patients suffering from spine disorders, and healthy individuals for the prevention of back pains, frozen shoulders, abdominal obesity, for increasing flexibility and maintaining body balance, and in growth promoting exercises(9). Kim reported that the public interests in swiss balls are on the rise due to the recent realization of its high potential utility in family exercise routines(11). Subsequently, muscle strength measurements, pain reduction stability and flexibility through swiss ball exercises are currently hot areas of research. According to McGill, swiss ball exercises were used for the prevention and alleviation of pain at the waist, neck, from strokes, spinal injuries and bad posture as means for physical therapy or as rehabilitation tools and have been used recently by professional athletes as tools for strengthening the central muscles capable of trunk muscle strength, joints exercises and sense of balance training for enhancing the flexibility and stability of the spine(2).

Aside from the swiss ball exercises, there are also special purpose tapes applied on the skin that adjust its electromagnetic flows. By providing electromagnetic stimuli to the muscles and organs underlying the skin, the tapes maximize the body's natural recovery ability and balance the body. This non-drug treatment method that utilizes special tapes is being applied in controlling not only pains resulting from disorders in the musculoskeletal systems but also in internal disorders(12). According to Lee, this tape treatment method is a medical treatment method which stimulates or applies its mechanical utility through the medium of tape in treating disorders and pains(13). The stimulatory and mechanical effects resulting from applying the tapes are what is utilized in this form of treatment. Kim et al. analyzed how much the muscle relaxing effects of the therapeutic taping on erector spinae muscles increase the lumbar extensor strength by using the lumbar extensor machine: Medx to measure the lumbar region extensor strengths before and after the treatments(14). They reported that upon comparison, the therapeutic taping was found to contribute to lumbar extensor strength through relaxation and strength increase in the erector spinae muscles via alleviation of muscle tone.

Following up, by analyzing the extent of the effects of the taping therapy and swiss ball exercises on the strength of the back muscles, this study aims to establish the basic reference data for future treatment programs related to back muscle strength disorders.

MATERIALS AND METHODS

Subjects

30 normal subjects were participated in this study. The mean age of test subjects were 22.23±1.91(age), the mean height 173.87±6.68㎝, and the mean weight 66.80±8.17kg. And all subjects who voluntarily participated in this study were randomly divided into control group(CG), a swiss ball exercise program group(SG), and a taping therapy group(TG). All subjects were volunteers who have taken interest in the study and were devoid of known clinical pains or musculoskeletal system disorders in their medical history and were known to be in good health and informed of the study method before they consented to voluntary participation in the study.

Protocol

Taping therapy

An elastic tape(Miracle Tape) from Tera Medical Co. measuring 5cm x 5m with main constituents such as 72% cotton, 3% spandex, 10% acryl polymerand 15%, ethyl acetate was used throughout the experiment. Taping therapy method consisted of applying non-extended tape on slightly extended erector spinae and external oblique muscles. As a precautionary measure, tapes were only applied on skin surfaces without moisture, hair or cuts and in cases of any itch or pain, they were immediately removed(Fig. 1).

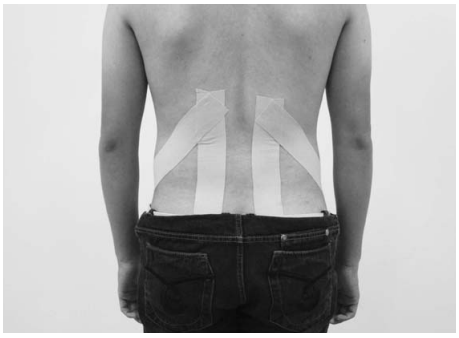

Fig. 1. Taping applied on erector spinae and external oblique muscles

Swiss ball exercise programs

The swiss ball comes in various sizes. But as shown on Table 1, the standards suggested that the swiss ball guidelines were followed. While due to differences in the lengths of each individual's legs, a ball one size bigger was used according to the guidelines, generally, balls that formed a 90° angle at the knee when the subject was seated upon it was chosen.

Table 1. Ball selection according to height at sitting posture.

Height(cm/inch)	Ball Size(cm/inch)	Ball Color
140–150/55–60	45/17.7	yellow
155–165/61–66	55/21.6	red
170–180/67–71	65/25.6	pink
183–190/72–75	75/29.5	blue

Exchanging arms and maintaining for 10 seconds each. The subject was first asked to adopt a posture slightly leaned back, sitting on the ball while slightly flexing their abdominal muscles. Meanwhile, the spine was to be kept naturally straight and the toes were poised upright off the floor. Then, one arm was raised over the head while the other was placed on its opposite knee. All the while, the subjects were asked to look at the raised arm. Alternating the arms, the posture was repeated 3 times for 10 seconds each(Fig. 2).

Lying face down with the upper body placed on top of the ball and the toes working as supports, the subject was asked to spread out their arms to the sides with their neck and spine in alignment. Next, to straighten the spine, they were asked to lift their chest off the ball for 10 seconds to slowly bring back to the original position. This exercise was repeated 3 times(Fig. 3).

Lying face down, the upper body is placed on top of the ball with arms and legs working as supports. Then the subjects were asked to raise one arm and an opposite leg to the height of the upper body and maintain the posture for 10 seconds. To maintain balance, the neck and the spine needed to be kept aligned in this process. Then slowly, the exercise is repeated 3 times alternating the arms and legs(Fig. 4).

With the upper body lying face down on the ball and the toes working as supports, arms were raised in front of the chest. Next, both the elbow and the shoulder blades were bent back. Maintaining for 10 seconds each time, this exercise was repeated 3 times(Fig. 5).

Fig. 2. Exchanging arms

Fig. 3. Trunk extension

Fig. 4. Trunk stabilization

Fig. 5. Trunk extensor strengthening

Measurement Methods

Back strength measuring method and tools

It was a product of the TAKEI Company from Japan. It is capable of measuring back strength readings in increments of 0.1kg within the range of 20-300kg and displaying them in columns. When taking back strength readings, the test subject is first required stand on top of the dynamometer foothold with their heels touching each other and their toes 15cm apart from each other, With both arms and knees straight, the handle on the chain from the dynamometer is grasped with the palms facing the body. Adjusting the chain length relevant to the body height, the test subject is then required to lean the upper body forward approximately 30° and finally required to pull the chain vertically upwards thereby providing the strength read ings(Fig. 6). Here, caution was taken so that the subjects do not lean the body back while pulling and also that they do not bend their knees or arms. All back strength measurements for all groups were taken before and after intervention.

Fig. 6. Measuring back strength

Data Analysis

The statistical analysis in this study employed the use of SPSS 12.0 program for carrying out paired sample t-test in comparing the before and after data for each group and a one-way ANOVA for assessing the data significance between taping, swiss ball, and control groups. Finally Scheffe post hoc test was conducted to evaluate the significant difference between three groups. Statistical significance level was set at .05.

RESULTS

Comparison of the Back Muscle Strength for Each Group Before and After Intervention

In comparing the muscle strength before and after the experiment for each group(Table 2), with 124.60 ±24.47kg before and 125.00±23.66kg after, CG showed insignificant($p>.05$) change. Meanwhile, with 124.80±11.31 before and 161.80±26.55kg after, the TG and the SG with 129.30±12.39kg before and 170.50±31.60kg after the experiment, both showed significant($p<.05$) changes.

Significant Difference Between Each Group in Back Muscle Strength

Upon assessment(Table 3), the CG with .40±10.86kg, the TG with 37.00±20.69kg and the SG 41.20± 22.67kg, the differences were found to be statistically significant between groups($p<.05$). As show in Figure 7, that was a Scheffe post test results were significant difference between the CG and the TG, CG and the SG. And also the differences were found to be signifi-cant difference between CG and SG($p<.05$).

Table 2. Comparison of the back muscles strengths for each group before and after the experiment

(unit : kg)

	Before Mean±SD	After Mean±SD	t	p
CG	124.60±24.47	125.00±23.66	-.116	.910
TG	124.80±11.31	161.80±26.55	-5.656	.000***
SG	129.30±12.39	170.50±31.60	-5.748	.000***

*p<.05, **p<.01, ***p<.001,

CG: control group, TG: taping therapy group, SG: swiss ball exercise group

Table 3. Examining the back muscle strength changes between experimental groups for significance

(unit : kg)

CG	TG	SG	F	p
.40±10.86	37.00±20.69	41.20±22.67	14.257	.000***

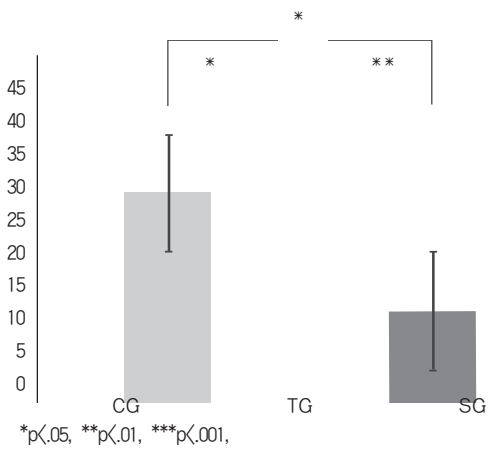

Fig. 7. Examining the back muscle strength changes between experimental groups for significance

DISCUSSION

Physiologically, the magnitude of a muscle strength is proportionate to the number of motor units involved in its contraction and muscle strength plays a central role in displaying physical strength functionally(15). Back muscle strength is a combined muscle strength brought about through simultaneous interactions between many different muscles groups within the body and is deemed essential for maintaining an ideal posture and in implementing various bodily movements(7). Among those muscles that are usually involved in back muscle strength, the erector spinae refers to muscles such as the spinalis, longissimus and illiocostalis that are connected from the pelvis to the skull, and is regulated by the spinal nerve post(14). Furthermore, the erector spinae muscles are mostly located parallel to the spine's axis and are comprised of many different muscles, it is not uncommon for their movements to overlap and they all together to straighten the spine, rotate or bend laterally(16).

Kim et al. reported that the Swiss ball posture adjustment exercises work to develop the erector spinae which plays an important role in adopting ideal body posture(17). In addition, they reported that it especially exercises the lumbar muscles at the dorsoventral region. There has been reports by Creager that exercises involving swiss balls have the effect of enhancing coordination, increasing lumbar flexibility and strengthening the surrounding muscles(18). Furthermore, it was also reported that the continued use of swiss balls in exercises provide stability in the spine(19). According to Tienetti and Milkesky, swiss ball exercises enhance one's sense of balance(20, 21), and Michael and Andre have reported it to be alleviate and prevent neck and back pains(22). Similarly, in the current study, it was found that the swiss ball exercises effect the erector spinae muscles to increase back muscle strength. Lee stated that taping is most effective when used against musculoskeletal disorders(13). Fundamentally, taping works to facilitate the circulation of blood or lymph by expanding the space between skin and the muscles thereby aiding in the recovery of motor functions, adjustment of muscle tonicity, adjustment of posture and adjustment of body balance(23).

To these principles of the taping therapy, Kim et al. states that the application of the tapes over the muscles or tendons underlying the skin with slight pressure provides stimuli that work on muscle spindles or tendon organs to alleviate muscle tone and aches(24).

Similarly, in the current study, it was observed that when taping is applied on the erector spinae, the continued treatment had an increasing effect on the back muscle strength. Furthermore, because results showed that the changes between the taping therapy and swiss ball exercises were no statistically significant, no conclusion can be made on the topic of which is a better means of treatment. The results agree with the findings by Kim et al. who reported that continued taping therapy is effective in the alleviation of muscle tone, pain and in increasing muscle strength(24).

Therefore, from this study, it was found that the continued swiss ball exercises and taping therapy treatments influence the increase in back muscle strength.

CONCLUSION

From this study which was implemented on test subjects consisting of 30 normal, male and female students in their 20s, attending the H University in Jinju, Gyeongsangnam-do with the purpose of determining the extent of the effect taping therapy and

swiss ball exercises have on back muscle strength, the following conclusions were made.

1. While the increases in back muscle strength before and after the experiment for swiss ball exercise group and taping therapy group were both found statistically significant($p<.05$), there was no significant change in the control group($p>.05$).

2. Upon analyzing the differences between swiss ball exercises and the taping therapy treatments, it was found that they were statistically insignificant ($p>.05$). Seeing from above, it was found that both swiss ball exercises and the taping therapy treatments have an effect of increasing the back muscle strength.

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