JKPT Vol. 27, No. 6, December 2015
J Kor Phys Ther 2015:27(6):419-424
pISSN 1229-0475 eISSN 2287-156X

Original Article

Effects of Lumbar Stabilization Exercise Program on the Ratio of Abdominal and Back Muscle Strength in White Collar Workers

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Purpose: This study aimed to evaluate the effects of lumbar stabilization exercise on the abdominal muscle-back muscle ratio in white-collar workers.

Methods: Forty white-collar workers without any pain who worked at an information technology (IT) company located in the Gyeonggi province were included in this study. Of these, 20 subjects were randomly allocated to the lumbar stabilization exercise group, whereas the remaining 20 were randomly allocated to the control group. The lumbar stabilization exercise group performed a 40-minute-long exercise once a week for 8 weeks. The strength of the abdominal and back muscles was measured using the CENTAUR 3-D Spatial Rotation Device (BFMC, Germany). Data analysis was conducted using SPSS 18.0 for Windows. The Paired t-test was performed to compare the values measured before and after exercise within each group. The independent sample t-test was performed to analyze the differences between the 2 groups. The statistical significance for all the analyses was set at .05.

Results: The strength of the abdominal muscles after the exercise significantly differed between the lumbar stabilization exercise group and the control group ($p < 0.05$). However, the increase in the abdominal muscle-back muscle ratio was significant in only the lumbar stabilization exercise group ($p < 0.05$), but not in the control group ($p > 0.05$).

Conclusion: The improvement of the abdominal muscle-back muscle ratio through lumbar stabilization exercise may have positive effects on lumbar stabilization. Moreover, lumbar stabilization exercise is considered beneficial for the prevention of back pain and musculoskeletal diseases.

Keywords: Lumbar stabilization Exercise program, White-collar workers

INTRODUCTION

As life environment gradually turns into office automation, people are exposed to the danger of each kind of diseases because of long-time computer work and the lack of physical activity and exercise.

For white-collar workers, their tensions and stress caused by content of work or burden of business is no less high than manual labor in intensity, which is increasing demand for health care.[1,2] Also, since these white-collar workers are in a very high risk of increasing their body mass index and waist measurement, it requires preventive care for such risk factors.[3-5]

Sparto et al.[6] reported that agonist and synergist act an important role in resisting tissue injury by means of harmony, not power, and that spinal stability is highly increased by co-contraction of antagonistic trunk muscles of abdominal muscle and back extensor.[7] According to him, co-contraction increases compression loading on the spine 12-18% or 440N, and lumbar stability 36-64% or 2925N.[8-10]

Sparto et al.[6] insisted that when paraspinal muscles, which support the spine and maintain physical stability and balance in activity, exercise strength, the balance ratio of flexion to extension should be at the level of 80% (1:1.2). As the ratio approaches 80%, it is closer to the normal ratio.

Received Nov 25, 2015 **Revised** Dec 19, 2015
Accepted Dec 21, 2015
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In the case of low back pain patients is less than 48%, and athlete has a reported more than 80%.[11,12]

More than 80% of patients with chronic back pain show greater differences in the imbalance ratio in comparison with normal individuals.[13]

For white-collar workers type of occupation with restricted physical activity, such ratio of balance could break because of reduced lumbar muscular strength and stamina and cause negative effect on lumbar stability.[14-16]

Thus, improving the ratio of muscle strength of paralumbar muscles for white-collar workers likely for low back pain would influence lumbar stability with the effect of preventing the problem. However, studies are still insufficient as to the ratio of abdominal and back muscle strength for the subject of white-collar workers.

Lumbar stabilization exercise reduces utmost stress on the spine while white-collar workers are carrying out everyday life or optimum activities. It is a very useful means of exercise to strengthen multifidus muscles, quadratus lumborum, lliopsoas and abdominal muscles, which are maintaining proper control and coordination and involved in stabilizing the area of waist and hip, while for shortened muscles, to induce extension.[17,18] So lumbar stabilization exercise can be used to optimize the ratio of abdominal and back muscle strength.

Accordingly, on the subject of white-collar workers with possible different ratio of abdominal and back muscle strength, the researcher will perform lumbar stabilization exercise program to look into its effect on the ratio.

METHODS

1. Subjects

This study was made on 40 white-collar workers working for N company located in Gyeonggi-do with random assignment in division into Lumbar stabilization exercise group (20 persons) and Control group (20 persons). All subjects were without the history of lumbosacral legions or trauma for the past one year, or sharp pain or abnormality on neurologic examination. Those who had received muscle strengthening exercise or an operation from big trauma were excluded from the subject. Table 1 shows general characteristics of the study subjects (Table 1).

Table 1. General Characteristics of the subjects

	Age (year)	Height (cm)	Weight (kg)
LSEG (n=20)	33.70±4.57	168.30±8.29	59.44±8.83
CG(n=20)	34.10±5.64	171.50±8.31	62.90±9.27
p	0.81	0.23	0.23

LSEG: Lumbar stabilization exercise group, CG: Control group.
Values are mean±standard deviation.
*p<0.05. †p<0.001.

2. Experimental methods

1) Measurement

Muscle strength of the abdominal muscle and back muscle was tested using CENTAUR 3-D Spatial Rotation Device (BFMC, Germany) (Fig. 1, 2).

2) Measuring method

Following gradual loading, maximum muscle strength was measured at two angles. 0° refers to erector spinae, multifidus and gluteus maximus, while 180° rectus abdominus, external oblique, and internal oblique. Testing was done by fixing pelvis and femur with pad with the subjects keeping neutral posture, putting the chin at "Chin-in" condition in the posture of cervical stabilization.

In this condition, ask the patient to keep a neutral posture while slanting him at two angles (0°, 180°) using gravity. If the patient

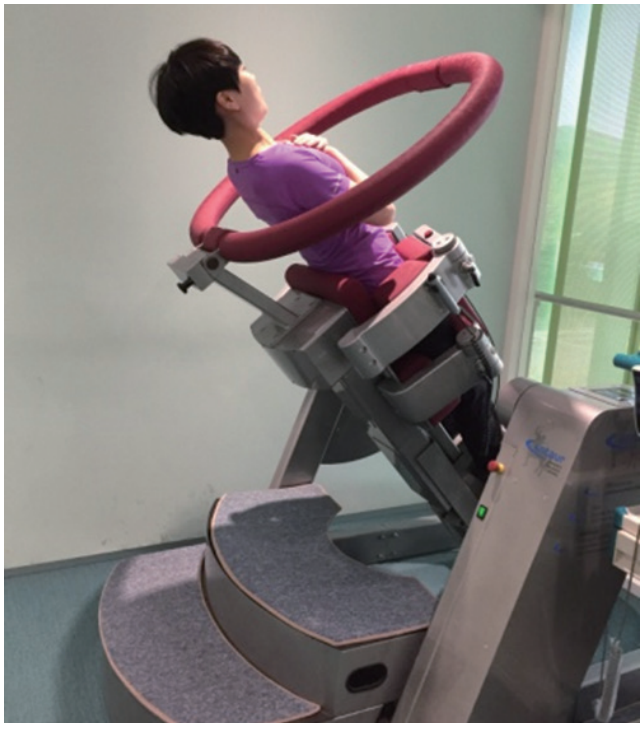

Figure 1. Abdominal muscle strength test (180°).

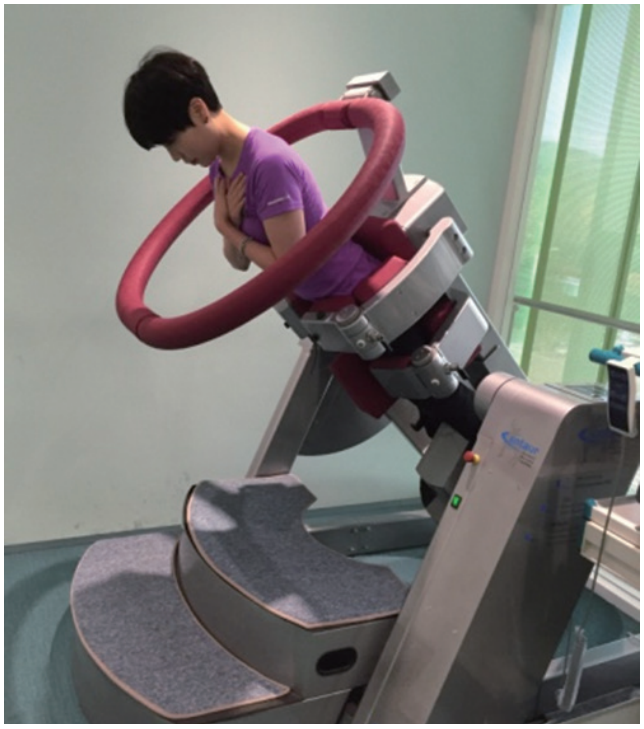

Figure 2. Back muscle strength test (0°).

complains of pain or fails to keep a neutral posture during the test, stop it.[19-21]

This study defined what was measured at 0° as back muscle strength and at 180° as abdominal muscle strength. Also, we measured the muscle strength before and after applying lumbar stabilization exercise to each group.

Abdominal muscle strength was calculated as multiplied by the 100 divided by the "measurement values of the subjects" in the "maximal possible strength of the subjects". Back muscle strength was also calculated same. Maximal possible strength values were calculated by height, weight, and age of subject with CENTAUR 3-D Spatial Rotation Device software program.

3) Abdominal Muscle-Back Muscle Ratio

Abdominal muscle-back muscle ratio values, multiplied by 100 divided in back muscle strength by abdominal muscle strength. The best optimal abdominal muscle-back muscle ratio means that the abdominal muscle strength is 1 when the back muscle strength is 1.2.[6,13]

$$\text{Abdominal muscle-back muscle ratio values (\%)} = \frac{\text{Abdominal Muscle strength (\%)}}{\text{Back Muscle strength (\%)}} \times 100$$

3. Method of exercise

For case of control group, without administering specific exercise, only prior and post measurements were conducted on lumbar stabilization exercise group for 8 weeks, 50 minutes a week. Before conducting lumbar stabilization exercise, basic tension exercise using transverse abdominis and multifidus was sufficiently instructed with stretching for 5 minutes on the lumber region and legs, respectively, as a warm-up and finish exercise.[22]

All movements were conducted keeping basic tension on and maintaining traverse abdominis and pelvic floor muscle.

For exercising method, the following was conducted: raising one arm, both arms, one leg, legs with flexion of hip and knee joints at 90°, moving both upper limbs and lower limbs alternately in a diagonal direction (dead bug exercise) keeping neutral posture in a lying position, raising one leg and marching in place in bridging stabilization exercise, raising one arm, one leg, and one arm and opposite leg simultaneously in four-point kneeling, squatting in a standing position, pulling down elastic band in a lying position with knees bent, raising one leg on a therapeutic ball, and pulling elastic band standing on unstable foothold.[23,24-30,31]

4. Statistical analysis

Data analysis was made using SPSS 18.0 for windows. To analyze the difference in muscle strength of each group comparatively, normality test was conducted and then for homogeneity test, independent sample t-test was conducted within each group. To compare before and after within groups, paired samples T-test was conducted and independent sample t-test was conducted to analyze the difference between the two groups. Statistical significance level was put at $p < 0.05$.

RESULTS

1. Comparison of Muscle Strength of Abdominal Muscle and Back Muscle

The strength of the abdominal muscles in LSEG after the exercise significantly differed between the lumbar stabilization exercise group and the control group ($p < 0.05$). But, strength of the back muscles after the exercise no significantly differed between the lumbar stabilization exercise group and the control group ($p > 0.05$) (Table 2).

Table 2. Comparison of Muscle Strength of Abdominal Muscle and Back Muscle (%)

		Pre	Post	t	p	t/p
Abdominal muscle	LSEG	37.39±6.99	48.20±6.68	-7.20	0.000†	-7.26/.000†
	CG	41.87±9.17	41.58±9.03	1.008	0.33	
Back muscle	LSEG	72.31±10.29	73.49±9.96	-0.46	0.65	-0.53/0.60
	CG	73.24±10.22	73.04±10.55	0.522	0.61	

LSEG: Lumbar stabilization exercise group, CG: Control group.
Values are mean±standard deviation.
*p<0.05. †p<0.001.

Table 3. Comparison of Abdominal Muscle-Back Muscle Ratio (%)

		Pre	Post	t	p	t/p
Abdominal-Back muscle Ratio	LSEG	52.87±13.57	67.02±14.39	-6.32	0.000†	-6.23/0.000†
	CG	57.76±12.09	57.57±12.09	0.37	0.72	

LSEG: Lumbar stabilization exercise group, CG: Control group.
Values are mean±standard deviation.
*p<0.05. †p<0.001.

2. Comparison of Abdominal Muscle-Back Muscle Ratio

The increase in the abdominal muscle-back muscle ratio was significant in only the lumbar stabilization exercise group ($p < 0.05$), but not in the control group ($p > 0.05$) (Table 3).

DISCUSSION

For white-collar workers, weakening of abdominal and back muscle strength caused by reduced physical activity gives much difficulty in keeping posture and inconvenience in everyday life. To strengthen such abdominal and back muscle strength, this study conducted lumbar stabilization exercise program on white-collar workers to learn what effect it had on the ratio of the abdominal and back parts.

Lumbar stabilization exercise is a way to keep maintaining the right arrangement of the spine, especially the hipbone, through simultaneous contraction of abdominal and lumbar muscles. This greatly reduces the stress exerted to the whole spine and lumbar part, prevents damage to para-lumbar tissues and increases recuperative elements, serving to reduce pain.[32-34]

Choi and Min[35] as a result of conducting lumbar stabilization exercise on modern dance majors in their 20's who complained of lumbar pain, reported a significant increase of muscle activity in abdominal and hip muscles together with decrease of subjective pain measures.

Also Lee[17] and Lee et al.[9] are reported that as a result of conducting stabilization exercise on the patients of low back pain, reported increased muscle activity in abdominal, back and trunk muscles for the reason of strengthening related muscles through stabilization exercise.

In this study, as a result of conducting lumbar stabilization exercise program on white-collar workers, abdominal muscle strength showed significant improvement similarly to forgoing studies ($p < 0.05$) but back muscle strength an insignificant improvement ($p > 0.05$). This is considered because lumbar stabilization exercise was characteristically conducted focusing on the increase of abdominal muscle strength.

Although strengthening extensor is very essential to prevent low back pain,[36] since, in this study, participant white-collar workers showed much lower abdominal flexion than back extension with serious imbalance of muscles, exercise was conducted with more focus on the improvement of abdominal muscle strength than on back extensor to adjust to the optimum ratio. It is considered that improvement of back muscle strength was insufficient for this reason. However, in the future, it will be needed to compose the exercise program with a focus on strengthening back extensor, too.

Kim and Han[37] are study reported that after 8 week isotonic exercises, the ratio between lumbar flexor and extensor changed significantly among female patients with chronic back pain. The exercises also had positive effects on reducing their low back pain, as well as enhancing their muscular strength. Therefore, the exercises will help them restore their ability to carry out daily routines and functions early. Besides, Kim et al.[38] reported that 8 weeks rehabilitation training improved the ratio between lumbar flexor and extensor. It

was also effective in reducing the chronic back pain of patients with different diseases. Thus, the training will help them reduce their pain and return to their daily routines and work early.

In this study, after 8 weeks of lumbar stabilization exercise program, the balance ratio of abdominal-back muscle strength increased almost to 80%. Such increase can be interpreted as very positive because when exercising para-lumbar muscles that perform keeping balance, the balance ratio between flexion and extension should be at the level of 80% (1: 1.2).[6,13] Thus, it can be said that lumbar stabilization exercise is a good exercise which can make the optimum ratio between abdominal and back muscle strength.

This study has limitations. There was difficulty controlling the variables of environment related to working conditions or business hours characteristically of white-collar workers. Another is too small a number of subjects to generalize the result of the study. Also, since the focus was laid on the ratio of abdominal and back muscle strength with limitation in the increase of extensor strength, further studies will be needed to conduct another exercise program for increasing extension jointly.

CONCLUSIONS

As a result of investigating the effect of lumbar stabilization exercise on the ratio of abdominal and back muscle strength on the subject of white-collar workers, there was a significant improvement in abdominal and back muscle strength and their ratio ($p < 0.05$). Thus, we should be able to prevent low back pain and musculoskeletal diseases for white-collar workers by conducting lumbar stabilization exercise program that can improve the ratio of abdominal and back muscle strength. Besides, in the future, not only lumbar stabilization exercise, we should need to find out exercise that can help improve the ratio of abdominal and back muscle strength for white-collar workers and explain how much such a method of exercise will be efficient in preventing low back pain through follow-up.

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