

The effects of t'ai chi on muscle activity, pain, and balance in females in their 20s with acute low back pain

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Abstract. [Purpose] This study was conducted in order to examine the effects of t'ai chi on females in their 20s with acute low back pain. The subjects were 30 females in their 20s with acute low back pain. [Subjects and Methods] They were equally and randomly divided into a t'ai chi group and a stretching group. The intervention was applied three times per week, one hour each time, for a total of eight weeks. During the one hour, the subjects conducted warm-up exercises for 10 min, primary exercises for 40 min, and cool-down exercises for 10 min. In order to examine changes in low back pain in the patients according to the intervention method, muscle activity, pain, and balance elements (left and right side movement distance, forward and backward movement distance) were measured. [Results] Muscle activity and the visual analog scale score significantly decreased in both the t'ai chi group and the stretching group. Regarding changes in balance elements, the t'ai chi group's left and right side movement distance decreased, which was statistically significant. However, the t'ai chi group's forward and backward movement distance and the stretching group's forward and backward movement distance and left and right side movement distance did not change. [Conclusion] According to the results of this study, t'ai chi is considered an appropriate exercise program to reduce acute low back pain in females in their 20s. This is because when compared with stretching, it enables posture maintenance with lesser force due to decreased muscle activity, it is more helpful for improvements in balance ability, and it is effective in decreasing pain.

Key words: T'ai chi, Low back pain

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INTRODUCTION

Low back pain, a representative symptom that appears due to a lowered stability of the body resulting from imbalance between the trunk flexor and extensor, is one of the most common disorders in life. Acute low back pain often presents because of excessive movements of the erector spinae muscle resulting from lowered flexibility caused by an imbalance of the trunk muscles or weakening of trunk muscle strength¹⁾. The weakening of the erector spinae muscle may be caused by a lack of muscle strength, resulting from insufficient exercise, obesity, and improper posture; such causes may lead to abnormalities in different structures of the lumbar region, resulting in acute low back pain²⁾. There are social and individual problems related to low back pain. Patients with low back pain find it difficult to lead a smooth, ordinary life due to the pain; social problems include many medical costs and failure to participate in socially productive activities³⁾.

To manage low back pain, diverse methods are used. Physical therapy is a representative low back pain management method. Various exercises, such as aerobics, yoga, and Pilates, as well as traditional physical therapy methods, are utilized to decrease low back pain. Recently, lumbar stabilization exercises have been frequently used as an exercise to ameliorate the muscle strength of low back pain patients and to relieve their pain. Lumbar stabilization exercises improve deep muscle strength and increase range of motion through enhanced muscle strength, with positive results for low back pain patients; therefore, these exercises are frequently applied in the clinical field⁴⁾. Although such lumbar stabilization exercises may be incorporated into training programs for young people, elderly people need therapists or trainers with expert knowledge because the difficulties and intensities of the exercises should be adjusted with precision. On the other hand, t'ai chi may be applied as a useful exercise for elderly people. T'ai chi does not demand great force in its motions but seeks improvements in balance through postural stability, increased flexibility, and slow motions, enabling elderly people to perform the exercises easily. It is not an activity involving instant great force, and therefore, it is appropriate for elderly people. T'ai chi is employed as an effective exercise for elderly people for different purposes, such as to build strength, flexibility, and cardiovascular endurance and to improve body composition⁵⁾.

In relation to self-help programs, t'ai chi and aquatic

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training may be utilized as effective exercise methods for patients with gonarthrosis^{6, 7)}. In addition, t'ai chi is helpful in terms of physical and mental health⁸⁾. Nonetheless, previous studies have focused on patients with osteoarthritis, which presents in middle-aged or older people or elderly stroke patients, while research on young adults has been insufficient. Acute low back pain is a common disease in young people. But most studies have been focused chronic low back pain. So we chose subjects with acute low back pain here. Therefore, this experiment was conducted in order to determine whether t'ai chi might be used as an effective exercise program for young female adults in their 20s with acute low back pain by comparing changes in muscle activity, pain, and balance ability.

SUBJECTS AND METHODS

The subjects were females in their 20s with acute low back pain that lasted for three weeks or shorter⁹⁾. The 30 subjects were divided into two groups. One group conducted t'ai chi, and the other group carried out stretching for eight weeks. An orthopedist had diagnosed the subjects with acute low back pain, and they voluntarily participated in this experiment. Those who had abnormalities other than low back pain were excluded. A surface electromyography system (MP150, BIOPAC Systems, Inc., Goleta, CA, USA) was used to measure muscle activity, and Ag-Ag/Cl electrodes were employed. The activity of the erector spinae muscle was measured, and the electrodes were attached 2 cm from the L3 spinous process. In order to eliminate noises, a 60-Hz notch filter was used. Data were processed by conducting band-pass filtering at 20 to 500 Hz. To calculate the value of maximal isometric contraction during a manual muscle test, %MVIC was used. Marching in place was conducted for 10 s. EMG was performed during the sit to stand maneuver, as this is the most frequently performed motion. Measurement of balance was performed in a standing position. Excluding the first and last two seconds, the average activity for six seconds was measured. Pain was measured using a visual analog scale (VAS), and a Good Balance system was used to measure balance ability. The measurement elements for balance ability were left and right side movement distance and forward and backward movement distance. The shorter the movement distance, the better the ability to remain in

a position using balance. The subjects carried out t'ai chi and stretching exercises three times per week, one hour each time, for a total of eight weeks. Each of the sessions was composed of warm-up exercises for 10 min, primary exercises for 40 min, and cool-down exercises for 10 min. A series of motions including yamabunjong, bongrian, baekhakyangsi, suhuibipa, nuseulyobo, jesusangse, and yeobongsapei were conducted in a flow mode for 20 min. The motions were carried out twice. For stretching, the subjects repetitively performed lower limb, trunk, and upper limb exercises in a sequential manner. This was conducted after approval of safety, all procedures, and ethics by the Research Ethics Committee of Kyungbook University. The subjects agreed to participate in this study after explanation of its methods and purpose. SPSS was used for statistical processing, and a paired t-test was carried out to examine changes according to the intervention, and an independent t-test was used to compare the two groups. The significance level was set at $p < 0.05$.

RESULTS

In both groups, muscle activity and pain significantly decreased. However, regarding balance, the left and right side movement distance significantly decreased in the t'ai chi group but did not statistically change in the stretching group. As measurement elements with significant differences, the t'ai chi group's muscle activity and pain decreased from $26.1 \pm 3.9\%$ MVIC to $22.7 \pm 0.6\%$ MVIC and from 3.6 ± 0.7 to 2.1 ± 0.6 , respectively, and its left and right side movement distance in relation to balance ability was reduced from 157.4 ± 41.1 mm to 131.5 ± 29.2 mm ($p < 0.05$). The stretching group's muscle activity and pain also decreased from $27.3 \pm 3.6\%$ MVIC to $25.7 \pm 3.4\%$ MVIC and from 3.6 ± 0.4 to 2.5 ± 0.6 , respectively ($p < 0.05$). However, with regard to the group's balance ability, its forward and backward movement distance decreased from 181.9 ± 52.8 mm to 164.3 ± 66.1 mm, with no statistical significance. In addition, the stretching group's left and right side movement distance and forward and backward movement distance decreased from 162.7 ± 51.8 mm to 153.6 ± 45.8 mm and from 219.1 ± 51.1 mm to 206.4 ± 69.1 mm, respectively, with no statistical significance ($p > 0.05$) (Table 1).

Table 1. Differences in muscle activity, pain, and balance in the two groups (%MVIC, VAS, mm)

		Group	Before	After
			M \pm SD	M \pm SD
Muscle activity	T'ai chi		26.1 \pm 3.9	22.7 \pm 0.6*
	Stretching		27.3 \pm 3.6	25.7 \pm 3.4*
Pain	T'ai chi		3.6 \pm 0.7	2.1 \pm 0.6*
	Stretching		3.6 \pm 0.4	2.5 \pm 0.6*
Balance	(left-right)	T'ai chi	157.4 \pm 41.1	131.5 \pm 29.2*
		Stretching	162.7 \pm 51.8	153.6 \pm 45.8
	(forward-backward)	T'ai chi	181.9 \pm 52.8	164.3 \pm 66.1
		Stretching	219.1 \pm 51.1	206.4 \pm 69.1

* $p < 0.05$

DISCUSSION

This study was conducted in order to determine changes in low back pain when t'ai chi was applied to female patients in their 20s with acute low back pain. In order to assess changes, muscle activity, VAS, and balance elements were measured as variables. Muscle activity decreased from $26.1 \pm 3.9\%$ MVIC to $22.7 \pm 0.6\%$ MVIC in the t'ai chi group and from $27.3 \pm 3.6\%$ MVIC to $25.7 \pm 3.4\%$ MVIC in the stretching group, showing statistically significant changes ($p < 0.05$). It can be interpreted that the activity of the postural muscles decreased because efficient postural maintenance was possible. This is similar to previous research that experimented with changes in muscle activity according to whether the subjects put on a waist belt. When the subjects did not wear a waist belt, their muscle activity was $190.0 \pm 31.7\%$ RVC (reference voluntary contraction), but when they put on a waist belt, their muscle activity decreased to $175.17 \pm 30.34\%$ RVC, with the change being statistically significant¹⁰. This is because putting on a waist belt heightened the stability and reduced the mobilization of the erector spinae muscle used for postural maintenance, resulting in lowered muscle activity. When stability was heightened, postural maintenance with the lowest mobilization of the muscles is possible, and therefore, the present study obtained a result similar to the results of previous research^{11–13}.

In addition, in the balance elements of t'ai chi, there were statistically significant changes in the left and right side movement distance and the forward and backward movement distance. Among them, the left and right side movement distance decreased from 157.4 ± 41.1 mm to 131.5 ± 29.2 mm, which was statistically significant ($p < 0.05$). Forward and backward movement distance decreased from 181.9 ± 52.8 mm to 164.3 ± 66.1 mm, with the change not statistically significant ($p > 0.05$). The left and right side movement distance and forward and backward movement distance of the control group, to which stretching was applied, decreased from 162.7 ± 51.8 mm to 153.6 ± 45.8 mm and from 219.1 ± 51.1 mm to 206.4 ± 69.1 mm, respectively, and the changes were not statistically significant. The smaller the left and right side movement distance and the forward and backward movement distance are, the more excellent the ability is to maintain balance within a small movement range. Although the movement distances of both the t'ai chi and stretching groups decreased, only the t'ai chi group's left and right side movement distance showed a statistically significant decrease, signifying that the intervention with t'ai chi improved balance ability.

It can be interpreted that decreased muscle activity means that even the use of a small amount of muscle strength enables stable postural maintenance, and a reduction in distances in balance elements signifies improvements in balance ability. In effect, low back pain will decrease because such a decrease in balance elements enables improvements in balance ability and postural maintenance with a smaller amount of force. This is shown in the VAS results of the present study. Pain decreased from 3.6 ± 0.7 to 2.1 ± 0.6 in the t'ai chi group and from 3.6 ± 0.4 to 2.5 ± 0.6 in the stretching group. Such changes were statistically significant in the

two groups. When the two groups were compared, the pain decrease of the t'ai chi group was greater than that of the stretching group. In particular, the decrease in muscle activity was greater in the t'ai chi group than in the stretching group; the subjects in the former group were able to stably maintain their posture with a smaller amount of force and saw a more greatly improved balance ability with reduced larger reduction in pain. Stretching is often used as a good exercise to manage low back pain. In particular, stretching is applied frequently in low back pain management programs for young adults. According to the present study results, t'ai chi was more efficient in enhancing balance ability and managing pain; t'ai chi will be useful as an effective low back pain management program, and it can be employed as an effective exercise program for females in their 20s with acute low back pain. This study was conducted in order to examine the effects of t'ai chi on female adults in their 20s with acute low back pain. The exercise effects of stretching, which was performed in the control group, were compared with those of t'ai chi. For this comparison, muscle activity, pain, and balance ability were measured. Muscle activity and pain decreased in both the t'ai chi and stretching groups, but t'ai chi was found to be more effective. Balance ability was particularly improved in the t'ai chi group. Therefore, t'ai chi is considered an effective exercise program for decreasing acute low back pain in females in their 20s.

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