

# Effects of Open and Closed Kinetic Chain Exercises on the Balance Using Elastic Bands for the Health Care of the Elderly Females

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## ABSTRACT

**Background:** Open chain and closed chain exercises carried out exercises using elastic bands are not complicated and easy to follow as health care of the elderly and to evaluate the impact on the balance of the elderly females.

**Objective:** The purpose of this study is to investigate the effects of elastic bands used in open and closed kinetic chain exercises on the balance of elderly females aged  $\geq 65$  years.

**Method:** This study included 30 females  $\geq 65$  years; participants, were randomly divided into two groups: the closed kinetic exercise group (n = 15) and the open kinetic exercise group (n = 15). Closed/open kinetic exercises were performed three times a week for four weeks.

**Results:** Static and dynamic balance abilities were measured before and after exercise to determine its effects. One leg standing balance test(OLST) was used to evaluate static balance, while an functional reaching test(FRT) was used to evaluate dynamic balance. The changes in the static balance (OLST) were significant difference ( $p < .05$ ) between the closed chain exercise group and the open chain exercise group, but the OLST between the two groups did not show any significant difference. The changes in the static balance (FRT) were significant difference ( $p < .05$ ) between the closed chain exercise group and the open chain exercise group, but there was no significant difference between the two groups. There was a significant difference ( $p < .05$ ) before and after exercise in the open chain exercise and the closed chain exercise ( $p < .05$ ) groups, but there was no significant difference between the two groups.

**Conclusion:** Open and closed chain exercises using elastic bands are effective in improving the balancing ability; may aid in minimizing falls in elderly individuals.

**Keywords:** Elastic bands, Closed kinetic exercise, Open kinetic exercise, Elderly women, Static balance, Dynamic balance

## Introduction

In order to prolong a healthy life, it is necessary to not only treat the diseases of the elderly but also to improve their health care. A decrease in the balance ability and exercise response time are the two physical characteristics associated with the elderly population,

which hinder independent living and lowers the quality of life. The emerging problem resulting from these issues is an increased risk of falling, which in turn, can have serious health implication<sup>1</sup>.

The Physical and functional disabilities caused by falls can lead to severe complications in the elderly and recovery time is considerably longer compared to younger individuals<sup>2</sup>. Although falling can occur at all ages, 50% of the elderly population experience falls and one third of the elderly population aged  $> 65$  years' experience recurrent falling<sup>3</sup>.

The causes of decreased balance are several factors such as degeneration of somatosensory senses including

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the proprioceptive sensation, visual impairment, electrography, and central nervous system damage<sup>4</sup>. Balongun et al<sup>5</sup>. reported that balance ability is maintained well until the age of 40, but balance ability is continuously decreased in both sexes after the forties. Overstall et al<sup>6</sup>. showed a sharp decrease especially before and after 60 years of age. Since the decline in balance ability is a factor of fall, the improvement of balance reduces the possibility of falling and reduces the economic cost of falling, which has an important effect on quality improvement and health care of the elderly.

It can be classified into kinematic closed chain motion and open chain motion according to the resistance motion method used. Closed kinetic chain exercise usually refers to weight-bearing exercise, a movement that receives strong external resistance by restricting the distal movement of the body<sup>7</sup>. The mechanical receptors are sensitive to changes in the pressure of the capsules and promote the proprioceptive sensation. In addition, it acts as an efferent and has a great effect on the stability of the injured joint<sup>8</sup>.

Open kinetic chain movement is a method of moving freely in the far side of the limb and exercising in a fixed state in the body side. As a result, not only does the superior muscle contraction dominate, but it also generates more traction and rotational force<sup>9</sup>. In previous studies, closed and open chain exercises have been reported to improve muscle strength. Therefore, it is conceivable that in elderly individuals with impaired physical function, it could improve their physical activity and increase their participation in social activities by reducing their likelihood of falling<sup>10</sup>.

Resistance exercise using a weight device is not suitable as an exercise for the elderly because it requires a lot of caution when applied to the elderly because of the risk of causing injury of the elderly due to the wrong use of the weight device<sup>11</sup>. Therefore, the elderly exercise program using the elastic band rather than the weight exercise device such as dumbbell or barbell or the mechanical load exercise can be a superior exercise method in stability and utilization.

Elastic band exercise may be used for muscle strength exercise using elastic resistance, aerobic exercise for improving cardiorespiratory function, flexibility exercise for improving muscle and joint height, stimulation of nerve root by inherent receptor stimulation in traumatic and disordered patients<sup>12</sup>.

Because it is easy to carry the elastic band, it is possible to exercise schedule anytime and anywhere by moving with the band. Also, the home program using the elastic band can promote exercise participation by exercising according to the convenience of the elderly<sup>13</sup>.

Elastic band exercise is not only an improvement in the strength, balance and flexibility of the elderly, but is also effective in maximizing muscle strength and increasing muscle strength as much as a traditional resistance exercise program<sup>14</sup>. Therefore, effective exercise in which elderly people with diseases such as muscles, nervous system, and the like are weak and weak, and those who are not regularly exercising are more secure and easily accessible to the elderly<sup>15</sup>.

In this study, we will try to derive more effective exercise results by evaluating and comparing the difference in balance of female elderly people by conducting open chain movement and closed chain movement using easy and intricate elastic band to the elderly.

## Method

**Participants and Duration:** This study was conducted from August 1, 2018 to August 29, 2018 in the welfare center in Daejeon. The study involved elderly persons aged  $\geq 65$  years and the criteria for selecting the subjects were as follows: 1) no visual field problems, 2) no circulatory systemic disease such as hypertension, 3) restricted exercise due to pain, 4) no neurological damage to balance or gait, and 5) those who voluntarily agreed to participate in the study.

**Evaluation Tools:** OLST were used to evaluate static balance, while FRT were used to evaluate dynamic balance. Measurements were taken three times at each session, from which the average value was calculated. Evaluations were performed before and after exercise training.

**One leg standing test (OLST):** To measure the static balance ability in a short time compared to the other tests and the interatomic as an evaluation tool for predicting the risk of falling reliability ICC = 0.9 and sensitivity is 95% and the specificity was 58%. The participant was instructed to opens his/her eyes in a line state and raise their hands sideways, horizontally to the ground, lifting one foot according to the direction of the inspector. The raised leg was then bent 90° to the knee joint. Both eyes were kept floating and the maximum start-up was measured until the upper and lower body was shaken<sup>16</sup>. A total of three measurements were performed and the mean values were recorded.

**Functional reach test (FRT):** The examiner stands next to the wall and tilts the body as far forward as possible, with the hand tip along the test line, with the shoulder 90 ° flexion and fully extended to the front horizontally. Measure the distance, in cm, that the fingertip of the subject's hair has traveled over the test line before falling from the ground. A check is placed next to prevent falls. The retest reliability of the FRT evaluation was 0.92 and the inter-rater reliability was .98. In addition, there is a limitation in functional balance if the measured value is less than 15cm ~ 17.5cm. This is because it is used to estimate the balance of the elderly in the community and to predict the fall<sup>17</sup>.

**Intervention Methods:** The exercise intervention method was applied to the exercise group by revising and supplementing the elastic band exercise program of a previous study<sup>22</sup>. Elastic band (ECOYOGI, China) is for orange beginner, size is 2m, width is 15cm, weight is 78g, and thickness is 0.3mm. The subjects were randomly assigned to each group and were divided into ten open kinetic chain exercise group using elastic bands and ten closed band exercise groups using elastic bands. Each group exercise was performed with 5 minutes of preparation exercise, 5 minutes of restorative exercise, and 1 minute of rest for pain or discomfort; this regimen was performed, for a total of 40 minutes, 3 times a week for a total of 4 weeks. Physical therapy was performed by four physical therapists and two assistants.

**Open Kinetic Chain Exercises:** Bending and stretching of the hip joint by pulling or pushing the elastic band around the ankle while keeping it standing. Sit on a chair or lie on the floor, tie an elastic band to the ankle, and pull or push back and forth to flex and move the knee joint.

**Closed Kinetic Chain Exercises:** The leg is bounded by the shoulder width, and the elastic band is tied to the waist belt and the ankle. The bending motion and the bending motion of the knee are performed by the mini squat movement while the bending motion and the bending motion of the hip joint are performed simultaneously.

**Analysis Method:** The SPSS 20.0 program was used for data analysis. To investigate the normal distribution of categories between the groups, the Shapiro-Wilk test was performed. To evaluate changes before and after the exercise programs in both groups, a Wilcoxon signed-rank test was used. Lastly, to evaluate differences between the two groups, a Mann-Whitney U test was performed. The significance level of the study ( $\alpha$ ) was .05.

## Results

**Characteristics of the Participants:** The mean age of the closed chain exercise group was  $73.73 \pm 2.52$  years, the mean height was  $159.26 \pm 4.72$  cm, and the mean weight was  $56.27 \pm 4.13$ kg, the mean age of the open chain exercise group was  $72.86 \pm 2.77$  years, the height was  $159.93 \pm 5.37$  cm and the weight was  $55.53 \pm 3.48$  kg. The general characteristics are shown in Table 1. Independent sample t-tests were performed to assess the homogeneity between the two groups. There was no significant difference between the two groups[Table 1].

**Table 1: General characteristics of the subjects**

	CKC group <sup>1)</sup> (n = 15)	OKC group <sup>2)</sup> (n = 15)	p
Age(years)	73.73 ± 2.52*	72.86 ± 2.77	.378
Height(cm)	159.26 ± 4.72	159.93 ± 5.37	.721
Weight(kg)	56.27 ± 4.13	55.53 ± 3.48	.603

\* mean ± standard deviation

1) Closed Kinetic Chain Exercise

2) Open Kinetic Chain Exercises

**OLST Change:** The closed kinetic chain exercise group with elastic band showed a significant increase in the OLST measured balance; from  $5.82 \pm 1.08$  sec before exercise to  $6.60 \pm 1.04$  sec after exercise ( $p < .05$ ). The open kinetic chain exercise group using elastic bands showed a significant difference before and after exercise [ $5.98 \pm 1.06$  sec before exercise to  $6.51 \pm 1.03$  sec after exercise( $p < .05$ )]. OLST between the two groups showed no significant difference [Table 2].

**Table 2: Change in balance**

	CKC group <sup>1)</sup> (n = 15)	OKC group <sup>2)</sup> (n = 15)	Z	p
<b>OLST(sec)</b>				
pre	5.82 ± 1.08*	5.98 ± 1.06	-3.53	.724
post	6.60 ± 1.04	6.51 ± 1.03		
Z	-3.411	-2.982		
P	.001	.003		
<b>FRT(cm)</b>				
pre	17.53 ± 2.55	17.86 ± 2.03	-1.195	.232
post	19.93 ± 2.22	19.00 ± 2.83		
Z	-3.487	-2.716		
P	.000	.007		

\* mean  $\pm$  standard deviation

<sup>1)</sup> Open Kinetic Chain Exercise

<sup>2)</sup> Closed Kinetic Chain Exercises

OLST: One Leg Standing Test

FRT: Functional Reach Test

**FRT Change:** The closed kinetic chain exercise group with elastic bands showed a significant difference from  $17.53 \pm 2.55$  cm before exercise to  $19.93 \pm 2.22$  cm after exercise ( $p < .05$ ). The open kinetic chain exercise group using elastic bands also showed a significant difference before and after exercise ( $17.86 \pm 2.03$  cm before exercise to  $19.00 \pm 2.83$  cm after exercise) ( $p < .05$ ). FRT between the two groups showed no significant difference [Table 2].

### Discussion and Conclusion

Recently, the Ministry of Public Administration and Security announced that Korea entered the aged society at the end of August 2017<sup>18</sup>, and now the elderly person needs a solution to maintain a qualitatively healthy life. In addition, there is a need for regular, diverse, and effective exercises.

The purpose of this study was to investigate the effect of exercise and open chain exercise on the balance of female elderly people.

Kwon et al<sup>19</sup>. reported on the effect and effectiveness of the open chain exercise and closed chain exercise on the balance control ability and muscle activity in the normal adult subjects for 6 weeks and found that the static balance and dynamic balance ability were improved in the closed chain exercise. Furthermore, Yi and Ki<sup>20</sup> investigated the effect of closed power chain exercise, using props, on physical fitness, fall efficacy, depression, physiological stress, physical fitness, and health consciousness of elderly women.

Duncan et al<sup>21</sup>. reported that the risk of falling is four times higher for elderly people below 15.24 cm than those below 25.4 cm. Using the elastic band exercise method, Kim et al<sup>22</sup>. showed that the balance of FRT was significantly increased from 16.89 cm to 23.41 cm postoperatively in 30 elderly subjects aged  $\geq 75$  years ( $p = .001$ ). Han et al<sup>23</sup>. demonstrated a significant (13.68cm) difference in the FRT values of 50 minute exercise three times a week for 8 weeks in subjects aged  $\geq 75$  years old. In the present study, there was a

significant difference in FRT between the open and closed chain exercise groups. In a study by Closed chain exercise has been demonstrated to be more effective than open chain exercise in terms of proprioceptive sensory input<sup>24</sup>. Increased sense knee and ankle joint position play important roles in restoring dynamic balance by increasing cognitive ability and perception of body parts.

The results of the previous studies and the results of this study suggest that the resistance exercise using the elastic band enhances the balance ability by strengthening the leg strength. In addition to the above results, it is strongly recommended that exercise therapy in combination with general physical therapy is recommended for elderly people in the elderly, because the exercise can be applied to the abdominal and back muscles using elastic band after general physical therapy. Muscle strength is an important factor in balance control and is reported to be a major cause of aging disability<sup>25</sup>. Therefore, we introduced the lower extremity strengthening exercise as a means to improve balance ability, and the resistance exercise using elastic band is an effective method for the elderly who can improve the strength reduction by aging.

Zhang et al<sup>26</sup>. regarded OLST as an elderly person with poor balance ability if they could not open his/her posture for more than 20 seconds. In the case of the performance of the OLST with eyes closed, except for visual information, the retention time was reduced in both groups compared to when eyes were opened and the, However, in the muscle strengthening exercise group using elastic bands, the retention time was significantly improved in both the open and closed states following the training. This was, when the eyes were opened and the, OLST retention time was  $6.60 \pm 1.30$  seconds, which is equivalent to more than 5 seconds<sup>27</sup>. In this study, there was a significant difference in OLST between the open and closed chain exercise groups.

In the present study, static balance and dynamic balance were significantly increased in both the open and closed chain exercise groups using elastic bands. However, there was no difference between the two exercise methods. Through the results of this study, we can conclude that open and closed chain exercise using elastic bands are more effective for improving balance ability.

In addition to the above results, it is strongly recommended that exercise therapy in combination

with general physical therapy is performed by elderly individuals. Furthermore, the exercise can be applied to the abdominal and back muscles using elastic band after general physical therapy. Therefore, we introduced the lower extremity muscle strengthening exercise as a means to improve the balance ability. Closed kinetic chain exercise using elastic bands can promote a reversal of the decrease in muscle strength aging. Future studies should focus on applying this research to a more diverse population in order to confirm the findings of this study.

**Ethical Clearance:** Not required

**Source of Funding:** Nil

**Conflict of Interest:** Nil

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