

The Effect of Complex Ankle Exercises on Balance with Functional Ankle Instability in Twenties

The purpose of this study was to investigate the complex ankle exercises on balance. 22 participants (male: 14, female: 8) with functional ankle instability were participated. Functional ankle instability was selected to be less than 24 points using the Cumberland ankle instability tool (CAIT) with people who had severe ankle sprain and then experiencing ankle giving way. A total of 20 minutes performed three times a week for four weeks with muscle strength and balance exercises. Muscle strengthening exercise was performed with Theraband, and balance exercise was performed with unstable support plates. Biodex balance system® was used to measure static and dynamic balance. The dynamic balance was selected in grade 2, 4, and 8. The static and dynamic balance (grade: 2, 4, and 8) balance was significantly decreased in anterior–posterior, and medial–lateral directions ($p < .05$). The instability was significantly increased after exercise ($p < .05$). These results suggest that complex exercises are beneficial to decreasing the functional ankle instability.

Key words: *Complex Exercises, Ankle Sprain, Functional Ankle Instability, Balance*

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INTRODUCTION

Sprain means that the ligament that stabilizes the joint is structurally damaged, and ankle sprains occurred mainly in the injured lateral ligaments¹. These ankle sprains were the most common musculoskeletal injuries, especially in sports injuries by 15–20%^{2,3}. According to Best et al.⁴, the ankle sprain showed symptoms such as pain, swelling, muscle weakness, and instability based on degrees and stages of impairment of ankle. Raugust⁵ mentioned that these injuries have caused the chronic ankle instability. Chronic ankle instability is characterized by decrease of proprioceptive, neuromuscular control, muscle strength and postural control¹⁶.

There have been various methods from the past to the present for ankle sprain treatment. For

example, fixation and surgery, functional therapy, taping, orthoses, and ankle exercises have been suggesting, and soft–tissue massage and joint mobilization have also been used in area of the physical therapy^{7,8}. The application varies depending on the level of ankle sprain, and is recommended primarily for non–surgical treatments if possible⁹.

These are some concrete examples of ankle sprain treatment. It was more effective to perform both strength and balance exercises than to perform only one of the strength or balance exercise¹⁰. To increase the sense of ankle balance, exercise was performed on unstable supporting surfaces such as a disk, a ball, and a foam roller^{11–13}. A study also used virtual reality programs to enhance the immersion of ankle training with functional ankle instability¹⁴.

There are a variety of ankle interventions, and although authors discussed about their effectiveness. They still did not find the appropriated treatment for ankle sprains. Therefore, this study attempted the complex exercises applying balance exercise through changing of unstable supporting surface with a medicine ball, and muscle strength exercise. Thus, we would like to provide you with information on how to find optimal treatment for an ankle sprain.

METHODS

Subjects

This study was conducted with twenties university students who have living in Daejeon city. A total of 22 subjects (male: 14, female: 8) were selected for functional ankle instability. Functional ankle instability was selected to be less than 24 points using the Cumberland ankle instability tool (CAIT) with people who had severe ankle sprain. They have been experienced ankle giving way, and this study chose subjects after acute symptoms. All subjects explained the purpose of the study, and gave them voluntary informed consent. The general characteristics of the subjects are as follows (Table 1).

Exercises

A total of 20 minutes were performed three times a week for four weeks with muscle strength (10 minutes) and balance (10 minutes) exercises in W university training center. Muscle strength exercise performed four directions such as dorsiflexion, plantar flexion, inversion and eversion to ankle joint using Therabands¹⁰. The intensity of strength exercise was performed by physical therapists who have qualified to teach this program for considering individual differences. Balance exercise was applied using a trampoline, a sliding board, a Bosu Ball, a basic balance board, a rocker & wobble board, and an Airex Balance Pad. The balance exercise consisted of six steps according to the degree of difficulty, and medicine ball was also used to control the difficulty^{15, 16}. The Theraband exercise was performed in three sets of 15 times, and the balance exercise was performed in three sets of 15 seconds each. It steps 1–3 exercises are eyes opened, and steps 4–6 are eyes closed (Table 2).

Table 1. General characteristics of subjects

Subjects (n=22)	
Sex(male/female)	14/8
Age(years)	20.3±0.7
Height(cm)	167.9±8.2
Weight(kg)	67.2±10.7
CAIT	14.5±5.5

Table 2. Stages of balance exercises

Stages	Contents
1	Standing with two feet
2	Standing with one foot
3	Receive a medicine ball in the standing position
4	with one foot or move up and down
5	Close your eyes and stand with your feet
6	Standing one foot with eyes closed

Measurements

In this study, Biodex balance system[®] (Biodex Medical System Inc, USA) was used as a tool to measure static and dynamic balance. The subject was standing on a platform with a pair of eyes open and another knee joint was bending 90°¹⁷. The platform is 55 cm in diameter, and the shape is circle and can be moved up to 20° in all directions. Grades can be selected up to 1–12, and the lower the grades, the higher the difficulty to balance. The static and the dynamic balance were measured, and the dynamic balance selected in grade 2, 4, and 8. Measurements were taken in overall, anterior–posterior and medial–lateral directions, and the lower the degree indicates a better sense of balance. The mean value was calculated by measuring the value three times in 30 seconds; a 10-second break time between measurements was given.

Statistics

IBM SPSS 21.0 was used for calculated the mean and standard deviation of all data measured in this study. To compare before and after exercises, a paired-samples t-test was conducted. The significance level of all statistical analyzes was set to $p = 0.05$.

RESULTS

The results of before and after applying the complex exercises to the functional ankle instability were as follows. There was a significant decrease in overall, anterior-posterior, and medial-lateral directions in the degree of static balance ($p < .05$) (Table 3). There was a significant decrease in the degree of dynamic balance of grade 2, grade 4, and grade 8 with overall, anterior-posterior and medial-lateral directions ($p < .05$) (Table 3). The degree of instability was significantly increased from 14.5 ± 5.5 to 20.7 ± 5.1 ($p < .05$) (Fig. 1).

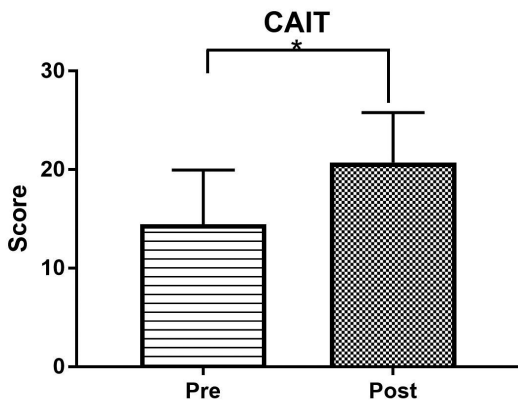


Fig. 1. Comparison in degree of instability of subjects who have functional ankle instability between pre and post exercises

DISCUSSION

The purpose of this study was to investigate the effect of complex ankle exercises on functional ankle instability by changing the unstable support surface. All participants were in twenties. The intervention was conducted for a total of four weeks. Measurements were made on the degree of balance and degree of instability of the ankle.

According to the results of this study, authors found a significant increase in static and dynamic balance sense. Because the decline in proprioceptive sensation has been worse with an ankle sprain, the improvement in balance in the ankle sprain is essential the recovery of ankle instability¹⁸. Balance exercise is a traditionally well-known method to improve ankle function, and is effective in rehabilitation, and prevention of ankle sprain and chronic ankle instability¹⁹. Unstable support surface was used in the previous study to enhance the proprioceptive sense of the ankle joint^{12, 20}. If the support surface is unstable, the subject is required to move quickly when exercise. Therefore, the results are clear evidence for ankle rehabilitation²¹. Considering this point, it can be said that the result from this study is meaningful. People must adapt quickly to various types of surfaces to protect our ankle joints in our daily life. In twenties, they participate in a lot of forms of sports and activities, often experienced hypermobility to ankles in different directions. Therefore,

Table 3. Comparison of balance of subjects who have functional ankle instability between pre and post exercise (n=22).

		Directions	Grades	Pre	Post	t	p
Static	Overall			1.39±0.70	0.86±0.27	3.067	0.006*
	AP			0.94±0.45	0.58±0.18	3.233	0.004*
	ML			0.85±0.47	0.49±0.20	3.096	0.005*
Dynamic	Overall			2.81±0.90	2.24±0.75	2.659	0.015*
	AP	2		1.27±0.47	0.91±0.20	4.068	0.001*
	ML			2.22±0.80	1.71±0.48	4.001	0.001*
	Overall			2.70±1.30	1.77±0.43	3.261	0.004*
	AP	4		1.11±0.46	0.72±0.22	3.993	0.001*
	ML			2.22±1.23	1.45±0.40	2.878	0.009*
	Overall			2.16±1.04	1.48±0.53	2.861	0.009*
	AP	8		0.83±0.32	0.61±0.19	2.970	0.007*
	ML			1.80±1.00	1.21±0.52	2.578	0.018*

Mean±SD, *: $p < .05$.

Overall: All directions including AP and ML, AP: Anterior-posterior, ML: Medial-lateral

it can be explained that the significant effects in overall directions, anterior–posterior direction, and medial–lateral direction from this study prove the effect of exercises. Furthermore, authors designed the complex exercises because it was important to design the exercise intensity based on the individual. In the previous study, the soft unstable supporting surfaces made it more difficult during training to adjust posture^{22, 23}. These results also support this study. Cumberland ankle instability tool (CAIT) has commonly used as an evaluation tool which has high reliability and validity for functional ankle instability²⁴. In this study, the CAIT scores were increased from 14.5 to 20.7; an improvement was 42.8%. The use of the medicine ball which improves the exercise effect may have contributed greatly despite the short intervention period of this study²⁵. It has also been proven through many studies that vision was an important function in maintaining a sense of balance^{26–28}. Therefore, authors think that all the exercises were taken good results by muscle strength, unstable support surface, and visual sense.

As limitations of this study, we did not apply the analysis through the control group because it proceeded as a single group with a short intervention period. In addition, this study provided strength and balance training, but authors clearly not know that which is more effect to this research. In future studies, it will provide a better insight into the visual effects of ankle intervention when set a control group for the application of a medicine ball.

CONCLUSIONS

This study recommends performing complex exercises to reduce frequent ankle sprains. The reason for this is that muscular strength, unstable support surface, and visual effects from medicine balls are beneficial to overcome various environments that can be caused ankle sprain in daily life. Therefore, physical therapists should prescribe the complex exercises for the individual who has functional ankle instability.

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