Original Article

J Babol Univ Med Sci
22; 2020. P: 298-303

Comparison of the Effect of External Focus on Postural Control in Athletes with or without Chronic Ankle Instability while Standing on an Unstable Surface

Gh. Abolghasemi (MSc)[1], S.M. Sohani (PhD)*[2], E. Ebrahimi-Takamjani (PhD)[2], R. Salehi (PhD)[3], Sh. Asgari (MSc)[1]

1.Rehabilitation Research Center, Iran University of Medical Sciences, Tehran, I.R.Iran

2.Department of Physiotherapy, Faculty of Rehabilitation Sciences, Iran University of Medical Sciences, Tehran, I.R.Iran

3.Department of Rehabilitation Management, Faculty of Rehabilitation Sciences, Iran University of Medical Sciences, Tehran, I.R.Iran

J Babol Univ Med Sci; 22; 2020; PP: 298-303

Received: Nov 30th 2019, Revised: Mar 2nd 2020, Accepted: Apr 5th 2020.

ABSTRACT

BACKGROUND AND OBJECTIVE: Chronic ankle instability is a common injury in athletes that leads to postural control disorders. The aim of this study was to compare the effect of external focus of attention and postural task alone on center of pressure sway in athletes with chronic ankle instability and healthy athletes during dual task training.

METHODS: This cross-sectional study was performed on 29 male volleyball athletes with a referral from a specialist and 29 healthy athletes matched with the affected group in terms of age, height and weight. Subjects in the two groups were on the balance board with single-leg and double-leg stance, standing in the center of the force plate for 60 seconds and performing postural tasks alone and with external focus. The degree of displacement of the pressure center was measured to investigate the variables of standard deviation of amplitude and mean velocity.

FINDINGS: In double-leg stance, standard deviation of amplitude in medio-lateral (14.2±2.1) and anterior-posterior (16.7±3.3), mean velocity in medio-lateral (39.2±9.8) and anterior-posterior (40.7±6.1) directions in patients during external focus were significantly less than the standard deviation of amplitude in medio-lateral (12.2±1.5) and anterior-posterior (13.9±2.4), mean velocity in medio-lateral (46.2±13.1) and anterior-posterior (48.4±9.6) directions during the single task. In single-leg stance, standard deviation of amplitude in medio-lateral (16.1±2.1) and anterior-posterior (13.1±1.7), mean velocity in medio-lateral (42.2±13.3) and anterior-posterior (40.7±8.6) directions in patients during external focus were significantly less than the standard deviation of amplitude in medio-lateral (11.1±2.1) and anterior-posterior (17.4±3.3), mean velocity in medio-lateral (47.8±16.6) and anterior-posterior (55.2±17.4) directions during the single task.

CONCLUSION: The results of the study showed that external focus task leads to distraction from postural control and reduces postural sway in athletes with chronic ankle instability.

KEY WORDS: *Chronic Ankle Instability, Postural Control, External Focus, Athlete*.

Please cite this article as follows:

Abolghasemi Gh, Sohani SM, Ebrahimi-Takamjani E, Salehi R, Asgari Sh. Comparison of the Effect of External Focus on Postural Control in Athletes with or without Chronic Ankle Instability while Standing on an Unstable Surface. J Babol Univ Med Sci. 2020; 22: 298-303.

***Corresponding Author: S.M. Sohani (PhD)**
Address: Department of Physiotherapy, Faculty of Rehabilitation Sciences, Iran University of Medical Sciences, Tehran, I.R.Iran
Tel: +98 21 22228051
E-mail: : sohani.soheil@gmail.com

[DOR: 20.1001.1.15614107.1399.22.1.41.3]

[DOI: 10.22088/jbums.22.1.298]

Introduction

External ankle sprain is one of the most common musculoskeletal injuries that can lead to long-term problems in people. Recurrent external instability due to excessive ankle ligament strain is called chronic instability. About 73% of people experience chronic ankle instability after ankle ligament strain (1). In athletes, this injury causes sustained changes in muscle activity, lower ankle range of motion, and balance disorders, as well as loss of training sessions and impaired professional performance (2, 3). In the past, balance control was assumed to be an automated task that required less attention (4, 5). According to recent studies, postural control requires attention and these needs depend on postural tasks, age of people and their balance abilities (6-8).

Dual tasks are used to assess the role of attention needed on postural control (7). In this model, the person is asked to simultaneously perform the posture control task along with another secondary task (motor or cognitive). The choice of the secondary task is such that it requires attention (9). In recent years, research has been done on the effect of the focus of attention, which has shown the advantage of the external focus of attention on motor skills (10). In the internal focus of attention, the person pays attention to the movements of his/her body and in the external type, the person pays attention to the effect that movement leaves in the environment. Based on the constrained action hypothesis, movements are done consciously in the internal focus of attention but in the external focus, automated processes control the movements, which leads to more effective execution. Thus, the benefits of using the external focus instructions have been reported to be beneficial not only for healthy adults, but also for patients with motor injuries and disorders, stroke, Parkinson's disease, and children with mental disabilities (11).

There is insufficient evidence to support research regarding the effect of external focus on postural control in people with chronic ankle instability. Due to the high prevalence of this issue and the possibility of orthopedic lesions being followed due to imbalance and simultaneous performance of many activities along with postural control, different training instructions are used to improve balance, and one of the important functions of training instructions is to direct a person’s focus; thus, external focus instructions can be used to improve balance in people with chronic ankle instability. Therefore, considering the important role of exercise interventions to improve balance and activities of daily living during dual task, the aim of this study was to compare the effect of external focus and postural task alone on indices of center of pressure sway in athletes with chronic ankle instability and healthy athletes during dual task trainings.

Methods

This cross-sectional study was registered in the ethics committee with the ethics code IR.IUMS.REC.1397.627 and were performed in the movement sciences laboratory of the School of Rehabilitation Sciences of Iran University of Medical Sciences. The non-probability sampling method was used and the sample size was calculated according to the previous similar study based on the comparison of two means formula (12).

29 male volleyball players with chronic ankle instability referred by a specialist and 29 healthy individuals between the ages of 18 and 36 years were included in the study voluntarily. Athletes who perform at least twenty minutes of exercise three times a week were used to assess balance indicators (13). The two groups were matched with each other in terms of height, weight and age and the level of physical activity. Inclusion criteria for people with chronic ankle instability were based on the International Ankle Consortium, which includes a history of at least one obvious ankle sprain with inflammatory symptoms at least one year prior to study, a history of recurrent sprain, or the feeling of instability in the injured wrist joint (at least two cases in the last six months) according to the CAIT questionnaire, and the presence of disability in the person according to the FAAM questionnaire (14).

Healthy subjects were included in the study if there was no history of ankle sprains. People with a history of surgery, dizziness and fainting, forgetfulness, eye problems that upset balance, head trauma in the last 3 months, a history of balance disorders of neuropathic origin, diabetes and neurological disorders such as multiple sclerosis, Parkinson's disease and Guillain-Barre syndrome, the presence of cognitive disorders with a score of less than 24 based on the MMSE questionnaire, the presence of anxiety with a score of more than 12 in the Beck Depression Inventory were excluded. Written consent was obtained from the candidates and they were able to leave the project at any stage of the test in order to comply with ethical considerations. Choosing the dominant foot was done based on at least 2 of the performance tests including kicking the ball with medium intensity and maximum accuracy towards the cones with a distance of 10 meters from the person and one meter from each other, standing on stool with a height of 20 cm, the stepping was performed by the examiner from behind after upsetting the balance (15).

To assess the postural control in dynamic mode, a balance board with a diameter of 41 cm in the center of the force plate was used. To perform the test, the two groups stood in double-leg stance without shoes in the most comfortable and best position whereas in the single-leg stance, healthy people stood on the balance board with their dominant foot and patients with their dominant and injured foot. In order to perform the external focus task, the Android version of alignment software was used. This software, which was installed on the mobile phone was placed on the balance board and was shown on the TV by a wireless interface at a distance of 3 meters in front of the person. The subject had to minimize alignment movements by focusing on the television. To complete the task, the mobile phone was placed in the middle of the balance board, and the person was asked to place their feet on either side of the balance board. To perform the task of single-leg stance, the mobile phone was glued to the balance board on one side, and on the opposite side, a mobile phone of equal weight was placed to create balance, and the person stood with one foot in the middle of the balance board (Figure 1).

In this study, a power plate machine (model AA69260, Kistler Company, Switzerland), with a sampling frequency of 100 Hz was used. In each test for 60 seconds, the sway velocity and standard deviation of the amplitude were examined in two directions: anterior-posterior and internal-external. The data was passed through a 10 Hz filter to eliminate noise. Each test was repeated 3 times and the mean of the 3 tests was used for statistical calculations. Data were analyzed by SPSS software version 21 and independent t-test and p<0.05 was considered significant.

Figure 1. The way of positioning the balance board relative to the screen

Results

Both groups were similar in terms of age, height and weight (Table 1). In single-leg stance and double-leg stance in the two groups, all indices of center of pressure sway when performing the external focus task were significantly lower than postural control (p<0.01) (Table 2). In double-leg stance, all indices of center of pressure sway in the healthy group were significantly lower than the case group (p<0.01) (Table 3). Moreover, in single-leg stance, all indices of center of pressure sway in the healthy group were lower than the patient group (Table 4).

Table 1. Anthropometric characteristics of the subjects

Variable	Healthy group Mean±SD	Patients group Mean±SD	P-value
Age (years)	24.76±3.12	24.41±3.07	0.67
Height (cm)	179.64±5.98	179.50±8.16	0.55
Weight (kg)	76.36±5.77	75.24±5.86	0.96

Table 2. Assessing the significance level of indices of center of pressure sway during external focus task compared to single task

Variable	Double-leg stance			Single-leg stance		
	Mean difference	Confidence limits	P-value	Mean difference	Confidence limits	P-value
standard deviation (AP) of amplitude	-2.65	-3.24 - -2.05	<0.001	-4.12	-4.89 - -3.36	<0.001
standard deviation (ML) of amplitude	-1.75	-2.24 - -1.26	<0.001	-1.40	-1.95 - -0.86	<0.001
(AP) mean velocity	-9.29	-11.28 - -7.30	<0.001	-6.71	-8.89 - -4.55	<0.001
(ML) mean velocity	-7.53	-9.39 - -5.68	<0.001	-14.07	-17.24 - -10.89	<0.001

[DOR: 20.1001.1.15614107.1399.22.1.41.3]
[DOI: 10.22088/jbums.22.1.298]

Table 3. Comparison of indices of center of pressure sway in the two groups in double-leg stance

Variable	External focus			Single task		
	Healthy	Patient	P-value	Healthy	Patient	P-value
	Mean±SD			Mean±SD		
standard deviation (ML) of amplitude	10.50±1.99	12.48±2.25	<0.001	12.22±1.54	14.28±2.10	<0.001
standard deviation (AP) of amplitude	11.36±2.44	14.07±3.51	<0.001	13.96±2.49	16.78±3.30	<0.001
(ML) mean velocity	32.30±9.58	38.13±9.31	<0.001	39.26±9.81	46.25±13.07	<0.001
(AP) mean velocity	31.98±6.13	38.54±5.71	<0.001	40.71±6.17	48.40±9.66	<0.001

Table 4. Comparison of indices of center of pressure sway in the two groups in single-leg stance

Variable	External focus			Single task		
	Healthy	Patient	P-value	Healthy	Patient	P-value
	Mean±SD			Mean±SD		
standard deviation (ML) of amplitude	8.72±2.30	16.10±2.03	0.01	64.10±2.86	11.06±2.11	0.52
standard deviation (AP) of amplitude	10.66±2.86	13.06±1.76	<0.001	14.49±3.78	17.49±3.36	<0.001
(ML) mean velocity	31.26±11.50	42.24±13.38	<0.001	39.06±13.06	47.87±16.60	0.002
(AP) mean velocity	30.79±8.41	40.71±8.69	<0.001	44.34±10.47	55.29±17.49	<0.001

Discussion

Comparison of indices of center of pressure sway in dynamic conditions while standing on the balance board in both healthy and case groups showed that the amount of center of pressure sway during the secondary task of external focus decreases compared to the postural task alone. Studies in healthy individuals have shown that performing external focus tasks leads to greater postural stability in healthy young people and the elderly on the force plate compared to preforming tasks without external focus (16). In a study by Wulf et al., it was shown that focusing attention in patients with Parkinson's disease reduced body sways (17). Diekfuss et al. showed that the effects of exercise on controlling the balance of healthy individuals are greater with external focus compared to internal focus or no focus training (18). In this study, markers were placed on the ground for external focus. Balance exercises were also performed on the ground. In a study on healthy individuals by Fortier et al., it was found that external focus leads to greater stability than postural task alone. They observed that the muscle activity of the tibialis anterior and gastrocnemius muscle did not change in this study, so this improvement in postural stability was due to a more automated postural control process and not to the phenomenon of stiffing (19). In the study conducted by Polskaia et al., there was no difference between external focus task and internal focus task. In this study, markers placed on the hip joints were used for external focus. The lack of difference observed in this study was due to the proximity of the markers to the body, which made it difficult to distinguish between hip movements and marker movements (12). In a study about the distance of markers from the body to perform external focus tasks, McNevin et al. suggested that to perform external focus tasks when using a task that is close to the body compared to when the external focus task is away from the body, it is more difficult to distinguish between the effects of movement of the external focus task and the effects of the movement of internal focus, and the postural sway is greater (20). Therefore, it seems that according to Wulf's constrained action hypothesis, people try to control their movements automatically by performing external focus, which as a result, leads to more effective execution. Therefore, it can be concluded that performing external focus task in people with chronic ankle instability leads to distraction from postural control and thus reduces postural sway. Therefore, imposing the external focus task along with balance exercises with balance board may be considered as an effective solution in the exercise program for patients with chronic ankle instability. One of the limitations of this study was the lack of providing

[DOR: 20.1001.1.15614107.1399.22.1.41.3]
[DOI: 10.22088/jbums.22.1.298]

guidelines for individuals to allocate attentional resources, and they were free to choose to pay attention to the posture control task or external focus task, so the ability to shift attention and the function of active memory inhibition were not directly assessed. It is suggested that future studies examine the effect of movement learning. Future studies are also recommended to investigate the effect of external focus based on dual tasks in individuals with different degrees of injury to chronic ankle instability.

Acknowledgment

We would like to thank the Physiotherapy Department of Iran University of Medical Sciences and all the people who helped us in this research.

[DOI: 10.22088/jbums.22.1.298]
[DOR: 20.1001.1.15614107.1399.22.1.41.3]

References

1.Terada M, Pietrosimone B, Gribble PA. Individuals with chronic ankle instability exhibit altered landing knee kinematics: potential link with the mechanism of loading for the anterior cruciate ligament. Clin Biomech (Bristol, Avon). 2014;29(10):1125-30.

2.Lin C-Y, Kang J-H, Wang C-L, Shau Y-W. Relationship between viscosity of the ankle joint complex and functional ankle instability for inversion ankle sprain patients. J Sci Med Sport. 2015;18(2):128-32.

3.Beazell JR, Grindstaff TL, Sauer LD, Magrum EM, Ingersoll CD, Hertel J. Effects of a proximal or distal tibiofibular joint manipulation on ankle range of motion and functional outcomes in individuals with chronic ankle instability. J Orthop Sports Phys Ther. 2012;42(2):125-34.

4.Shumway-Cook A, Woollacott M. Attentional demands and postural control: the effect of sensory context. J Gerontol A Biol Sci Med Sci. 2000;55(1):M10-6.

5.Yardley L, Gardner M, Leadbetter A, Lavie N. Effect of articulatory and mental tasks on postural control. Neuroreport. 1999;10(2):215-9.

6.Huang HJ, Mercer VS. Dual-task methodology: applications in studies of cognitive and motor performance in adults and children. Pediatr Phys Ther. 2001;13(3):133-40.

7.Woollacott M, Shumway-Cook A. Attention and the control of posture and gait: a review of an emerging area of research. Gait Posture. 2002;16(1):1-14.

8.Hedayati R, Fatemi E, Hajihasani A, Ehsani F, Ramezanpour S. The attention needed for balance controlling in young patients with flatfoot. Koomesh. 2016;18(1):25-34. [In Persian]

9.Lajoie Y, Teasdale N, Bard C, Fleury M. Upright standing and gait: are there changes in attentional requirements related to normal aging?. Exp Aging Res. 1996;22(2):185-98.

10.Fasoli SE, Trombly CA, Tickle-Degnen L, Verfaellie MH. Effect of instructions on functional reach in persons with and without cerebrovascular accident. Am J Occup Ther. 2002;56(4):380-90.

11.Wulf, G. Attentional focus and motor learning: a review of 15 years. Int Rev Sport Exer P. 2013;6(1):77-104.

12.Polskaia N, Richer N, Dionne E, Lajoie Y. Continuous cognitive task promotes greater postural stability than an internal or external focus of attention. Gait Posture. 2015;41(2):454-8.

13.Brown CN, Mynark R. Balance deficits in recreational athletes with chronic ankle instability. J Athl Train. 2007;42(3):367-73.

14.Gribble PA, Delahunt E, Bleakley C, Caulfield B, Docherty C, Fourchet F, et al. Selection criteria for patients with chronic ankle instability in controlled research: a position statement of the International Ankle Consortium. Br J Sports Med. 2014;48(13):1014-8. Available from: https://bjsm.bmj.com/content/bjsports/48/13/1014.full.pdf

15.Cruz-Diaz D, Lomas-Vega R, Osuna-Pérez MC, Contreras FH, Martínez-Amat A. Effects of 6 weeks of balance training on chronic ankle instability in athletes: a randomized controlled trial. Int J Sports Med. 2015;36(9):754-60.

16.Richer N, Polskaia N, Lajoie Y. Continuous cognitive task promotes greater postural stability than an internal or external focus of attention in older adults. Exp Aging Res. 2017;43(1):21-33.

17.Wulf G, Landers M, Lewthwaite R, Töllner T. External focus instructions reduce postural instability in individuals with Parkinson disease. Phys Ther. 2009;89(2):162-8.

18.Diekfuss JA, Rhea CK, Schmitz RJ, Grooms DR, Wilkins RW, Slutsky AB, et al. The Influence of Attentional Focus on Balance Control over Seven Days of Training. J Mot Behav. 2019;51(3):281-92.

19.Fortier N, Richer N, Ly K, Lajoie Y. The effects of attentional focus and cognitive tasks on postural control in healthy older adults [PhD Thesis]. Canada: School of Human Kinetics, University of Ottawa; 2018. Available from: https://ruor.uottawa.ca/bitstream/10393/37486/1/No%c3%a9my%20Chanelle%20Fortier.pdf

20.McNevin NH, Shea CH, Wulf G. Increasing the distance of an external focus of attention enhances learning. Psychol Res. 2003;67(1):22-9.

[DOR: 20.1001.1.15614107.1399.22.1.41.3]

[DOI: 10.22088/jbums.22.1.298]