Research Paper

The Effectiveness of Focus of Attention in Static Balance and Functional Ability of Chronic Ankle Instability: A Pilot Study

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ABSTRACT

Objectives: The focus of patients' attention during the physiotherapy program has been reported to affect the rehabilitation goals. The study aimed to investigate the effectiveness of an external focus of attention (EFA) on static balance and functional ability in individuals with chronic ankle instability (CAI).

Methods: Fourteen subjects with CAI, aged from 19 to 25 years, were randomly assigned to two groups: external and internal focus of attention (IFA) group. The outcome measures of the study were static balance and functional ability. A pre-intervention evaluation was performed. Following instructions to an external or an IFA, subjects practiced on a balance board 3 times per week for 4 weeks. At the end of each week, they performed evaluation tests, including a time balance test, foot lift test, side hop test, figure-8 test, and star excursion balance test (SEBT). Parametric (mixed analysis of variance) and non-parametric analysis (the Mann–Whitney and Friedman tests) were performed between measurements and groups.

Results: The intervention program showed a statistically significant improvement in static balance and functional ability in both groups. The results indicated the main effect of time ($F_{(2.488, 29.855)}$=43.880, P<0.001). For the time in balance test, analysis of variance revealed a main effect of time ($F_{(2.571, 30.855)}$=11.188, P<0.001). Regarding the SEBT, every direction indicated a main effect of time for both groups. No significant differences between the two groups were found in static balance and functional ability.

Discussion: Even though there were no statistically significant differences between the two groups, both types of focus of attention contributed to the improvement of static balance and functional ability, which may reveal an increase in motor control and neuromuscular ability of the subjects with CAI.

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Highlights

An attention intervention physiotherapy program improves static balance.

External focus of attention (EFA) lacks a more positive effect on balance and functional ability than an internal focus.

Motor control techniques may increase the rehabilitation process.

Plain Language Summary

Balance and functional ability may be decreased in chronic ankle instability (CAI). The focus of patients' attention affects the rehabilitation program. We aimed to investigate the effectiveness of an EFA on static balance and functional ability. Fourteen subjects were assigned to the external and internal focus of attention (IFA) groups. A pre-intervention evaluation of all tests was performed. They practiced on a balance board 3 times per week for 4 weeks, following instructions either to an external or an IFA. At the end of each week, they performed evaluation tests of static balance and functional ability. There was an improvement in static balance and functional ability during the intervention program in both groups. No significant differences between the two groups were found in static balance and functional ability. Both types of focus of attention contributed to improving static balance and functional ability.

Introduction

Chronic ankle instability (CAI) is a pathological condition usually occurring when a person has sustained one or more ankle sprains. Regardless of degree, every ankle sprain has a 40% chance of having a CAI [1]. Some of the symptoms of CAI are pain, a feeling of "giving away," limited motion, and swelling, which result in reduced static balance and functional ability [2]. Most people do not seek treatment; therefore, these symptoms may remain in the ankle for years. Patients suffering from CAI exhibit altered joint kinematics and neuromuscular control, kinesiophobia, and sensorimotor deficits resulting in reduced motor control [2, 3].

Health professionals examine the effectiveness of focus of attention in healthy populations, sports injury, and other clinical populations [4-7]. They provide instructions that guide the patients' attention to achieve goals in their rehabilitation process. The attention can be directed to focus either internally or externally. An internal focus of attention (IFA) is used when the person focuses on their body, its movements, and sensations, and an external focus of attention (EFA) when they focus on the environment and the effect their movements cause on it [8].

An EFA enhances motor learning compared to an IFA in various physical characteristics or motor skills, one of which is balance [8]. An EFA contributes to increased static and dynamic balance, an increased maximum force production, and a more economical and sufficient movement [8, 9]. Piccoli et al. [10] reported limited research examining the effect of attentional focus on people with musculoskeletal disorders. Laufer et al. [11] and Rotem-Lehrer and Laufer [12] examined the effect of attentional focus during dynamic balance short-term training following an acute ankle sprain. They concluded that, in the EFA group, the increase in stability was greater than in the IFA group during training and in the retention test. Gokeler et al. [13] investigated the effectiveness of attentional focus in patients after anterior cruciate ligament reconstruction during the single-leg jump test. They reported that using an EFA enhances a safer movement pattern during rehabilitation and reduces re-injury risk.

Therefore, very few studies have examined the efficacy of attentional focus on musculoskeletal injury. Also, the effect of attentional focus on the rehabilitation process of CAI has not been assessed, which is caused mainly by ankle sprains, one of the most frequent musculoskeletal pathologies [14]. Also, no experimental studies have confirmed the psychophysiological processes of attentional focus on musculoskeletal injury rehabilitation. These psychophysiological processes should be investigated not only due to their theoretical importance but also have clinical relevance. Indeed, this knowledge might enhance the evaluation and rehabilitation techniques of musculoskeletal clinical populations by physiotherapists.

As a result, we investigated the effectiveness of attentional focus on static balance and functional ability in participants with CAI. It was hypothesized that the EFA

group would improve static balance and functional ability more than the IFA group.

Materials and Methods

This randomized, single-blind, controlled study employs an experimental design.

Study participants

Fourteen volunteer university students (6 males and 8 females) (19-25 years old, Mean±SD 21.43±1.60 years) participated in this study. All participants had unilateral CAI. They were randomly divided into two groups using the block randomization method. Each group consisted of 7 participants: the EFA group of 2 men and 5 women and the IFA group of 4 men and 3 women (Table 1).

The sample was informed about the study's procedure and signed a written informed consent form proposed by the researchers. Notably, the sample had the right to stop their participation at any time, and the publication of the results must have been anonymous. The inclusion criteria for the samples were as follows: (i) have CAI, identified using the Cumberland ankle instability test (CAIT) [15, 16], (ii) have no history of other injuries to the ankle and no surgeries performed in the area, and (iii) lack any other cognitive, neurological or psychological issues that would not allow them to follow instructions.

Study measures

Cumberland ankle instability test (CAIT)

The Cumberland ankle instability test is a reliable self-administered questionnaire that uses questions about everyday life activities and occurrences to diagnose CAI (the Cronbach α=0.83). The Greek cross-cultural validation of CAIT consists of 9 questions with a maximum score of 30, where a score of ≤24 shows the existence of CAI [16].

Static balance tests

Time in balance test: The time in balance test uses a single-bare-legged stance on a firm surface with the participant's eyes closed. The examiner measures the time the participant can remain in balance before moving the foot that is tested or the contralateral foot touches the ground. Three trials are performed, and the best is used. The maximum time of each trial is set at 60 seconds. The test is reliable (Fisher P=0.006; 95% CI, 1.74%, 42.17%) [17, 18].

Foot lift test: The foot lift test is valid and uses the same stance as the time in balance test. The participants' eyes are closed. The examiner counts every time a part of the foot is lifted, and each lift counts as a point. A point is also given every time the contralateral foot touches the ground, and a point is added for every second it stays on the ground. Three trials are performed, and the best is used. Each trial lasts 30 seconds [18, 19].

Functional ability tests

Side-hop test: The sample hops single-legged, laterally 30 cm, and back for 10 repetitions as quickly as possible. It is correlated with CAI (Pearson r=0.35) [20].

8-figure-Hop test: The sample hops single-legged in an 8-figure course twice, outlined by two cones with a 5-m distance between them, as fast as possible. It is correlated with CAI (Pearson r=0.31) [20].

Star excursion balance test (SEBT): The SEBT is a valid and reliable functional test commonly used worldwide. The participant is standing single-legged in the middle of 4 tape lines put on the floor at a 45-degree angle with each other to create a "star," and the participant tries to touch the other foot along these lines as far as possible. The anteromedial, medial, and posteromedial lines were used [21].

Study procedure

Thirty participants volunteered to take part that had symptoms in their ankles. Only 23 were found to have CAI and meet all the other inclusion criteria. Of the 23 participants, 2 participated in the pilot research, 3 could not complete the tests due to severe CAI with acute pain, 2 dropped out due to personal reasons, and 2 dropped out due to an injury to the hand. In the end, 14 participants took part and completed the present study.

A 4-week pilot experiment was performed where the 2 participants had to attend training sessions 3 times per week. They performed a pre-intervention evaluation of the tests mentioned above. We changed the Romberg test with the foot lift test and the time in balance test [22]. Also, we followed the Hertel et al. [21] report to perform only 3 directions from the SEBT instead of the original 8 directions due to participants' tiresome.

All participants were required to attend 3 training sessions per week for 4 consecutive weeks and have a re-evaluation of static balance and functional ability every week after the last training session. Static stability was assessed

during the foot lift test and the time in balance test, and the functional ability was assessed using the side hop test, the 8-figure test, and the SEBT. All participants wore their preferred training shoes during training and evaluation. The first author performed a pre-intervention evaluation of all the tests. A wooden balance board (50×50 cm) was used for the training period. One training session consisted of 7 trials, each lasting 90 seconds, with a break between each trial. Before the training sessions, the participants were given 2 sets of verbal instructions depending on the group of focus of attention they were randomly assigned. The IFA and the EFA groups received instructions from two different examiners, respectively, such as "try to keep your feet as stable as possible," "focus on your feet and their movement," and "try to keep the board as stable as possible" and "focus on the movement of the board" instructions, respectively. All participants were instructed to step on the balance board using their left foot first and then put their right one on but still keep their weight on the left so that the platform was touching the ground on the left. Then, the participants waited for the examiner to give them the signal to start balancing by splitting the weight on both legs. Once each trial ended, they were instructed to stop balancing on the board by putting all their weight on the left side and stepping off the board using their right foot first.

Statistical analysis

The t-test was conducted firstly to compare the demographical characteristics and the pre-intervention evaluation of all tests. The Kolmogorov–Smirnov normality tests were done to assess the normal distribution of the measurable variables. Repeated measures ANOVA (mixed ANOVA) examined the differences between the two groups of the study and the changes due to time for the parametric measures. The Mann–Whitney test assessed the differences between the two study groups for every week separately. A Friedman test investigated the difference between measurements in each group separately for the non-parametric variables. The IBM SPSS statistics software, version 25 was used with a $P<0.05$ level of statistical significance.

Results

No significant differences were observed between the two groups before the training session in the demographic characteristics of age, weight, height, history of sprains, and time since the last sprain. Also, no statistical differences were found between the two groups for all the pre-evaluation test measures of the foot lift test, time in balance test, 8-figure test, side hop test, and SEBT.

Static balance

Repeated measures ANOVA was used for the foot lift test and the time in balance test. The results indicated a main effect of time ($F_{(2.488,\ 29.855)}=43.880$, $P<0.001$) (with Greenhouse-Geisser corrections) but no statistical group effect ($F_{(1,\ 12)}=0.025$, $P>0.05$) for the foot lift test. No significant interaction was found between group and time ($F_{(2.488,\ 29.855)}=1.876$, $P>0.05$) (with Greenhouse-Geisser corrections). For the time in balance test, ANO-

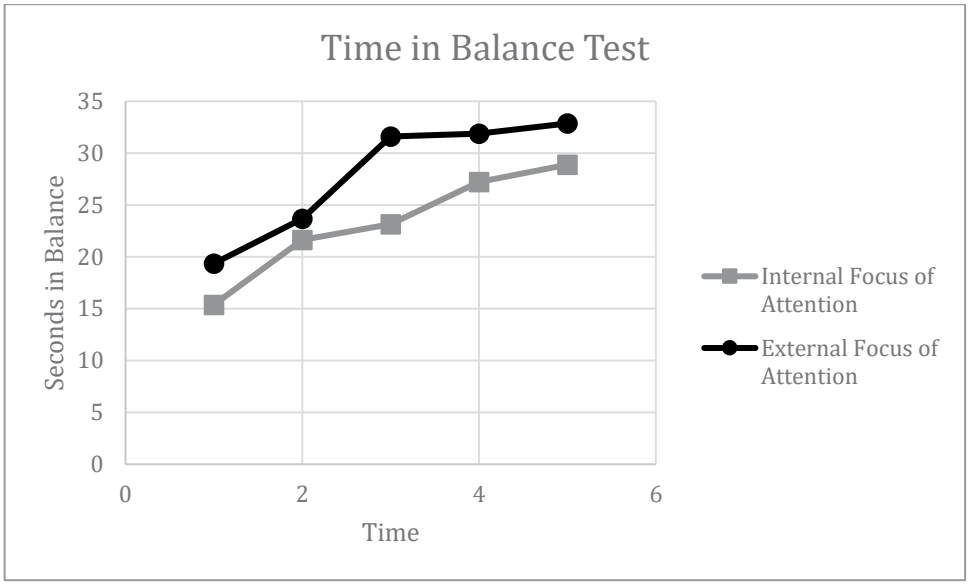

Figure 1. ANOVA for the time in balance test between the two groups

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Notes: No significant interaction was found between groups, but there was an improvement over time for both groups.

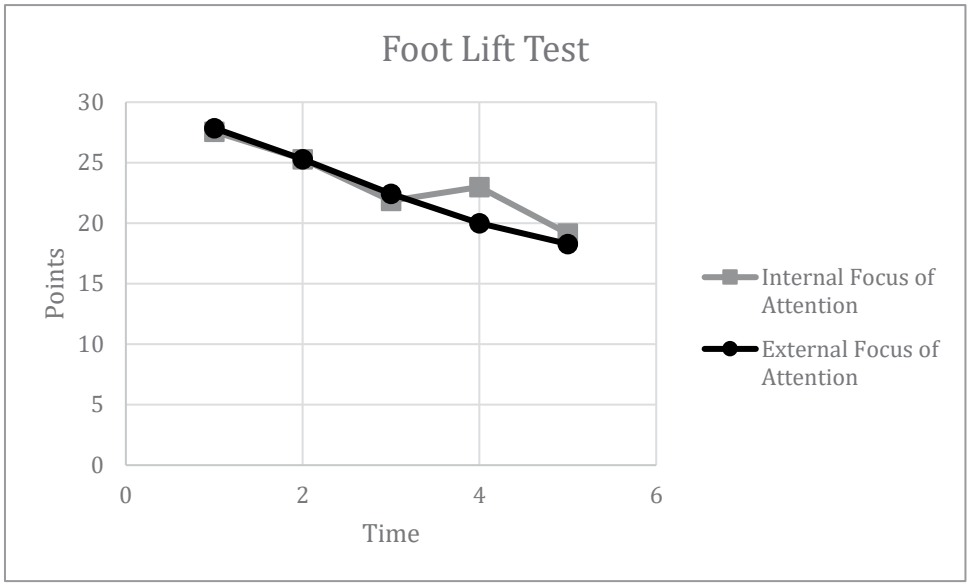

Figure 2. ANOVA for the foot lift test between the two groups

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Notes: No significant interaction was found between groups, but there was an improvement over time for both groups.

VA indicated a main effect of time ($F_{(2.571, 30.855)}$=11.188, P<0.001) (with Greenhouse-Geisser corrections), but no statistical group effect ($F_{(1, 12)}$=0.041, P>0.05). No significant interaction was found between group and time ($F_{(2.571, 30.855)}$=0.510, P>0.05) (with Greenhouse-Geisser corrections). Therefore, there was an improvement over time in both tests for both groups, but with no difference between them (Figures 1 and 2).

Functional ability

A Mann-Whitney test was used to compare the two groups each week for all the functional ability tests. The results indicated no statistically significant differences between the two groups.

A Friedman test was conducted to detect differences for both groups in each week of the training period for the functional ability tests. The results showed a significant difference for both groups in every test, specifically: (a) for the IFA group the results were $\chi^2(4)$=16.229 (P<0.05) and $\chi^2(4)$=21.029 (P<0.001) for the Side Hop test and the 8-figure test respectively; (b) for the EFA group $\chi^2(4)$=21.036 (P<0.001) and $\chi^2(4)$=22.514 (P<0.001) for the side hop test and the 8-figure test, respectively. For the SEBT, every direction was examined separately: (a) for the IFA group the results were $\chi^2(4)$=12.058 (P<0.05), $\chi^2(4)$=14.514 (P<0.05) and $\chi^2(4)$=17.943 (P<0.05) for the anteromedial, medial and posteromedial direction, respectively and (b) for the EFA group the results were $\chi^2(4)$=16.571 (P<0.05), $\chi^2(4)$=23.657 (P<0.001), and $\chi^2(4)$=10.171 (P<0.05) for the anteromedial, medial and posteromedial direction, respectively.

Table 1. Descriptive statistics of the sample

Variables	Mean±SD	
	IFA Group	EFA Group
Age (y)	21.86±1.86	21.00±1.29
Weight (kg)	83.57±19.81	68.71±13.73
Height (m)	1.80±0.10	1.74±0.12
History of ankle sprains (times)	3.71±2.21	2.57±1.81
Last sprain (months)	15.29±13.19	18.43±9.55

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Discussion

We examined whether the EFA would better benefit static balance and functional ability than an internal focus in individuals with CAI.

The results revealed no differences in static balance between the two groups. On the contrary, Wulf et al. [23] examined the effect of attentional focus in Parkinson patients with balance deficits. They found that the patients had significantly reduced body sway when utilizing EFA, meaning better static balance. The EFA had much better results than the IFA and control groups. Wulf et al. [24] found a significant difference between the IFA and EFA groups on the static balance of healthy participants. In those studies, there was an improvement in both groups throughout the sessions, but the improvement in the EFA group was much higher.

A non-statistically significant difference between the groups of IFA and EFA was detected in the functional ability tests in the present study. On the contrary, Laufer et al. [11] and Rotem-Lehreretal and Laufer [12], who examined the effectiveness of attentional focus instructions during dynamic balance training on young people with an acute ankle sprain, concluded an increase in overall stability and functional ability in both groups and the EFA group's improvement was significantly better. Chiviakowsky et al. [25] found that when Parkinson patients were guided to focus their attention externally, they were better at keeping their balance, especially at the retention test on the day after practice. They concluded that the benefits of EFA to functional ability can be generalized to older adults and Parkinson patients. Similarly, McNevin et al. [26] reported that in healthy subjects, the further away from the body a person focuses their attention, the better results the subjects have on a dynamic balance task.

The superiority of EFA in contrast to IFA in balance and other tasks, as suggested by the aforementioned studies, could be explained by the constrained action hypothesis [8, 10, 26]. When focusing internally, a person tends to actively negatively interfere with an almost automatic process of the body that controls movement and results in a coordinated and fluid outcome. This automatic process is active when the person focuses externally, resulting in better-quality movement [26]. That theory was based on research done on healthy subjects, but it has been shown that it most likely applies to people with musculoskeletal disorders, too [10].

Although the present study adds to the experimental research, investigating the effectiveness of focus of attention on balance and functional ability of CAI, there are some limitations. First of all, the tests of the present study may be reliable and appropriate for our sample, but they lack the sensitivity of an electronic device. Additionally, this study used a relatively small sample size. At last, we lacked a control group to study whether the training alone improved our groups or the attentional foci had any effect. Future results should repeat the present findings with more participants and the impact of focus of attention on other orthopedic injuries in different parts of the body (e.g. knee). It is not easy to recruit participants with the same demographic characteristics and type of injury. Research should also examine balance or functional ability using other reliable and valid measurement instruments. Moreover, future experiments may investigate attention's effectiveness on gender.

Conclusion

According to our findings, an EFA did not affect the balance and functional ability of patients with CAI more positively than an internal focus. Repetition of the present study with a larger sample examining the effect of attentional focus during balance training for patients with CAI is most needed in the future. Also, future studies should examine the insight psychophysiological processes of focus of attention during the rehabilitation of a musculoskeletal injury.

Ethical Considerations

Compliance with ethical guidelines

The study was approved by Institutional Ethical Committee of University of West Attica, Athens, Greece (Code: 44805/30-06-2020).

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Authors' contributions

Conceptualization, methodology, and project administration: Anna Christakou; Investigation: Aikaterini Gkikopoulou and Eudokia Iosif; Software, data curation, and writing the original draft: Aikaterini Gkikopoulou; Review and editing: Anna Christakou and Giorgos Gioftsos; Supervision: Giorgos Gioftsos.

Conflict of interest

The authors declared no conflict of interest.

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