Internal and external attentional focus imagery related differences on dynamical balance in ADHD children

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Abstract

The purpose of the current study was to examine the effect of imagery in improving the dynamic balance in ADHD children and then examine internal and external attention focus imagery in dynamic balance in them. 43 male children with ADHD disease (9-12 years, average age: 10.72 years, SD: 3.12; average weight: 31.90 kg, SD: 4.12; average height: 129.12 cm, SD: 8.02) participated in this study. Participants were randomly divided to four groups. (Internal attention focus imagery, external attention focus imagery, and traditional imagery and control groups). Timed Get up and Go test was used to evaluate the functional mobility and postural balance. Study design consisted of pre-test, training, post-test and the retention test. A one-way ANOVA was used to compare TUG scores on the pre test to ensure the four groups were not different at the initiation of practice. A one-way ANOVA was also used to compare post test and follow up test performances. The results of this study showed that compared to other situations (internal attention focus imagery, traditional imagery and control groups), external attention focus imagery causes further improvement of children ADHD dynamic balance. According to current study results, it seems external attention focus imagery is a practical and effective method for improving the dynamic balance of ADHD children and this way we can improve balance controlling and motor skills in occupational therapy.

Keywords: Internal attentional focus imagery. External attentional focus imagery, Dynamical Balance, ADHD children

Introduction

The main purpose in motor learning and control is the cognition of variables that there were involving in maximizing learning and control (Schmidt & Lee, 2011). One of the recent methods and variables to improve motor skills and maximize rehabilitation is mental imagery which is also the focus of specialists. Mental imagery in sports is widely utilized; and recently is being used as a tool to improve the performance of people with neurological injuries (Zimmerman-Schlatter, 2008). Mental imagery is the simulation and recreation of a perceptual experience among sensory moderators (David, 2013). Also, Moran (2009) defined imagery as mental activity which involves internal representation of information in the absence of stimulus. Since 1930, variety of studies has been done in the field of improving motor skills; the
results reflected the positive impacts of imagery in improving performance (Decety, 1991). The use of imagery in rehabilitation areas began in mid-70s. Positive role of imagery improving the performance and implementation of some motor skills in stroke patients has been identified (Hosseini et al., 2012). In spite of, during the imagery, motion does not run physically; but, it has been shown that the motor mental imitation remained many characteristics in according to the actual acts (Hermans et al., 2008). Among the effective factors on skilled performance, attention plays an important role and refers to the levels of consciousness and awareness (Magill, 2011). Allocating capacity to apply various tasks is one of the aspects of attention. According to single channel theory, we turn our attention to the stimuli in order to select and plan a proper response (Schmidt & Lee, 2011). Researchers and specialists have long been focused on attentional focus as an effective potential factor. Attentional focus has been studied in various aspects. Recent studies showed that directing attention during performing an action is an important factor for successful performance (Wulf, 2012). Attentional focus is a one method for increasing learning and out put. Attentional focus means knowing an issue and leaving others behind, that can be studied in terms of width and direction. Width indicates that our attention could encompass focus and be broad (wide) or narrow on environmental information and mental activities. Direction indicates that our attention focus could be external or internal. Attention could focus on environmental or intellectual signs, programs and internal actions on solving problems (Magill, 2004). Allocation of attention in doing motor skills has been illustrated differently, but common characteristics in attention based studies are how we administer attention in tasks or how we direct different signs. In previous studies, controlling attention has been studied as a tool for acquisition of motor skills in athletic skills. These results indicate that focus of attention on movement goals (external focus) alliance on the movement itself in learning and controlling different motor skills is beneficial (Wulf et al., 2000). In external attention focus, ones focus is on the effects that actions have on environment; while, in internal attention focus, ones focus would be on body movements (e.g. legs) (Wulf, 2009).

Landin (1994) suggests that coaches should directed learners attention into environmental information (external) in open skills teaching in order to receive an appropriate motor response. So many studies have been done concerning the effect of external attention focus on learning and performing; and using different types of balance tasks (McNevin et al., 2003; Wulf et al., 2001) and athletic skills (Wulf et al., 2001 & 2002) pointed out the excellency of external attentional focus comparing internal attentional focus. From Wulf’s point of view, internal attention leads to movement conscious control and consequently, follows by clumsy and slow performance (Wulf, 2008).

Imagery has recently been known as a practical tool for training rehabilitation of neurological patients (Heremans et al., 2012). One of the most common central nervous system diseases is Multiple Sclerosis (MS) which is a chronic central nervous system and can affect the major motor and sensory system during standing or walking (Sharissa et al., 2013). The common symptom of MS is imbalance. Role of balance is crucial in every day activity and life. Balance disorders can lead to decreasing stability and it can have a profound impact in nervous pathological patients. Stability disorders decreases independent performance, increases disabilities and also spreads the risk of falling (Shumway-Cook and Woollacott, 2001). In these patients, weakness of the muscles and spasticity effects balance by involving sequences of muscle contraction (Frozvic et al., 2000).

In the past decades, imagery suggested being a decongestant method in order to practice movements; for example patients with cerebral palsy, it has been proven that imagery is more beneficial comparing to other exercises (Murier et al., 2007; Zimmerman-Schlatter et al., 2008). Also in Patients with Parkinson, some preliminary evidence showed effectiveness of the mental imagery treatments (Temir et al., 2007; Heremans et al., 2011). Moreover during the recent years, studies on patient populations showed that attentional focus performs favorable effects on the motor skills; for example positive effects of external attentional focus in Parkinson’s diseases (Wulf et al., 2009). But for other patients such as ADHD children, mental imagery and attentional focus imagery (internal and external) factors remain unknown and there is no reliable results using this method. Due to wide range of skills in this field, further examinations seem necessary. Also, it seems that using imagery and attentional focus and testing the results are new and still rarely studied; there is no previous study about ADHD children as well. So in the present study we have evaluated the effect of imagery in improving the dynamic balance in ADHD children and then examined internal and external attentional focus imagery in dynamic balance in them.
Methods and materials

Participants
43 male ADHD children (9-12 years, average age: 10.72 years, SD: 3.12; average weight: 31.90 kg, SD: 4.12; average height: 129.12 cm, SD: 8.02) participated in this study. They had no prior experience with the task and all gave their informed consent before participating in the study. For the purposes of this study only those children who had imagery ability 20-30 based on the kinesthetic and Visual Imagery Questionnaire (Malouin et al., 2007) were selected. Children were excluded if they had other medical illnesses, any kind of pain that interfered with their daily activities, or if they were unable to perform the experimental task.

Instrumentation and procedure
Timed Get up and Go test was used to evaluate the functional mobility and postural balance. In this test, the patient is sitting on an adjustable handled chair, while her hands are resting on the handles, in a comfortable position. Chair is situated 3 m away from a cone. The patient is asked to stand up after hearing the command “go” toward the cone, approach it and then return back to sit on the chair. The time is recorded by using a chronometer. KVIQ-10 was used to homogenise imagery ability of the patients. The KVIQ is a reliable and valid test for indexing mental imagery ability in people with disabilities. Malouin et al (2007) developed the KVIQ for use with both non-disabled people and people with disabilities (ie, stroke). The KVIQ assesses both visual and kinaesthetic components of mental imagery. The test-retest reliability and internal consistency of the KVIQ have been reported in non-disabled individuals and in people with stroke (Malouin et al., 2007) and Parkinson disease (Bubblepreet et al., 2010). The intra class correlation coefficients (ICCs) for test-retest reliability for non-disabled persons ranged from 0.72 to 0.81 ,from 0.81 to 0.90 for a group of people with stroke (Malouin et al., 2007) and from 0.82 to 0.95 for people with Parkinson disease (Bubblepreet et al., 2010). In this study, the test-retest reliability and internal consistency was obtained from 0.76 to 0.84 in children with ADHD.

Participants were randomly divided to four groups: internal attentional focus imagery, external attentional focus imagery, traditional imagery and control groups (physical exercise group was supposed to be control group). Study design consisted of pre-test, acquisition phase and the retention phase. Acquisition phase lasted for 6 weeks, 3 sessions per week. The test was done in end of per session. Retention phase was done 2 weeks after the last training session. The TUG test was done for 10 min by both of groups (internal and external attention focus imagery groups), and each session lasted for 20 minutes totally. External attentional focus imagery group was instructed to focus on the road ahead or the cone. In the internal attentional focus imagery group, participants were instructed to focus on their feet. Also the time of each session was 20 minutes for the control group and traditional imagery. Participants in traditional imagery group practiced mentally for 10 min and then practiced physically for 10 min. Control group practiced physically for 20 min. physical practicing took 20 min in which the first 10 min was allotted to warm-up and the remaining 10 min was allotted to TUG test. Since these patients were imbalanced, number of TUG test was recorded for 10 min. Mental Imagery took 10 min in which the first 3 min was allotted to relaxation practices and the remained 7 min was allotted to mental imagery. In mental imagery, the participant was lying supine in a bed with closed eyes, imagining himself on an adaptable armchair, and imagining how to stand up and go. Then he imagined by visualizing himself that he stands up and approaches a wall which is 3 m far away, turns round without stop and comes back to the armchair and sits on it. The patient imagined this activity again next time but with more speed and carefully.

Statistical Method
We first checked the normality of the data as well as the homoscedasticity. The sphericity assumption was also tested using the Mauchly's sphericity test. Data showed that the normality and sphericity were not violated and thus that parametrical statistical tests could be used. TUG scores during the acquisition phase were analyzed in a 4 (group) x 6 (week) analysis of variance (ANOVA) with repeated measures on the second factor. A one-way ANOVA was used to compare TUG scores on the pre-test to ensure the four groups were not different at the initiation of practice. A one-way ANOVA was also used to compare retention test performances.

Results
To test for groups (i.e., External attentional focus imagery, Internal attentional focus imagery, Traditional imagery, and Control) difference on dependent variable (i.e., TUG test time) in the pre-test phase, a one-way analysis of variance (ANOVA) were utilized. Results indicated the groups were similar at the pre-test phase F (3, 39) = 1.02, p = 0.39 (see Figure 1).

The TUG scores in acquisition phase were analyzed using a 4 X 6 (group X week) ANOVA with repeated
measures on the second factor. This analysis indicated a significant main effect for groups, $F (3, 39) = 11.86, p = 0.001, \eta^2 = 0.442$. A Tukey-Kramer post hoc analysis indicated that there was significant difference between external attentional focus imagery and traditional imagery ($p=0.001$) and control-groups ($p=0.001$). The post-hoc analysis also indicated the internal attentional focus imagery and traditional imagery ($p=0.001$) and control-groups were significantly different ($p=0.001$), but the external attentional focus imagery and internal attentional focus imagery-groups were not significantly different ($p=0.05$). The week main effect was significant, $F (5, 280) = 313.77, p = 0.001, \eta^2 =0.91$. Participants significantly improved from week 1 to week 6. The groups X week interaction was also significant, $F (15, 150) = 9.45, p = 0.001, \eta^2 =0.38$ (see Figure 1).

The TUG scores in retention phase were analyzed using a one-way ANOVA. This analysis indicated a group main effect, $F (3, 39) = 39.21, p = 0.001, \eta^2 = 0.87$. A Tukey-Kramer post hoc analysis indicated the external attentional focus imagery group ($M= 11.55, SD= 1.11$) was significantly better than the internal attentional focus imagery ($M= 12.39, SD = 0.40$), traditional motor imagery ($M= 13.24, SD = 0.32$), and control- groups ($M= 14.55, SD = 0.43$). The post-hoc analysis also indicated the internal attentional focus imagery group with traditional imagery and control-groups were significantly different, in addition the traditional imagery and control-groups were significantly different (see Figure 1).

**Figure 1.** Mean TUG scores for external attentional focus imagery, internal attentional focus imagery, traditional imagery, and control groups in pretest, weeks, and retention phases.

### Discussion and Conclusion

The primary purpose of this study was to examine the effect of mental imagery on improvement of dynamic balance in ADHD children. The usefulness of imagery in improving balance performance has been investigated (e.g. Hosseini et al., 2012). Currently, so many studies have been done on mental imagery and its effects on psychological sciences, motor learning, and cognitive learning, most of these studies suggest the positive role of imagery on motor learning (Malouin et al., 2003). Previous studies reported that mental imagery could be a suitable tool in rehabilitation of the patients suffering neurological injuries; although, nervous system diseases can affect patient’s performance on doing imagery movements, e.g. it has been shown that patients suffering cognitive and motor injuries abilities for précised and organized moves have been reduced (Hermans et al., 2012). This study showed that mental imagery effects on dynamic balance of the patients with MS. Jacobson’s psychological neurological muscular theory (1932) argues that the sent impulse to muscles from the brain is during the movement similar to sent
impulse to muscles from the brain is during the imagery. Although the efferent activities are much more less than real activities, improvements in balancing among ADHD CHILDREN could be a modified method; such like in imagery moment, neurological-muscular pattern in real situation being activated in one’s mind that causes better muscular readiness which is useful in planning a learning, so that the mental practice leads to getting close to a better muscular activity (Hosseini et al., 2012). White and Hardy (1995) reported that in acquisition and retention of athletic skills, external imagery is more effective than internal imagery; also comparing these two imagery, Fery (2003) showed that external imagery or visual has the most effect on tasks that there were emphasized on movement pattern. Nichola & Ross (2010) reported about the usefulness of external imagery comparing to the internal imagery. In this study, the second purpose is to examine the effect of attentional focus imagery (internal and external) on ADHD children’s dynamic balance; patients were asked to visualize their group tasks and try to do it as their imagery; that way, when you walk (internal attentional focus imagery group) focus on your feet or on the path (external attentional focus imagery group). Results showed that attentional focus imagery in both groups is effective in dynamic balance of the patients and cause time reduction in TUG test. During the test attentional focus imagery groups didn’t have any significant differences; but in the retention test, the external attentional focus imagery group performed better than the internal attentional focus imagery group.

The general results showed that external attentional focus imagery group comparing to the internal attentional focus imagery group performed better in retention test. Also, comparing traditional imagery group and control group, the external imagery group performed better. In previous studies, some evidence represented on the effectiveness of external attention focus (e.g. Wulf et al., 2009); these results supported the previous findings about the effect of external attentional focus on performance of neurological patients (McNevin et al., 2003).

The results of this study were parallel to the motor control perspectives related to attentional focus. The findings of this study can be illustrates by the Constrained action hypothesis. This hypothesis indicates that attempts for movement conscious control, like internal attention situation, limits motor system and prevents autonomous process that controlling movement. On the contrary, turning the focus from movement to the movement results (external attentional situation) allows the system to self-organize naturally (McNevin et al., 2003).

The results of this study support Masters and Maxwell’s conscious processing hypothesis. According to this hypothesis, conscious controlling processes in stress and pressure conditions cause returning to the first stages of learning because performance was not autonomous and it done voluntary (Maxwell & Masters, 2002). These researchers presented different illustration about the excellency of external attention. Thus, external attention focus attracts the attention of learner to the external important information (e.g. focusing on the ball’s landing spot). Therefore, adopting internal attention focus enforces more burdens on attentional resources or working memory, and its possible reason for poor performance that focuses on internal factors (Maxwell, Masters, and Eves, 2000).

The results of this study showed that compared to other situations (internal attention focus imagery, traditional imagery and control groups), external attentional focus imagery causes further improvement of ADHD children dynamic balance.

According to current study results, it seems external attentional focus imagery is a practical and effective method for improving the dynamic balance of ADHD children, and this way we can improve balance controlling and motor skills in occupational therapy. We also can advise rehabilitation and occupational therapists, if you want to improve dynamic balance especially when performing tasks is not suitable due to the lack of physical exercises and risk of injury, you can benefit from the alternative mental imagery. Finally, for future studies, it is suggested that researchers investigate the effect of attentional focus imagery on other specific neurological diseases.

Conflict of interest
The authors declare no conflict of interest

References


