

Research Paper

**The Effect of Visual Reference on the Balance of
Taekwondo Practitioners During Training**

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Abstract

Due to the significance of balance during daily activities and sports exercises and the necessity of identifying the factors affecting it, the present study aimed to explore the effect of visual reference on the balance of Taekwondo practitioners during training. Accordingly, 20 Taekwondo practitioners were selected and studied by a convenient sampling method. Participants were divided into two groups (Control and experiment) of 10 individuals. Then, their height, weight, and body mass index were measured to ensure that the groups are identical. Every subject performed a training session including warm-up, pre-test, Tornado kick, post-test, and cooling down, and they performed balance (pre-test and post-test) in 60-seconds endeavors. Balance indexes of the medial and lateral directions (right and left) were collected by using a swing balance device. Descriptive statistics, mean, and standard deviation were applied to designate the data, and a one-way ANOVA test was used for comparison between groups. The results indicated that placing the visual reference during the tornado kick upgraded the balance of male Taekwondo practitioners ($p \leq 0.005$). Therefore, it can be concluded that placing the visual reference on the mat and performing Taekwondo rotational techniques can improve the balance of Taekwondo practitioners. Thus, it is recommended that Taekwondo coaches and athletes apply the exercises and results of this research in designing training programs to participate in competitions and belt promotion tests.

Keywords: Balance, Taekwondo, Visual Reference

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Introduction

Taekwondo is one of the most popular sports consisting of several sections (pumice, combat, performance, etc.). It is very essential to sustain and control balance in all Taekwondo skills. Balance, in action and reaction, is an essential requirement of performing many Taekwondo movements, including hitting the opponent. Moreover, most techniques are performed on one leg, associated with rapid rotation, jumping, and changing the direction of the limbs, especially the lower limbs (Ziaee, Rahmani, & Rostami, 2010). In the meantime, balance is a significant factor that its existence is required for the best and correct performance of Taekwondo techniques for athletes in this field (Lystad, Pollard, & Graham, 2009). Relying on the available evidence, athletes use the balance control systems in different levels due to different environmental needs and tasks (Bressel, Yonker, Kras, & Heath, 2007; Perrin, Deviterne, Hugel, & Perrot, 2002). One of the remarkable skills in balance is rotational movements. Understanding the balance strategies involved in this group of movements develops our knowledge of balance control (Wada, Tateuchi, & Ichihashi, 2014). Given that in Taekwondo, most techniques are performed on one foot and in the form of rotation and jumping (Lystad et al., 2009), it can be claimed that the employment of all techniques and rotational movements requires maintaining balance (Wada et al., 2014). The present study aims to find a way to enhance the balance of Taekwondo practitioners while performing the Tornado kick.

Furthermore, another factor that necessitates research in the field of balance is the inverse relationship between balance control and the rate of falls and injuries, even in athletes (Dizaji, Memar, & Sadeghi, 2016). The special features of Taekwondo, changes in refereeing rules in which any balance discomposure leads to a fall results in a positive score by the opponent, and the use of electronic shock absorbers, lead to the increasing importance of maintaining balance in the competition. On the other hand, research has shown that knee and ankle injuries are among the most common sports injuries (Kazemi, 2012). These injuries are more common in sports that are associated with clipping, jumping, and sudden movements. Non-contact mechanisms such as falling from a jump position that leads to ligament and joint injuries may be due to insufficient muscle strength or imbalance (Rabello et al., 2014). Athletes in martial arts such as Taekwondo must have four abilities: speed, accuracy, balance, and strength in all movements and techniques. Hence, Taekwondo is a sport in which a high incidence of lower extremity injury has been observed (Kazemi, 2012).

Additionally, the research has revealed that visuality influences directly balance control and is highly significant in performing most skills. Visuality is the preception of information about the position and movement of the head concerning the environment which helps to stabilize the position of the head and upper body in space. Therefore, the center of gravity keeps the body in the

anticipated position (Tjernström et al., 2019). If we close our eyes when performing sports or the body is in a changing position, the visual system will not be able to transfer the correct information to the cerebellum, resulting in difficulty in managing body stability. Establishing the anticipated balance while performing movements requires the provision of appropriate and necessary information through the systems involved in this process (eyesight, somatic sense, and vestibular system). This process is accomplished through the integrated operation of these systems together (Matsuda et al., 2011). Among the balance strategies, visuality is imperative for making changes in the position of the head and its movements concerning the environment. Buchanan et al. concluded that the stability of the head and body in space has three important functions: 1. Stabilization of visuality for eye movements and the pursuit of objects. 2. Stabilization of the center of gravity of the head and body within the point of support. 3- Reduction of external forces on the head and body (Buchanan, Docherty, & Schrader, 2008). The specific orientation in the position of the observed object is called the main direction of vision (Prentice, 1999).

Due to the above information about the correlation between balance and visuality and with the development and expansion of sports injury prevention methods in recent years, sport coaches often employ particular exercises to increase balance or reduce the risk of injury for athletes. Owing to the dynamic nature of Taekwondo techniques and the importance of balance in performing the best techniques, improving performance during training and competition, reducing sport injuries due to poor balance, finding a low-cost intervention effective on stability, and reducing sports injuries are required. Therefore, this study aims to explore the effect of visual reference on the balance of Taekwondo practitioners.

Method

Due to the application of intervention variables and having a control group and random grouping of samples, the present study is quasi-experimental. A randomized controlled clinical trial design was carried out as a pre-test and post-test. The statistical population of this study was Taekwondo practitioners of Koryo and Padideh clubs in Urmia. Among them, participants aged 24 to 28 years were selected by purposive sampling.

Inclusion and exclusion criteria of this study include: completing the written consent form of conscious participation in the study, having at least six years of regular activity in Taekwondo, benefiting from physical health (no history of surgery or fracture that affects balance), having an index normal body mass, no hearing aid and no inner ear disorders and balance problems, having no history of visual and vestibular problems. It is worth stating that the screening of individuals was carried out using a medical history form that was completed by the participants before the study. After homogenizing the samples (in terms of age,

balance, and other demographic indicators), they were randomly divided into two groups of 10 (experimental and control groups). The experimental group then performed an intervention for half an hour, which included warming up, performing ten tornado kicks (Figure 1) in a row, placing a visual reference on the mit (Figure 2), and cooling down. The control group also performed the above protocol without having a visual reference. It is noted that the person holding the mit was one person for both groups and the position of the mit was placed at the height of his head and face for each person. Then, the balance of both groups was measured one minute before and immediately after the implementation of the protocol using a swing balance device ($r = 0.89$, $ICC = 0.88$) (Chatzopoulos, Galazoulas, Patikas, & Kotzamanidis, 2014).

Figure 1: Steps of performing tornado kick

Figure 2: The place of visual reference (yellow mark) on the mit

Kolmogorov-Smirnov statistical test was applied to evaluate the normality of the data. The differences between the groups were assessed by one-way ANOVA and the paired t-test was used to examine the differences between the pre-test and post-test within the group. Significance level ($p \leq 0.05$) was considered in all tests.

Results

First, using the Kolmogorov-Smirnov test, the assumption of normal data distribution was examined. Comparison of the mean results of some individual characteristics of the participants in the two groups, including height, weight, age, and body mass index did not indicate significant differences (Table 1). In addition, to homogenize the balance of the groups in the study and to control the effect of Taekwondo exercises and the skill level of the subjects, the balance of the participants of the control and experimental groups was examined in the pre-test. There was no significant difference between control and experimental groups in the pretest (Table 2) ($P \geq 0.05$).

As it is observed in Table 3, the effect of the intervention (placing the visual reference on the mit in performing tornado kick) was significant as an independent variable, indicating the effect on the dependent variable (subjects' balance). The effect of the group was also significant, indicating a significant difference between the experimental and control groups in assessing balance. Therefore, the research hypothesis based on the effectiveness of the intervention is confirmed.

Discussion

The results of this study indicated that placing a visual reference on a mat for Taekwondo practitioners while performing a tornado kick has a positive effect on controlling their body balance. In the process of maintaining balance, different systems of aural, somatosensory, and visual are used in combination, which is prioritized in the central nervous system due to their relative importance during the task (Tjernström et al., 2019). Horak, Nashner, and Shumway maintain that, in evaluating balance, systems that are effective in maintaining balance and their components should be considered separately (Horak, 1997; Shumway-Cook & Woollacott, 1995). In this way, by making changes and interventions in the input information of systems involved in balance, the ability of the individual to maintain balance in different states can be measured and evaluated. On the other hand, balance is a significant component of movement and plays an important role in performing skills and preventing sport injuries. The nature of Taekwondo skills requires maintaining balance while performing fast and agile movements in dynamic conditions (Ziaee et al., 2010). Therefore, finding ways to improve and strengthen the balance of Taekwondo sportspersons is of special importance and status.

Previous studies have revealed that the rate of balance fluctuations in the open eye is 22%, which increases to 56% when the eyes are closed. Correspondingly, in this case, the rate of deviation from the center of gravity in response to discomposures increases (Liu, Kong, & Zou, 2007). In another study, it was stated that lack of proper orientation and rapid eye movements decrease the balance. In this study, the static balance of the participants was enhanced when the participants had a fixed visual reference (Riach & Starkes, 1989). Researchers have also presented that head stability is provided by the vestibular system and neck muscle reflexes, and by keeping the head steady through visual stability, posture control can be improved (Rad Kaftroudy, Daneshfar, & Shojaei, 2020). Considering the results of the above studies and comparing them with the results of the present study, it appears that they confirm the role of visuality in balance and are consistent with the results of the present study. The difference is that the effect of visuality on balance has been highlighted in these studies, while practical methods have been underlined in applying and increasing the effects of visuality on balance in the present study. The present study attempted to figure out a simple and practical way to improve the balance of athletes by placing a visual reference on the mat while performing a tornado kick. Visual information about the position and movement of the head concerning the environment increases body balance control and helps to stabilize the position of the head and upper body in space. Thus, the center of gravity keeps the body in the anticipated state (Moore, 1997). The results of the present study confirm the findings of several studies that peripheral visuality influences balance. Evidence has shown that peripheral vision in the anterior-posterior direction and central vision in the internal-external

directions play a role in balance control; in general, peripheral vision is more important for balance control (Agostini et al., 2016; Taneda et al., 2021). Manchester et al. (1989) found that imbalance in the elderly decreases with reduced peripheral vision (Manchester, Woollacott, Zederbauer-Hylton, & Marin, 1989). Peripheral vision, which surrounds the central field, automatically assists to identify spatial features such as the location and movement of objects in the environment (Masson & Ilg, 2014; Schmidt, Lee, Winstein, Wulf, & Zelaznik, 2018). In the present study, it is likely that the athletes in the experimental group attempted to follow the visual reference while performing the tornado kick in moving and rotating states, and used their peripheral vision abilities more to control the balance of the experimental group during the technique. Therefore, the balance of the experimental group, who had a visual reference, was better than the other group.

Furthermore, the practitioner's visual reference on the mat may have helped maintain visual stability during rotation and improved the body's balance. In this regard, Kalloniati et al., in their research, concluded that any object that can change the main direction of vision may change its visual space and this change will affect the balance and perception of position (Kalloniati, 2007). The results of Tjernstrom et al. (2019) also demonstrated that the dominant sense for maintaining balance is the sense of sight and then the proprioception, and the share of atrial inputs is less compared to them (Tjernström et al., 2019); atrial inputs are attained through vision and head movement (Sedaghati, Zolghare, & Shahbazi, 2019) and by keeping the head steady through visual stability, balance can probably be influenced.

On the other hand, Perrin et al. reported that there is no significant difference among athletes of diverse levels of competition in judo in their dependence on vision in maintaining balance in performing two-way standing activities (Perrin et al., 2002). According to Golomer et al. (1999), the higher level of competitions, the more athletes are dependent on visuality in keeping balance, as they reported exercises like dancing and ballet rely on balance for coordination and concentration (Golomer, Crémieux, Dupui, Isableu, & Ohlmann, 1999). However, the results of some studies have presented that the dependence of athletes in judo and triathlon on visuality in maintaining balance performing tasks reduces (Gauchard, Gangloff, Vouriot, Mallie, & Perrin, 2002; Harringe, Halvorsen, Renström, & Werner, 2008). The contradictions of these studies can be justified on the ground that the degree of visual dependence in balance control depends on various components such as person, environment, and task. Consequently, the probable reason for the difference between some of the above results and the results of the present study is the differences concerning the task and skills of sports and also the difference between the dependence of different skills on visual and vestibular systems with Taekwondo.

Conclusion

According to the study's findings, it can be concluded that placing visual reference and using it while performing rotational techniques such as tornado kick can improve the balance of Taekwondo practitioners. Thus, it is suggested that visual reference can be applied while performing rotational techniques of Taekwondo practitioners for improving their balance.

Declaration of competing interest

The authors declare no conflict of interest in this research.

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