

Evaluation of Core Stability and Foot Kinematics of Taekwondo Athletes

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ABSTRACT- To score in taekwondo competition requires faster kicking. Among the factors that influence kicking velocity, core stability is important, but the relationship between core stability and kicking velocity in taekwondo is unclear. The aim of this study was to investigate the association between core stability and foot segmental COM velocity at the moment of kick. A total of 13 taekwondo instructors (gender: male, height: 172.6±7.3 cm, weight: 64.3±11.78 kg, age: 29±4 years) participated in this study. The center of mass velocity of the left foot segment at the moment of the kick and the level of core stability was measured using the Sahrman core stability test. During the Naraechagi, the velocity of the foot segment COM relative to the laboratory origin at the moment of the aerial phase kick was positively correlated in the forward and backward directions X-axis. Moderate correlation in the left and right direction Z-axis. Very strong correlation in the up and down direction Y-axis. Through the current experiment, we found a strong correlation between core stability and kicking speed in the forward and backward and up and down directions. Therefore, we believe that adding core stability training to taekwondo training has the potential to increase kicking speed.

KEYWORDS- Taekwondo, Core Stability, Kick Velocity, Kinematics

I. INTRODUCTION

Previous research has found that the core can influence athletic performance[1] because it is key to the generation and transmission of force during exercise[2]. However, the core, like other muscle groups, has multiple functions in terms of strength, endurance, and stability[3]. The current core research in taekwondo has focused more on the effects of core strength on the effectiveness of taekwondo movements[4], and other studies have found that core stability contributes to force transfer and control of movement, as proximal stability is for distal movement. The superficial muscles responsible for force transfer can only be better if the deep muscles responsible for stability are strong enough[5]. While for other sports such as handball, Muay Thai, Tennis and other sports where core stability can increase velocity at the distal[6,7,8]. But there is no research on the relationship between core stability and kicking

velocity in taekwondo. The Sahrman core stability test is among several medical rehabilitation diagnostics and biomechanics studies that have emerged in recent years[9,10]. It serves as a valuable tool for assessing the stability of the core muscles, offering a credible scientific indicator. Therefore, as the association between core muscle activity and taekwondo performance may vary for different tasks, the relationship between core stability and kicking velocity in taekwondo is currently unclear, although there is some current research on the core muscle groups of taekwondo athletes.

II. METHOD

A. Participants

A total of 5 female subjects participated in this study. They were fit and used to shooting right-handed. In addition, the subjects were fully informed of the purpose and necessity of the study procedure before the experiment. For accurate study results, subjects were advised to avoid excessive exercise or physical activity and to get plenty of rest before the experiment. They had no history of musculoskeletal injuries in the previous 6 months prior to the examinations. Their characteristics are followed (Table 1).

Table 1. Age and Experience

	N=5
Age	25.3±2.6
Height	166.4±4.3
Weight	55.5±4.6
Years	8

B. Procedure

During experiments, 6 infrared cameras (Prime 17W, OptiTrack, Natural Point, Inc., Corvallis, OR, USA) were used to capture kinematic data for each participant at a sampling rate of 120 Hz. In the experiment, matching markers were 14 mm reflective markers and each subject was tagged with 37 whole-body reflective markers. Data were achieved through Motive (OptiTrack, Natural Point, Inc., Corvallis, OR, USA). Lastly, the collected data were imported into visual3D software (Professional 6.0, C-Motion Inc., Germantown, MD, USA) for data analysis.

Before the actual experiment, all participants introduced to the test protocol and the objective of the present study. Then, personal information was collected and no one had injuries in the past 6 months (Table 1). All participants were evaluated in Sahrman Core Stability Test (SCST) before performing the double flying kick. During SCST test, the participants performed in their supine position, using the Stabilizer Pressure Bio-Feedback device (A&B physiotherapy, CHINA) located below the lumbar spine. The pressure gauge was inflated to 40 mm Hg and the participants was asked to perform an abdominal wall gutting procedure. If the participants followed the protocol properly, there was no change in pressure.

The correlation analysis was performed using GraphPad PRISM 8.0 (GraphPad Inc., San Diego, CA, USA) between SCST rating and foot kinematics. COM velocity of the foot segment in X,Y,Z directions were included in the analysis.

III. RESULTS

One-way repeated measured ANOVA results suggested that there was no significant difference in all joint angles of lower extremity during air gun shooting.

Table 2: Correlation of Core Stability Level with Foot Segment Velocity(N=5)

Foot X axes velocity	Foot Y axes velocity	Foot Z axes velocity
r=-0.5645	r=-0.9777	r=-0.663
p=0.028*	p < 0.001***	p=0.007**

IV. DISCUSSION

In this study, the core stability of each athlete was assessed using the Sahrman Core Stability Test (SCST) and correlated with kinematic measures. A significant correlation was found between SCST and kinematics, consistent with our hypothesis.

In Taekwondo Naraechagi tasks, rapid kicking velocity is considered a crucial factor in improving scores[11]. Previous studies have primarily focused on enhancing kicking speed through observations of isokinetic torque[12], isometric strength[13], or joint coordination[14]. In our study, we observed a strong correlation between the Sahrman Core Stability Test (SCST) and kicking velocity during the Naraechagi in Taekwondo. The phase of interest in our study was the aerial phase, specifically the moment from maximum knee flexion to maximum knee extension (kicking time). Our results demonstrated a significant positive correlation between SCST scores and center of mass (COM) velocities in forward - backward and up - down directions, consistent with previous research in other sports[5], indicating a positive impact of enhanced core stability on distal segment velocity. However, it is important to note that the action in our study was performed in aerial, while previous research was conducted on the ground, which may lead to differences. Although significant correlations were found in the forward - backward and up - down directions, only a moderate correlation was observed between SCST scores and foot COM in the left -right direction. This could be attributed to the characteristics of

the Naraechagi action, where the emphasis is more on the forward - backward and up - down directions. Based on our current experimental findings, it can be inferred that increasing core stability levels may contribute to improving kicking velocity in Taekwondo.

V. CONCLUSION

The results of this study found a correlation between the athlete's core stability level and the COM velocity of the foot at the moment of the kick during the Naraechagi.

VI. RESEARCH QUESTION

1. What will be other factors influencing kicking performance along with core stability?
2. What will be the effective training method to improve core stability?
3. Will fatigue decrease kicking performance?

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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