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Original Research Article

The kinematics analysis of preferred and non-preferred front leg axe kick according to stance position in Indian Taekwondo Players

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Guru Nanak Dev University, Amritsar, Punjab, India***Article History:****Received:** 13/01/2017**Revised:** 17/02/2017**Accepted:** 21/02/2017**DOI:** <https://dx.doi.org/10.7439/ijbr.v8i2.3854>**Abstract**

Background: Taekwondo is the technique of unarmed combat for self defense that involves the skillful application of techniques that include punching; jumping kicks, blocks, dodges, parrying actions with hands and feet. The stance position has been pointed out as important factor that can potentially affect the kick performance, so the stance position can be seen as a constraint for the execution. Therefore, the purpose of the study was to compare kinematic variables in preferred and non-preferred front leg axe kick in taekwondo according to two stance position (0°, 45°).

Methods: 10 elite taekwondo players participated in the study. Kinematic analysis was performed by using sports motion analysis system.

Results: Significant differences in kinematic data were found in front leg axe kick during 0° and 45° stance positions at the beginning of the kick; these differences disappear at the end of the kick. In comparison of kick at 0° and 45° the kick performed at 45° stance position reacts faster than the kick performed at 0° stance position.

Conclusion: According to the result of this report, experienced athletes are able to adapt their execution thus getting similar output at the end of the kick, that is, when the kicking leg impacts the target. Therefore, the stance position is a factor that affects the execution technique of taekwondo athletes kick so the stance position must be seen as a constraint to which athletes must adapt.

Keywords: Kinematic, taekwondo, execution technique, stance position.

1. Introduction

Taekwondo is a competitive sport in martial arts. The kicking leg, the unique feature to Taekwondo, is the major attack weapon in the competition [1]. Previous studies [3-5] showed that axe-kick was one of the main offensive actions with high percentage of offense, scoring and success during competition. Axe-kick is the main method of face kick, and which can be divided into front-leg axe-kick and back-leg axe-kick. The purpose of the kick is to attack opponent's head and generate a powerful and downward force. Generally, the faster and the more powerful the front-leg axe-kick is the more advantages can be gained. However, there was little study to discuss the biomechanics about front-leg axe-kick. The stance position

has been pointed out as an important factor that can potentially affect the kick performance [6,7]. In taekwondo combats, athletes maintain different stance positions, which have been seen as an example of constraints for the performance. The adoption of the most suitable stance position could be key in a sport performance of taekwondo athletes [7]. In a pilot study, Estevan *et al* [7] found the execution and total response time from the lateral stance position (90°) to be longer than forward (0°) and diagonal (45°) stance positions. These authors reported the 45° stance position as the most appropriate position in combats. Thus, it seems necessary to continue to research the kick performance according to the stance position thoroughly,

with the objective to clarify it as a constraint. So far, there has been no study done on Indian taekwondo athletes players till date, which has stressed upon the kinematic variables measurements. This study will put an insight or the baseline kinematic data with all this comment in mind the aim of my research is to compare kinematic variables in preferred and non-preferred front leg axe kick in taekwondo according to two stance position (0°, 45°).

2. Materials and methods

Ten elite national level male Taekwondo players (mean age, training experience were 21 ± 2.29 years, 5±1.70 years respectively) were recruited as subjects for

this study. Sports motion analysis system was used to capture the motion and an LED was placed on the target. After a personal warm-up each participant's preferred target distance was used as the execution distance [7] and they performed five kicks in each of the stance positions. Each trial started when the LED lit up. The stance position was established by three lines (0°, 45°, 90°) were prepared [7]. The motion of front leg axe kick was divided into leg-lifting phrase (from the moment of leg taking off till the moment of minimum joint angles of knee) and leg-downing phrase. All dependent variables were entered into Statistical Package for Social Sciences (SPSS Inc., Chicago, Ill) 17 version.

3. Result

Table 1: The variables of movement time and total motion time

	Preferred Leg		Non-Preferred Leg	
	Movement Time (Sec)	Total Motion Time (Sec)	Movement Time (Sec)	Total Motion Time (Sec)
0 Degree	0.39±0.06	0.85±0.23	0.39±0.04	0.85±0.15
45 Degree	0.29±0.11	0.77±0.11	0.36±0.03	0.80±0.08

In 0° stance position movement time and total motion time of preferred and non-preferred front leg axe kick were same. It showed that there were no significant differences between preferred and non-preferred leg in movement time and total motion time (p>0.05).

In 45° stance position movement time and total motion time of preferred leg is less than non-preferred leg it showed that there were significant differences between preferred and non-preferred leg in movement time and total motion time (p<0.00).

Table 2: Front leg axe kick (angles at the time of take off) at different stance positions

Stance Position	Hip Angle		Knee Angle		Ankle Angle	
	Preferred Leg (deg)	Non-Preferred Leg (deg)	Preferred Leg (deg)	Non-Preferred Leg (deg)	Preferred Leg (deg)	Non-Preferred Leg (deg)
0 Degree	174.7±3.77	170.4±5.14	144.5±6.90	140.4±5.75	124.2±9.53	118.9±8.10
45 Degree	171.3±5.12	169.7±5.51	138.7±5.47	148±16.12	134.6±11.51	127±6.42

Table 2 showed the mean joint angles of Hip, Knee and Ankle preferred (right leg) and non-preferred (left leg) front leg axe kick at the time of take off at 0 degree and 45 degree stance position .

In 0° stance position in comparison of preferred and non-preferred front leg axe kick the angles at the time of take off significant differences were found in Hip and Ankle (p<0.01, p<0.04) whereas there were no significant changes in the knee (p>0.05).

In 45° stance position in comparison of preferred and non-preferred front leg axe kick the angles at the time of take off significant differences were found in Knee (P< 0.03) whereas there were no significant changes in Hip and Ankle (p>0.05).

According to the theory, H=ω, if the more reduction on angle of knee, the greater the angular velocity. Thus, the time of front leg axe kick is influenced by angle of knee during the motion.

Table 3: Front leg axe kick (angles at the time of impact) at different stance

Stance Position	Hip		Knee		Ankle	
	Preferred Leg (Deg)	Non-Preferred Leg (Deg)	Preferred Leg (Deg)	Non-Preferred Leg (Deg)	Preferred Leg (Deg)	Non-Preferred Leg (Deg)
0 Degree	97.3±6.91	96.2±13.37	171.6±5.98	168.1±9.83	140.8±17.69	138.9±15.52
45 Degree	113.5±7.76	112.8±11.26	167.4±5.89	168.7±5.73	154.6±5.27	154.5±5.44

Table 3 showed the mean joint angles of Hip, Knee and Ankle preferred (right leg) and non-preferred (left leg) front leg axe kick at the time of impact at 0 degree and 45 degree stance position .

In 0° stance position in comparison of preferred and non-preferred front leg axe kick the angles at the time of impact there were no considered significant differences were found in Hip, Knee and Ankle ($p > 0.005$).

In 45° stance position in comparison of preferred and non-preferred front leg axe kick the angles at the time of impact there were no considered significant differences found in Hip, Knee and Ankle. ($P > 0.005$).

4. Discussion

The purpose of the study was to compare kinematic variables in preferred and non-preferred front leg axe kick in taekwondo according to two stance position (0°, 45°). The results show significant differences in kinematic data were found in front leg axe kick during 0° and 45° stance position at the beginning of the kick; these differences disappear at the end of the kick. In comparison of kick at 0° and 45° the kick performed at 45° stance position reacts faster than the kick perform at 0° stance position. Taking into account that Estevan *et al*[7] reported the 45° stance position as the most appropriate position in combats, we also could suggest that taekwondo athletes use this position preferably because they react faster than in the 90° stance position and the execution technique is similar. So in the 45° stance position the performance and execution could be more favorable than in the 0° and 90° stance positions.

Moreover, Davids *et al* stated that constraints, such as different stance positions, should be studied as an inherent part of a performance that affects the motor system output. The results of this study show differences in the execution technique at the beginning of the kick due to the different stance positions.

That is, the stance position affects the execution technique. However, these differences disappear at the end of the kick, which makes us side with Davids *et al*, who stated that athletes adapt to constraints and their performance becomes similar in the end part of the execution. Results of this study suggest that taekwondo athletes are able to adapt their execution technique even if the stance position is different. Moreover, these future studies should analyze the relationship between the execution technique and the performance so that reporting practical applications based on empirical data. For decreasing the movement time, it's suggested that increasing the power and flexibility of lower extremities will be necessary.

5. Conclusion

According to the result of this report, experienced athletes are able to adapt their execution thus getting similar output at the end of the kick, that is, when the kicking leg impacts the target. Therefore, the stance position is a factor that affects the execution technique of taekwondo athletes kick so the stance position must be seen as a constraint to which athletes must adapt. In comparison of kick at 0° and 45° the kick performed at 45° stance position react faster than the kick perform at 0° stance position and Significant differences in kinematic data were found in front leg axe kick during 0° and 45° stance position at the beginning of the kick; these differences disappear at the end of the kick.

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