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SELECTED KINEMATIC ANALYSIS OF SIDE KICK TECHNIQUE OF ELITE WUSHU PLAYER

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ABSTRACT

The purpose of this study was to analyse on side kick technique of elite wushu player over selected kinematic parameters. For the study One International Wushu player who represents India was selected as a subject. All the selected kinematic parameters were recorded using 'Go Pro Hero 5 Black' motion capturing camera and data was analyzed by using silicon coach pro software. It was observed that the preparatory time increase compare to execution time in Wushu side kick. Contact velocity increases along with the increases of knee velocity. The contact velocity is highly correlated with execution time and knee velocity during the Wushu side kicking technique.
***Keywords:** Side kick, elite, wushu, kinematic parameters.*

1. INTRODUCTION

History said that there are many forms of martial arts which turn in to systematic combative sport. These include Judo, Taekwondo, Karate, Kick boxing, Mix Martial Arts etc. All of them have their own history and background but the motive behind their existence was almost similar. Wushu is one of the most important martial art among different types of self defence activities. Wushu was originated in China. The word Wushu was composed of two Chinese words "Zhi" which means "To stop" and "Ge" means an ancient weapon of war. "Wu" means that to stop conflict and promote peace (Jonathan, 2014; WUSHU, 2014).

Wushu was first introduced in India in 1989 with the efforts made by Late Sri Anand Kacker by formation of Wushu Association of India and gaining its popularity day by day with its thirty five units in all over India. He was also a founder General Secretary of the Wushu Association of India (Wushu Accociation of India, 2010; Jonathan, 2014).

In Wushu there are different types of techniques like kicking; punching, holding, throwing etc are used by players. A kick is a physical strike using the foot, leg, or knee. The side kick refers to a kick that is delivered sideways in relation to the body of the person kicking (Falco, Estevan, & Vieten, 2011). There are two areas that are commonly used as impact points in sidekicks: the heel of the foot or the outer edge of the foot (Gavagan & Sayers, 2017). The heel and outer edge of the foot is use to hard targets such as the thigh, ribs, stomach, jaw, temple and chest. So, when executing a side kick with the foot, the toes should be pulled back so that they only make contact with the heel and outer edge of the foot, not with the whole foot (Kim, Kwon, Yenuga, & Kwon, 2010; Lan, Wang, Wang, Ko, & Huang, 2000).). If a person hits with the arch or the ball of the foot, the impact can injure the foot or break an ankle. It is a flexible, powerful,

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very high speed, long-distance technique. It can be used for both defence and attack, and it is a primary means for gaining points in a Wushu Sanda competition (Green, 2001; Shouzhenge, 2006).

Depending on the point of impact, side kick can be divided into three variations (Serina, & Lieu, 1991). The 'low side kick' where the attacker kicked below the hip level means thigh, knee, calf etc of the defender. In the 'medium side kick', attacker kicks below the shoulder and above the hip level mean ribs, chest, stomach etc of the defender. When the player hit above the shoulder line of the defender, can be called the 'high side kick' (Sørensen, Zacho, Simonsen, Dyhre-Poulsen, & Klausen, 1996).

The first attempts made at delivering a scientific biomechanical description of the techniques performed in martial arts go back to research projects conducted in the 1970s and 1980s (Vos & Binkhorse, 1966; Blum, 1977; Walker, 1975). Those studies described kinematic aspects of strikes and analyzed the process of breaking hard objects with bare hands.

Description and analysis of a sports technique in relation to appropriate rules of biomechanics and with regard to its efficiency comprise the fundamentals of technical training which is directed at enhancing sport performance. This problem is of great importance in taekwondo, where a single strike might reveal the winner. In the Olympic Games, taekwon-do has been limited to sports combat whereas the traditional version of taekwon-do sports competition (International Taekwon-do Federation) comprises four competitive events, i.e. sparring, patterns, power tests and special techniques (Choi, 1983; 1995).

The power test involves breaking as many boards as possible by way of using a variety of strikes comprising two hand strike techniques and three kicking techniques, one of which is the side kick. The side kick (in wushu) is a technique in which athletes tend to declare the highest number of broken boards (Tsai, Gu, Lee, Huang, & Tsai, 2005; Shouzheng, 2006; Tsai, Huang, & Gu, 2007).). Thus, it is bound to affect the final score in each competition. Hence, the aim of this study was to investigate side kick biomechanical optimization on the basis of kick execution time and the foot and knee velocity values obtained.

2. METHODS AND MATERIALS

2.1 Subjects

One International player who represents India was selected as a subject of this study. Researcher considered three numbers of kicks from each of the low side kick, medium side kick and high side kick.

2.2 Tools Used

The data were recorded using one 'Go Pro Hero 5 Black' of high speed motion capturing video camera with tripod. Motion analysis software (Silicon coach Pro8), reference scale, steel tap, weighing machine, marker, light, cone etc. were used.

2.3 Experimental Protocol

The experimental data was collected through 'Go Pro Hero 5 Black' motion capturing camera. The recorded data was analyzed by using silicon coach pro8 software. The wushu player was filmed only from one angles i.e. sagittal plane. The camera was placed at a distance of 2.8 meters and the height of the camera (lenses) was fixed at a height of 1.15 meters from the ground level. Camera speed was set in 60 fps with 2.7K pixel of resolution.

2.4 Kinematics Parameters

- Preparatory Time
- Execution Time
- Knee Velocity
- Velocity of foot at contact

2.5 Data Extraction and Analysis

Data collected during the execution of side kick in Wushu were extracted. Brief review methods were used to synthesize the data and descriptive analysis of the data was conducted.

2.6 Statistical Analysis of the Data

The data for different selected parameters were obtained in the form of numerical scores using Silicon coach Pro8 software. Collected data out of movement analysis were statistically analyzed for getting results and drawing inference. Descriptive statistic of mean and correlation was employed. Statistical analysis was done using R-programming software.

3. RESULTS

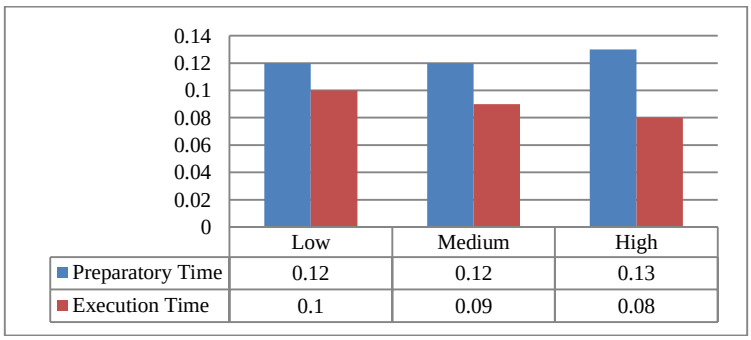
After recording of the movement the data were analysed by using the Silicon Coach Pro8 video analysis software. The Personal details of the subjects were recorded. The age, training age, height, weight, sitting height, total leg length, lower leg length, calf girth, thigh girth of the subject was recorded in the table 1.

Table 1: Personal details of the subject

Age (Yr)	Training Age (Yr)	Height (CM)	Weight (KG)	Sitting Height CM)	Total Leg Length (CM)	Lower Leg Length CM)	Calf- Girth (CM)	Thigh Girth (CM)
29	14	178	87.7	92	100	48	40.60	61.10

To achieve a certain preparatory time and execution time before kicking is necessary and the body also leans in the opposite direction of the kick. Preparatory time means when the knee lift in maximum height and execution time means after the knee lift maximum height to contact of side kick. So the preparatory time and execution time during kicking was recorded.

Figure 1: Mean value of preparatory time and execution time in deferent variation of side kick



The figure showed that preparatory time increased for high kick. But the execution time was decrease gradually from low to high kick.

With the increase of impact height the impact velocity increases. So, to observe the changes of velocity during impact, the knee velocity and contact velocity were observed. Obtained data were tabulated and presented in the Table 3**.**

Table 3: Mean knee velocity and velocity of foot at contact in deferent variation of side kick

Variation	Knee Velocity (m/s)	Velocity of foot at contact (m/s)
Low	3.81	4.09
Medium	5.25	6.38
High	5.95	6.48

The tabulated data indicates that both knee velocity and the velocity of foot at contact increases from low kick to high kick. It indicated that there is a correlation between the knee and foot velocity in each of the kicks.

Correlation between average contact velocity and the execution time achieved during the side kick was calculated. The knee velocity was highly correlated with the mean value of contact velocity of the subject. The calculated value has been tabulated in Table 4.

Table 4: Correlation of knee height and kicking leg height with vertical velocity of side kick

Variation	Execution Time	Velocity of foot at contact (m/s)	Knee Velocity (m/s)	Velocity of foot at contact (m/s)
Correlation		-0.88		0.95

4. DISCUSSION

The results of the study showed that preparatory time was increase due to need more time to lifting the knee maximum height from low to high side kick. The execution time was decrease due to high speed of contact. The knee velocity and contact velocity increased rapidly in low to high kick. The contact velocity was increase in comparison of knee velocity. It means that the knee displacement was less than the feet displacement at contact.

The result of the correlation indicated that in the both cases velocity of foot at contact increases significantly with the change in other two variables. This study was supported by Wasik (2011) conducted a kinematic analysis of the side kick in Taekwon-do. In his study the correlation dependence (r = 0.97) showed that a higher knee velocity significantly affects the velocity which the foot develops. On the basis of the study we can say that the velocity of foot at contact was highly correlated in the both cases.

5. CONCLUSION

On the basis of the discussion above following conclusions may be drawn:

- Preparatory time increases from low to high side kick and the execution time decreases in Wushu side kick.
- The preparatory time is more in higher kicks for the production of higher impact velocity in side kick.
- Velocity of foot at contact at impact is highly related with the knee velocity. That suggests a very good knee joint flexibility is important for side kick.

- The velocity of foot at contact is highly correlated with execution time and knee velocity during the Wushu side kicking technique.
- Longer time of preparation is required for a greater production of greater impact velocity in higher side kick in Wushu.

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