

## Mechanical Analysis on Side Kick of State Level Wushu Players

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### Abstract

The purpose of this study was to analyse the side kicking technique of State level Wushu players. For the study Three (N=03) state level Wushu players were selected. Their age ranges from 18-25 years. 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 knee height gradually increases with the increase of kick height, head position remains unchanged in all types of side kick, the vertical velocity of leg increases with the increase height of impact.

**KEYWORDS:** Wushu, Mechanical Analysis, Side Kick.

### Introduction

Wushu is one of the most important martial art among different types of self defence activities. There are many such 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. 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. It is one of the most adaptable kicks, useful as both an offensive move and as a defensive counter to a blitzing opponent. 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. The heel is more suited to hard targets such as the ribs, stomach, jaw, temple and chest. However, when executing a side kick with the heel the toes should be pulled back so that they only make contact with the heel and not with the whole foot. If a person hits with the arch or the ball of the foot, the impact can injure the foot or break an ankle. A standard sidekick is performed by first chambering the kicking leg diagonally across the body, then extending the leg in a linear fashion toward the target, while flexing the abdominals. The "side kick" is one of the most important kicking techniques in Chinese martial arts (Liu, 1983). It is a flexible, powerful, 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.

### Material and Methods

#### Subjects

For the purpose of the study Three (N=3) State players who represents Assam in was selected as a subject. Their age ranges from 18-25 years.

## 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 pro 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 of resolution. The Side Kick was divided in three types, Low Kick (Kick below the Hip), Medium Kick (Kick below the shoulder level) and High Kick (Kick on face, jaw, head etc. ).

## Biomechanical Parameters

- I. Max. Knee Height at Innominate phase
- II. Height of the Head at contact phase
- III. Height of the Kicking Leg at contact phase
- IV. Horizontal and Vertical velocity at contact

## Data extraction and analysis

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

## Statistical analysis of the data

Descriptive statistic of mean was employed. The data was analysed with the help of MS Excel 2007.

## Result and discussion

After recording the movement the data were analysed by using the Silicon Coach Pro video analysis software. The Personal details of the subjects were recorded. The Height and weight of the subjects were recorded in the table 1.

Table 1: Personal Details of the Subject

| Subject   | Height (cm) | Weight (kg) |
|-----------|-------------|-------------|
| Subject 1 | 177         | 80.02       |
| Subject 2 | 167         | 62.9        |
| Subject 3 | 170         | 61.4        |
| Mean      | 171.33      | 68.10       |
| SD        | ±5.13       | ±10.34      |

The above table shows that the mean height was  $171.33 \pm 5.13$  cm and the weight was  $68.10 \pm 10.34$  kg for the subjects. Their age ranges from 18-25 years.

To achieve a certain knee height before kicking is necessary and the body also leans in the opposite direction of the kick. So the maximum knee height during innominate phase was recorded. The height of the head from ground during impact was noted down during different types of kick.

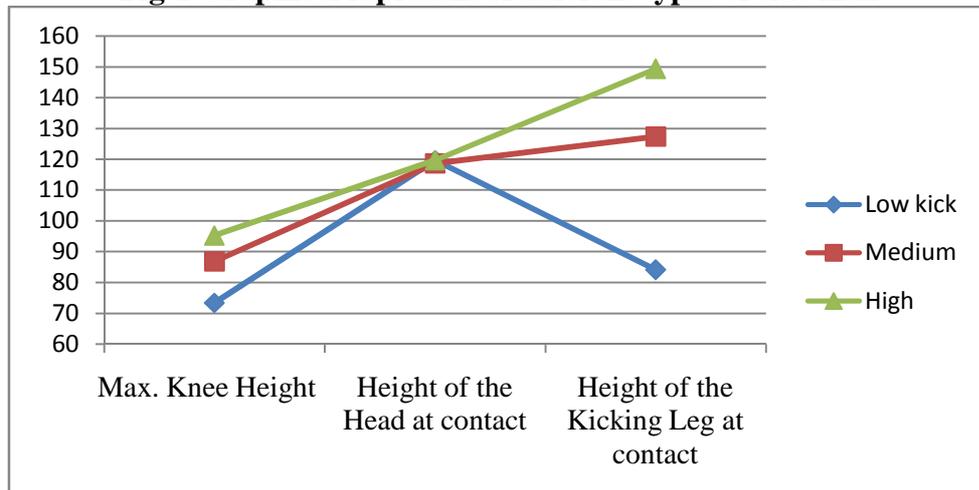
Table 2: Mean value of Max. Height of the knee, head, leg in deferent types of side kick

| Type   | Max. Knee Height (cm) | Height of the Head at contact (cm) | Height of the Kicking Leg at contact (cm) |
|--------|-----------------------|------------------------------------|---|
| Low    | 73.36                 | 119.7                              | 84.1                                      |
| Medium | 86.83                 | 118.66                             | 127.36                                    |
| High   | 95.23                 | 119.66                             | 149.26                                    |

The table shows the performance of the mean value of deferent types of side kick. It seems that the mean value of maximum knee height was 73.36 cm during Low kick and increased to 95.23 cm at high kick. This indicates that the knee height increases with the increase of kicking height. The height of the head during impact of kick remains similar in all type of kicking.

The phenomenon has been shown in Fig.-1 where these changes can be seen through line graph. It clearly shows the change in positions like height of Knee, head and kicking leg of the kickers in deferent types of side kick.

Fig-1 Graphical represent of deferent types of side kick



It seems that knee height should be gradually increased in low to high kick. It may be an indication that the low kick requires a lesser knee lift in the innominate phase. The height of the head remains in a same position in different types of side kick. With the increase of impact height the impact velocity might change. So, to observe the changes of velocity during impact, both Horizontal and vertical velocity were observed. Obtained data were tabulated and presented in the Table 3.

Table 3: Mean velocity at contact in deferent types of side kick

| Type   | Horizontal Velocity (m/s) | Vertical Velocity (m/s) |
|--------|---------------------------|-------------------------|
| Low    | 2.12                      | 2.28                    |
| Medium | 2.32                      | 3.57                    |
| High   | 1.88                      | 5.8                     |

The tabulated data indicates that the mean value of horizontal velocity was 2.12 m/s, 2.32 m/s and 1.88 m/s from low to High kick respectively. The vertical velocity at contact was 2.28 m/s, 3.57 m/s and 5.8 m/s at different contact points of side kickers. It seems that the vertical velocity increased rapidly in comparison to Horizontal velocity from low to high kick. It can be observed that the Vertical velocity was a determinant factor to gain the higher momentum of kick.

Correlation between average vertical velocity and the maximum knee height achieved during the innominate phase was calculated. The kicking leg height at impact was also correlated with the mean value of vertical velocity of the kickers. 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

| Type        | Max. Knee Height (cm) | Vertical Velocity (m/s) | Height of the Kicking Leg at contact (cm) | Vertical Velocity (m/s) |
|-------------|-----------------------|-------------------------|---|-------------------------|
| Correlation |                       | 0.95                    |   | 0.94                    |

It can be observed that in both cases vertical velocity increases significantly with the change in other two variables.

### Conclusion

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

1. Knee lifting at inominate phase increases with the increase of kicking height in side kick.
2. The head position remains unchanged in all types of side kick.
3. Maximum knee height is correlated with the vertical velocity of impact.
4. The vertical velocity of kicking leg increases with the height of impact.

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