

ANALYSIS OF THE **PRESSURE** DISTRIBUTION PATTERN AND THE CONTROLLING BALANCE DURING **KICK** MOVEMENT OF TAI-CHI CHUAN

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The purpose of this study was to compare the pressure distribution patterns of the stable kick and unstable kick from the kick movement of a Tai-Chi Chuan athlete. A national elite female Tai-Chi Chuan athlete was the subject for this study. The Tekscan HR Mat Pressure Measurement System was used to collect the vertical ground reaction force and the pressure history of the standing foot in right kicking movement and left kicking movement. All the data of the standing foot were divided into metatarsals, tarsals and phalanges to calculate the partial force and partial pressure. The pressure-time diagram of the phalanges, metatarsals and tarsals indicated that the pressure histories trended to be stable in each time as the left kick completed, and the phalanges produced 'snatchy' and larger pressures acting on the ground.

KEY WORDS: pressure distribution, balance, Tai-Chi Chuan

INTRODUCTION: Tai-Chi Chuan is the only world sports event from China, which embodies the good characteristics of the traditional Chinese martial arts and could infuse participants with the inimitable Chinese philosophical thought. Tai-Chi Chuan competition in Asian Games is in the form of performance through the required routine. Tai-Chi Chuan is different from the other kinds of Chinese martial arts. No quick jumping, powerful force and speedy rhythm are needed. Under the state of tranquilization, players try to combine body-mind as one through their mind to conduct Tai-Chi Chuan motions. Therefore, their actions should be light and smooth and become slow in order to experience the relationships between body and mind. Tai-Chi Chuan players need flexible bodies and strong legs to perform the routine. In all of the movements of Tai-Chi Chuan, standing on one foot and acting in another is the most difficult motion. For example, when kicking (Figure 1), the kicking leg in Tai-Chi Chuan is required to lift up and land down slowly, and the standing leg should stand still. Within the kicking period time, the standing leg should continuously have strength to keep body balance and to present it standing still. According to the Tai-Chi Chuan competition rules, lifting and landing the foot slowly, fluidly, and unfalteringly during kicking are required. But, the athletes cannot always have such a good performance and usually have deductions in score by this kind of movements. So, kicking and balance in Tai-Chi Chuan becomes the issue.

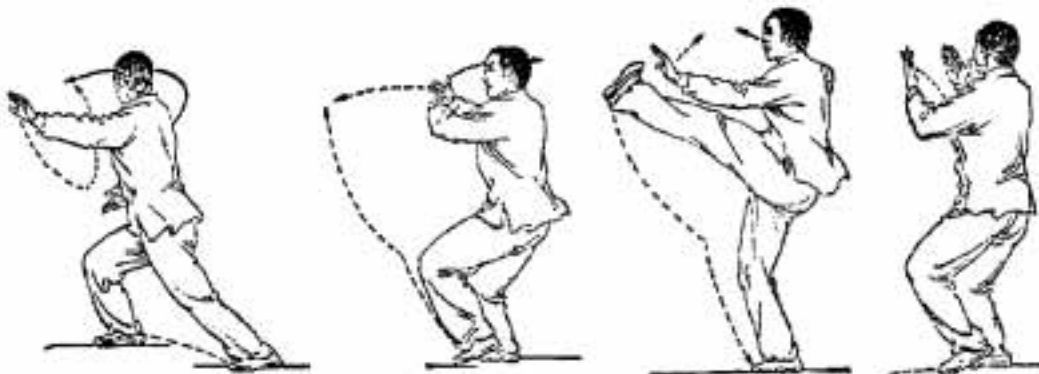


Figure 1 - A left kick movement.

Among the forty-two movements of Tai-Chi Chuan routine in Asian Games, there are seven movements standing on one foot and acting in another. The kick movement is one of the most typical of unstable equilibrium actions in Tai-Chi Chuan. For a kick movement, an athlete is required not to bend the knee joints both on the standing and kicking legs, to slowly kick over the shoulder height and to slowly land, too. Keeping the body balance and legs stable during the kick movement in Tai-Chi Chuan competition is very important because it

affects the score.

Tai-Chi Chuan masters believe that the foot is one of the most important key points about Tai-Chi Chuan training. Hsu, Shuan-Ping said that the foot was the third assistant (Chang, 1983). Chang, San-Feng said that the root of Tai-Chi Chuan movements is the foot (Wu, 1995). In fact, the foot of the standing leg supports whole bodies and keeps it on balance and stable. So, it is very important to know how the foot standing leg has strength within the kicking period of time. The purpose of this study was to compare the standing leg's foot pressure distribution patterns of the stable kick and unstable kick from the kick movement of a Tai-Chi Chuan athlete.

METHODS: A national elite female Tai-Chi Chuan athlete was the subject for this study. Her height, body mass and age was 160 cm, 47 kg and 35 years respectively. According to the subject's coach's expression and her feeling, it indicated that the athlete was often unstable on the left foot standing when kicking the right leg. The Tekscan HR Mat Pressure Measurement System was used to collect the vertical ground reaction force and the pressure history of the standing foot in the right kicking movement and left kicking movement. The sampling rate of the Tekscan System was 30 Hz, and the sampling time was 8.5 second. All the data of the standing foot were divided into metatarsals, tarsals and phalanges to calculate the partial force and partial pressure.

RESULTS AND DISCUSSION: In the topography of force, the force of the phalanges from the subject's right standing foot was larger than the left leg's. The pressure-time diagram (Figure 2) of the phalanges, metatarsals and tarsals showed that the pressure histories tended to be stable at the time the left kick completed, and the phalanges (line d of Figure 2a) produced 'snatchy' and larger pressures acting on the ground. A Chinese martial arts proverb states 'five toes grasping ground made as stable as mountain' (Wang, 1990). It might be the pressures from the phalanges keeping the right standing foot balance. In the right kick, the pressure history of the tarsals declined with the leg's lifting (line c of Figure 2b). It made the left heel rise from the ground before and after the time when the right leg kicked up to the maximum point (the arrow sign in Figure 2b). When kicking, having a rising heel was a big mistake to Chinese martial artists who need a stable standing (International Wushu Federation, 1991). In the period that the heel rises, the position of forces and the center of gravity were focused on the small area of the front foot, so it was not easy to keep balance on the left standing foot with small area while the heel was rising.

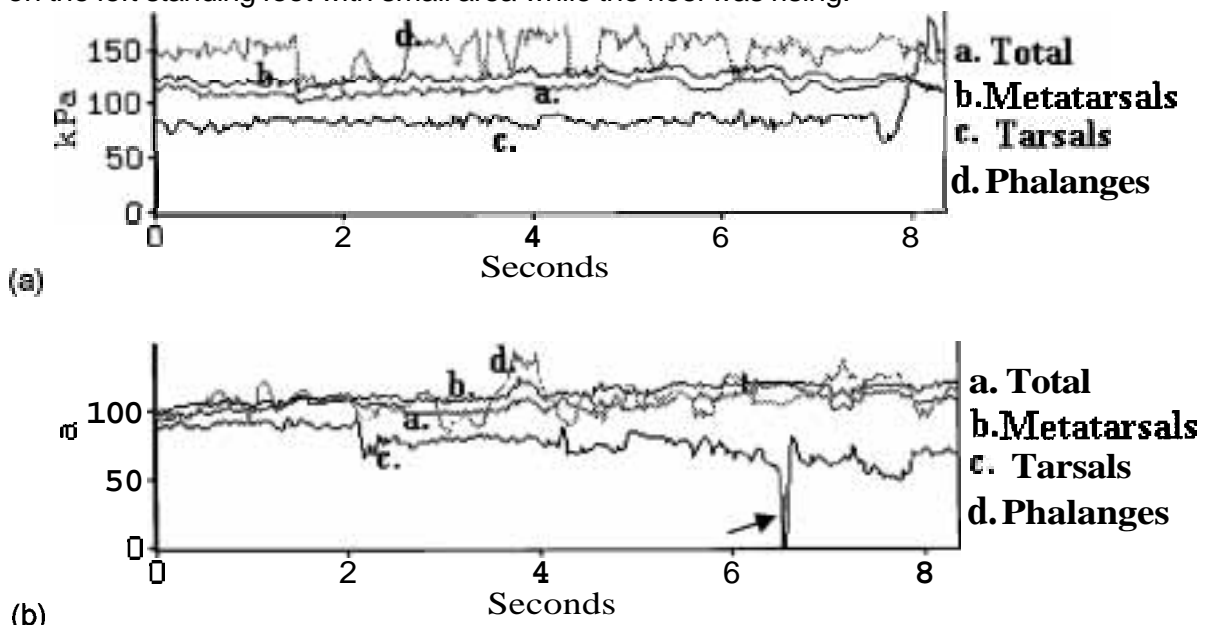


Figure 2 - A comparison of pressure distributions history in standing foot during a left kick (a) and a right kick (b).

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