

# CHANGES OF GROUND REACTION FORCE AND CENTER OF MASS IN BAGUA GAIT: A QUALITATIVE OBSERVATION.

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**KEYWORDS:** ground reaction force, gait, center of mass, Tai chi, Bagua

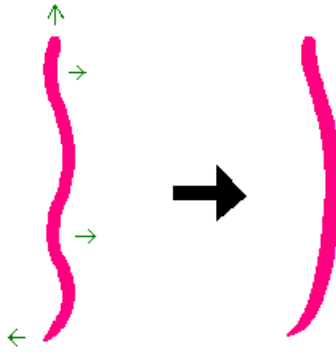
**INTRODUCTION:** Tai chi and Bagua are forms of Chinese martial art that consist of exercise techniques and self-defense disciplines. They are characterized by gentle, slow and continuous movements. The major difference between these two disciplines can be seen in the direction of movement. Tai chi is performed along a straight line, whereas the movements of Bagua are performed with practitioners walking around a circle with Bagua gait (Fig1). Both Tai chi and Bagua were employed as effective self-defense techniques in ancient battlefields before rifles and cannons were used in China. Today, many people practice it for sports, health and fitness, recreation and rehabilitation.



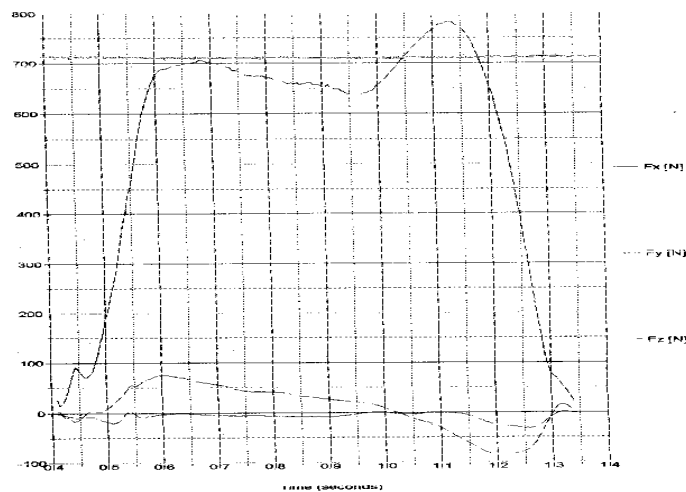
**Figure 1 - Body spiral, continuous movement along Tai chi Symbol with Bagua gait.**

Bagua gait differs from normal walking gait. The center of mass (COM) of the body in Bagua gait is always lower than that of normal gait. Practitioners can adjust their level of COM to meet individual requirements, obtaining different training intensity and degree of difficulty. The trunk posture should be maintained as illustrated in figure 2 during practice sessions. Furthermore, Bagua practice provides mental relaxation, should be performed at a constant and slow speed, and requires concentration on the technique. The COM should not move up and down or left and right. Finally, Bagua gait should adhere to the requirements mentioned previously for as long as possible throughout training. Based on Bagua master's experience, this training principle can help practitioners reduce energy expenditure during Bagua gait when sustained at a constant speed and at a certain COM height. The purpose of this study was to profile the kinetic characteristics of Bagua gait so as to provide scientific basis for this martial art form.

**METHODS:** The subject selected for this study is a male master of both Tai chi and Bagua. He was 32 years of age with a body weight of 70kg and height of 178cm. The subject has practiced Tai chi and Bagua for 10 years in his leisure time. The KISTLER force platform was used to collect the vertical ground reaction force (GRF) in one stride of Bagua gait with sampling rate of 1000Hz for 3 seconds.



**Figure 2 - The spin shape in normal gait (left) and Bagua gait (right).**



**Figure 3 - GRF pattern recorded by Kistler force platform during Bagua gait.**

**RESULTS AND DISCUSSION:** Figure 3 illustrates the GRF pattern of Bagua gait. Compared to normal ground reaction force, it was found that there were two peaks in GRF curve of Bagua gait. The first peak was lower than the second peak and it did not exceed body weight line. The second was similar to that observed in normal walking gait. The time from zero force to the concave was longer than that from the concave to zero at the end of the movement. Observation also showed that the second cliff was sharper than the first cliff. COM was kept relatively stable without rising and falling at a constant speed that was in line with the training principle of Bagua. It is obvious that the benefit of maintaining a stable COM would be a reduction in energy expenditure.

**REFERENCES:**

The National Sports Institute Committee of Textbook. Sports Physiology.  
 The National Sports Institute Committee of Textbook. Sports Biomechanics.  
 Qiu, S., Han, Y., & Yan, Z. Human Anatomy.