

# Chapter 85

## Model Analysis of the Impact on Physical Fitness of Taichiquan

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**Abstract** This paper first described the existing several types of Taichiquan and then analyzed the health effects of Taichiquan on the cultivation of the human body. Finally, through the automatic identification system of the Qualisys infrared light point, the paper made a mechanical analysis of the human upper body movement, looking for changes in law, which will play a crucial role for the carry forward of Taichiquan.

**Keywords** Tai chi • Tai chi culture • Qualisys • Kinetic analysis

### 85.1 Introduction

Taichiquan is a traditional martial arts project and has a long history in China, now developed into a sport, a fitness program, and favorite sports for the public [1]. Tai chi chuan is called Tai chi, covering spread from the I Ching yin and yang, movement of the reason, empty or full growth and decline of the machine.

China's Tai chi chuan has Chen style, Yang style, Sun style, Wu style, Wu style and Wudang, Zhao Bao, and other variety of genres. Among them, Chen style, Yang style, Sun style, Wu style, Wu style are the five schools of Chinese Tai chi chuan.

Chen style Taichiquan is ever-changing and invincible, although the movement trend is multiterminal outside from the virtual with open style. To be full open, not only hands, hearts of ideas along with open; to closure, not only the hands to the foot together, hearts and the idea with both together. A move of a potential, where the self with the want to move charmed under who want to move on from the collar of God to go where up and down action in the central and God coordinate, where the desire to move up and down the auxiliary ancestral connected both inside and outside, before and after the phase required, the actual situation of the

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**Fig. 85.1** Chen style tai chi

opening and closing totally together, and the force will naturally rapid and clever. Chen Taichiquan standard movements are as follows: Fig. 85.1

Yang style tai chi is very beautiful; its frame stretches zhongzheng, action and simple and smooth, soft AIDS, in one take, like the lake on light spirit calm both. Its methods are concise, by the general public's favorite, and are also the most popular. Young's action requires the emerging of Taichiquan along Yangtze River with its words pouring out [2]. The action is complete, but the next action's beginning is sequential. The method also needs one take. The movements are as follows: Fig. 85.2.

Accord with tai chi theory of Yin and Yang, Wu style Taichiquan mainly includes the following aspects: GongJia compact, quiet nature, recruit potential



**Fig. 85.2** Yang style tai chi



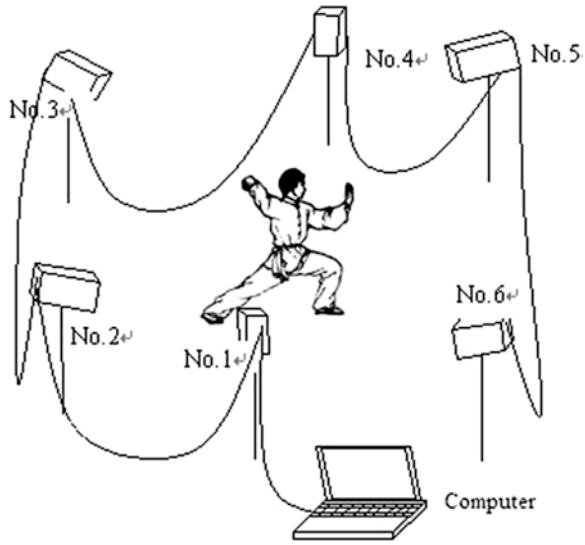
**Fig. 85.3** Sun-style Taichiquan

strictly, exquisite soft continuous. Wu style Taichiquan, according to the comprehension and exercising, is in tight quan type small compact, set physical, self-defense, cultivate one's morality as a whole, and more suitable for uniting the literati of Tai chi chuan, and future generations called Wu style tai chi. Practice with the change of the requirement to control the movement of appearance emphasizes walk and not uncover strength inside the appearance, in order to reach the people and not hurt the magic of the state. Wu style Taichiquan melts with the Confucian culture, and Taoist traditional Chinese medicine health care, health care, martial arts physical at an organic whole have increased longevity, illnesses and health, beauty educational model body effect. Often, Wu style practice Taichiquan can effectively "ease the mental stress, remove physical disease," to treatment, and chronic fatigue syndrome has remarkable effect [3]. All Wu style tai chi in spirit, the solid frame and easy and comfortable, posture dignified, the momentum of the move STH, open, compact have exquisite. Sun-style Taichiquan characteristic is a go, stretch round live, action quick, a change of direction as close to connect with, so it is also called "live close step Taichiquan," is the three sent swords, creating Sun-style tai chi Fig. 85.3.

## 85.2 The Qualisys Infrared Light Automatic Identification System

This trial uses infrared light Qualisys automatic identification system collection of tai chi of athletes' action; its main use is the Qualisys—MCU 500 type of high-speed video image motion capture video camera. This set of equipment is composed by the Motion Capture Unit, target, and the camera has the computer and the corresponding software component. Specifically, see Fig. 85.1. The infrared high-speed camera work principle is: the goal of infrared radiation on environment, and the camera to the target of reflected light; at this time, the computer

Fig. 85.4 Qualisys testing system test site schemes



system can detect the target corresponding numerical. Therefore, the equipment can obtain the accurate complex 3D-movement of sports information [1] and then select Taichiquan quan for dynamic analysis Fig. 85.4.

### 85.3 The Experiment Process

Step 1: put the camera as required below besides Tai chi chuan athletes [4]:

- (1) Camera distance: the distance between the high-speed cameras is 15 m, each camera from goal 10 m far.
- (2) Camera height: each camera body height is 1.5 m.
- (3) Camera angle between the adjacent: the camera angle between adjacent and 45°.

Step 2: athletes of Taichiquan movement test.

In the upper body, Taichiquan athletes can produce the reflection of the markers, and then in the test, to complete the qualified Taichiquan athletes each act, each test the movements to achieve the fundamental requirement just calculate, through, and the action taken by the camera Taichiquan completely recorded before [2].

Step 3: Data collection

The whole process of Taichiquan was recorded using cameras, and then signal conditioning was carried out followed by transmission of data to the data acquisition card, which in turn will signal the number (A/D) to the computer, and the computer program operation and treatment will eventually display the data on the screen.

Step 4: Qualisys index selection, as is shown in Table 85.1:

**Table 85.1** Qualisys index selection

Name	Description
Sacral vertical height	Sacral vertical ground levels
Sacral level speed	Sacral level speed
Torso angle	Angle of torso vertical and the ground
Thoracic curvature	Thoracic sagittal alignment projection curvature
Lumbar curvature	Lumbar sagittal alignment projection curvature

### 85.4 Taichiquan Movement Analysis

This paper chooses X-axis for the human body shoulder the positive direction left for the right shoulder to the left shoulder for, and the Y-axis for the vertical direction, then we can get the following formula [5]:

$$L_1 = (x_2 - x_1)i + (y_2 - y_1)j + (z_2 - z_1)k$$

$$L_1 = \begin{bmatrix} x_2 - x_1 \\ y_2 - y_1 \\ z_2 - z_1 \end{bmatrix} \tag{85.1}$$

$$L_3 = (x_4 - x_3)i + (y_4 - y_3)j + (z_4 - z_3)k$$

$$L_3 = \begin{bmatrix} x_4 - x_3 \\ y_4 - y_3 \\ z_4 - z_3 \end{bmatrix} \tag{85.2}$$

Shoulder midpoint, hip midpoint

(1) According to mechanical relationship, we can get the following formula: The human body is the human body sagittal of x-axis and human body vertical-Axis vector product after pointing,  $L_2 = L_1 \times L_3$ .

$$L_2 = L_1 L_3 = \begin{bmatrix} 0 & -z_3 & y_3 \\ z_3 & 0 & -x_3 \\ y_3 & x_3 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ y_1 \\ z_1 \end{bmatrix} = \begin{bmatrix} z_3 y_1 + y_3 z_1 \\ z_3 x_1 - x_3 z_1 \\ x_3 y_1 - y_3 x_1 \end{bmatrix} = \begin{bmatrix} x_2 \\ y_2 \\ z_2 \end{bmatrix} \tag{85.3}$$

(2) Based on the xyz-axes of the human upper body, we can determine the plane equation [6]:

X-axis is the normal vector of the plane equation:

$$X_3 + y_3 y + z_3 z + D = 0 \tag{85.4}$$

Y-axis of the plane equation:

$$x_1x + y_1y + z_1z + D = 0 \tag{85.5}$$

Z-axis vector of the plane equation:

$$x_2x + y_2y + z_2z + D = 0 \tag{85.6}$$

D contained in the above equation is used to determine the coefficient of the plane location, and generally is 0.5–1.

(3) Analysis of test results

Athletes in the tai chi used to fill the gap of the word to describe again the state of the sacrum up and down, and the paper uses Qualisys test system to get test results as follows: Figs. 85.5, 85.6, 85.7, 85.8, 85.9.

Then for athletes in the tai chi on the degree of tilt of the upper extremity to make the data analysis:

Finally, we improve the performance of the athletes' lumbar and thoracic spine in the tai chi. And the curvature changes is shown as below:

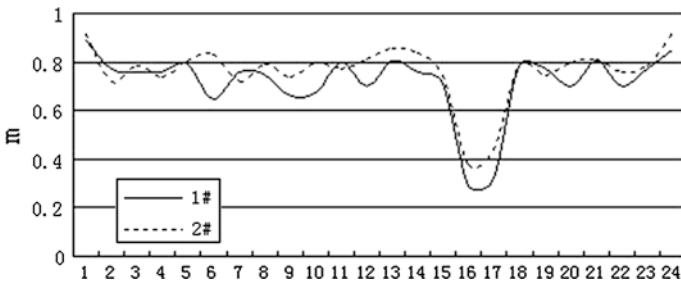


Fig. 85.5 Sacral ups and downs movements

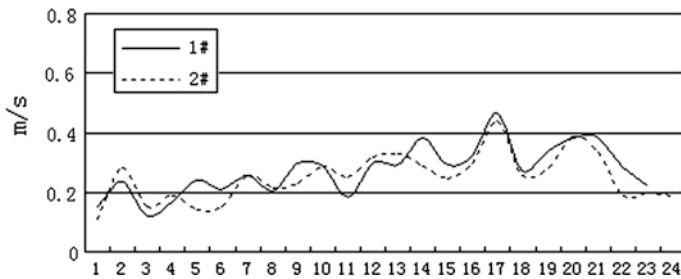


Fig. 85.6 Sacrum ups and downs with its movements

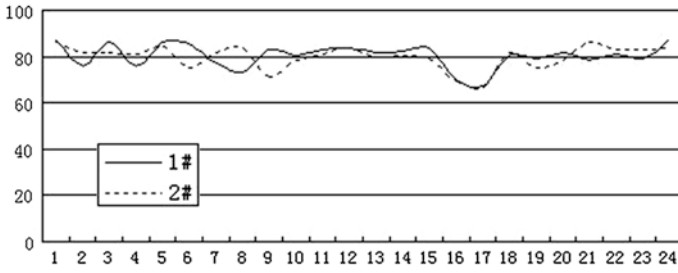


Fig. 85.7 Upper limb inclination changes

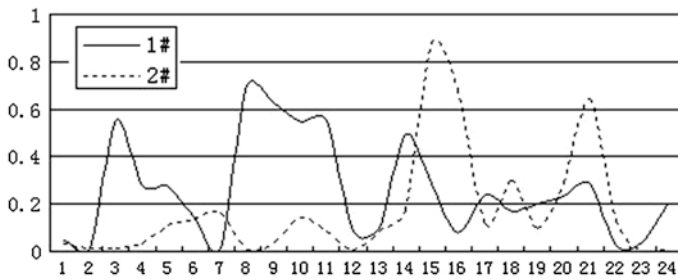


Fig. 85.8 Changes of the lumbar curvature

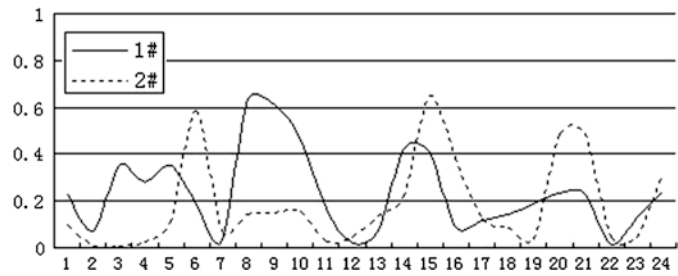


Fig. 85.9 Changes of the thoracic curvature

### 85.5 Conclusion

Through Qualisys test systems, this paper analyzes the sacrum of tai chi athletes, trunk, vertebral, thoracic, and lumbar spine related changes in the data. From the data, it is very obviously good for health care functions in human physical effect by exercise Taichi.

## References

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