

A Study on the Body-Building Values of Daoyin Illustration in Light of Neurophysiology

從神經生理學觀點探析馬王堆漢墓〈導引圖〉的健身價值

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Abstract

Daoyin Illustration, with 44 Daoyin postures unearthed from the Western Han Dynasty Tomb III at Mawangdui in Hunan Province, China, is the earliest body-building Illustration found by Chinese archaeologists. Other ancient Chinese sports of DaoyinShu, such as Wuqinxi, Baduanjin, Yijinjing and Taijiquan, were the results of evolution and development of Daoyin Illustration according to their dates of appearance and movements. The people in ancient times practised them, combining the movements of body and limbs with breathing and therapeutic treatment with keeping fit and motion with tranquility in order to keep the harmony between Yin and Yan. From the viewpoint of neurophysiology, the central nervous system (CNS) receives the inputs from all of the organs and tissues, which bring the information of changes in the external and internal environments. The information from contractions and stretches of muscles and tendons inputted by thicker afferent fibers can inhibit and adjust the activities of internal organs controlled by thinner nervous fibers. All inputs interact with the changes in external and internal environments and be in harmony with them. This is the process of the central integration. The value of Daoyin Illustration in building up health is to maintain the internal homeostasis through moderate movements of the body and limbs to affect the activities of the internal organs.

摘要

馬王堆漢墓〈導引圖〉是我國考古發現中時代最早的健身圖譜，共有四十四個術勢。從出現年代和動作結構分析，它的導引術如五禽戲、八段錦、易筋經、太極拳等是從〈導引圖〉繼承和演化而來。古人操練這些動作是通過肢體運動與呼吸結合，治療與健身結合，動靜相結合以求陰陽平衡。從神經生理學觀點來看，中樞神經系統接受來自所有組織與器官發來的衝動，這些衝動帶來了關於外環境變化和自體機能狀態即內環境變化的信息。體表下軟組織（特別是肌肉與肌腱的收縮和牽張所引起的）由較粗神經纖維的傳入電衝動，對於較細神經纖維所支配的內臟器官的活動有某種抑制與調節作用。各種信息在中樞神經系統內相互作用，相互制約，以確定最後的反射活動，使有機體適應體內外所發生的變化，以維持有機體與環境的平衡，這就是中樞整合過程。馬王堆漢墓〈導引圖〉所體現的健身價值就在於通過適當的肢體運動以影響內臟活動，調理機體內環境的穩定平衡。

Introduction

Daoyin Illustration of movements to keep fit painted on silk, was unearthed from the Western Han Dynasty tomb III, at Mawangdui, Changsha, Hunan Province, China, in 1973. It is 110 cm by 53 cm, with 44 figures demonstrating Daoyin postures and the figures are 9 to 12 cm in height. Daoyin Illustration is the body-building illustration of the earliest age found by Chinese archaeologists so far (Zhou Yi Mou, 1988) (from 206 B.C. to A. D. 23, about the initial stage of Chinese Western Han Dynasty). However, Daoyin Illustration was never mentioned in other popular traditional Chinese body-building sports. Now, according to the movement features of Daoyin Illustration, we probe into its values in building up health, especially from the viewpoint of neurophysiology.

The Movement Features of Daoyin Illustration

According to the introduction to a tourist guide map of the Mawangdui Western Han Dynasty tomb (He Jie Jun, 1982) Daoyin Illustration shows three kinds of movements; the movements for treating some diseases, the movements imitating animals' activities and daily life movements.

Zhou Shi Rong (1980) has thus summarized his study of the features of Daoyin Illustration. For example, most people who practised Daoyin were the common people. Daoyin movements of the body and limbs included 8 essential movements of modern setting-up exercises to radio music. Sticks, balls, discs and bags were used as sports apparatus. Daoyin combined different ways of respiration, traction and massage. Daoyin aimed at the prevention of diseases combined with the treatment of disease and the dynamic Gong with eye activities combined with the static Gong with closed eyes and there were movements of 8 kinds of animals etc.

Shen Shou (1989) however, put forward that the different movements of Daoyin Illustration were classified along the "Channels" (the routes distributed over the whole body according to the theory of traditional Chinese medicine) on the basis of Yin and Yang (the two fundamental principles or forces in the body, ever opposing and supplementing each other) of 11 "Channels". On the Illustration, the vertical sets of 4 postures each from top to bottom, correspond to the 11 "Channels". It was indeed a rare case for the sets of Daoyin postures to apply the theory of "Channels" and to combine with the 11 "Channels" and the seasons respectively as did Daoyin Illustration.

On the basis of the above-mentioned comments we would like to supplement observations on the features of Daoyin Illustration as follows:

1. There were men and women, old and young among the 44 figures on Daoyin Illustration. Most of them were common people according to their dress style. Thus it can be seen that Daoyin exercises were very popular at that time.
2. The movements involved all parts of the body and most of them were activities of the arms (39 postures). Half of the postures involved movements of head, body and legs. Thus it can be seen that building up all parts of the body was under consideration at that time.
3. Using Sticks, balls, discs and bags to practise Daoyin exercises was conducive to finishing the movements perfectly. For example, holding sticks allowed the arms to stretch as far as possible; looking at balls and discs could focus the exerciser's attention; most of the men took exercises barefooted and barebacked, which, might be conducive to generating power. Thus it can be seen that people in ancient times regarded taking Daoyin exercises most seriously.
4. There were about 9 postures imitating animals' movements. Thus it is shown that people in ancient times wished to have strength and endurance as tigers and bears and speed and nimbleness as deer and birds as a result of taking the exercise.
5. Wuqinxi (A.D.150), Baduanjin (A.D.1117), Yijinjing (A. D.1624) and Taijiquan (A.D.1644 to A.D.1911), which had been well-known long ago, had lots movements the same as or similar to those shown in Daoyin Illustration. Thus, it can be seen that they originated and developed from Daoyin Illustration, had the same purpose as Daoyin Illustration i.e. to keep fit and treat diseases, and reflected the philosophic thinking of Daoyin in the beginning of Qin Dynasty. It is thus evident that the influence of Daoyin Illustration was indeed most amazing.

Appraising the ancient conceptions of building up health from Daoyin Illustration

In the light of historical records, the ancient traditional Chinese thinking of health preservation and the arts of body building originated from Xia, Shang and Western Zhou Dynasties (Bi Shi Ming, 1989) (21st cent. B.C. -771 B.C.). It was elucidated in "Shang Shu. Hong Fan" and "Yi Jin", two ancient Chinese classical, historical and philosophic books that human beings used Eight Diagrams and Sixty-four Diagrams to explain the waxing and waning of Yin and Yang. It means that people should utilize laws of nature to keep fit. In the time of spring and Autumn period and Warring States (770B.C.- 221B.C.) the conception of "building up health through exercises" put forward by Xun Zi, incorporated the important thinking, in the origin of ancient Chinese Sports theory, which embodied the correct understanding of the functions of exercises. The period marked the formation of the viewpoint that the movements should be

combined with tranquillity in order to keep fit. At that time the ancient Chinese DaoyinShu was a way of doing exercises still in an embryonic stage that mainly required the movements of the body and limbs in coordination with respiration.

According to Li Yi's explanation of "Zhuang Zi. Ke Yi", an ancient Chinese philosophic book, DaoyinShu demanded the coordination of respiration and slow and lithe movements of body and limbs with the aim of directing "Qi" to uphold harmony guiding the body to induce flexibility.

Hua Tuo, a famous physician in ancient China, held that the human body needs physical exercises, but one must not exert oneself to the extreme. Motion promotes digestion and absorption, helps smoothly blood circulation and thus no disease occurs. This is just like a door-hinge which never gets worm-eaten with constant motion.

It was written in "Huan Nan Zi. Jin ShenXun", an ancient Chinese philosophic book, that "all things in the world bear Yin behind and embrace Yang in front, and conduct Qi (vital energy) to keep the harmony," with harmony there is balance between Yin and Yang. The relationships of the functions in the human body are just like the contradictory movements of Yin and Yang in the unity of opposites. If the harmony between Yin and Yang is breached, the function of the body will be in disorder and Qi and blood circulation will come abnormal.

Taijiquan was also created for the purpose of letting a person keep fit. Taiji derived from "Wu Ji Tu", a book of Taoism on health preservation. The features of its movements were that "motion generates Yang, extreme motion will bring tranquility, extreme tranquility will generate Yin, which will again bring motion, motion and tranquility transform into each other".

According to the above-mentioned quotations the quintessence of ancient Chinese thinking on body-building can be summed up. Thus, people take exercises combining the movement of the body and limbs with the respiration, the treatment of diseases with keeping fit and motion with tranquillity in order to keep the harmony between Yin and Yang. From the beginning, while practicing Chinese gymnastics, people in ancient times paid much attention to the worth of sport in the treatment of disease, while not simply considering it as a way to build up their strength and physique or as a means to succeed in grappling, or as a game to play, nor and as an activity to prepare themselves for a contest.

"Huang Di Nei Jin", the first ancient Chinese book on physiology, medicine and health preservation, emphasized that "prevention precedes treatment" and considered DaoyinShu as

a therapeutic art. It means that the abnormal functions of internal organs could be corrected by the different activities of the body and limbs. Baduanjin, a set of gymnastics appearing in the Jin Dynasty (265-420A.D), paid much attention to the functional training on the internal organs, including the heart, liver, spleen, lungs, kidneys and stomach, etc.. Why are the exercises of the body and limbs called "DaoyinShu"? It means that the latent energy of self-adjustment in the body can make the abnormal functions of organs return to normal, but it has to be inducted before it plays the function adjustment. The different movements of the body and limbs coordinated with the respiration, massage and dancing were just the techniques to induct the latent energy.

Daoyin Illustration showed the ancient gymnastics in detail and most of the figures had words beside them to explain the intentions of treatment. Even when there were no words to explain in a few of the pictures, the aim of treatment could be seen obviously from the postures. Thus the ancient DaoyinShu is the forerunner of the modern physiotherapy. However, there are completely different aims of the development of physical culture between ancient Greece and ancient China. The aim in ancient Greece was to build up people's physique so that they could defeat the enemies and preserve themselves in wars, while they could win triumphs over their opponents in sports contests during peaceful times. The early Olympic Games in the West developed along this line. "Theory of surplus energy" put forward by Schilless (18th century) and Herbert Spencer (19th century), which expounded the origin of sport, were in concert with the above view (Yan Shao Lu, 1990).

The above-mentioned views, however, were not the only ones. A gigantic gymnastic sport most occurred in Europe during 19th century. Pehr Henrik Ling, of Sweden, created a set of therapeutic gymnastics to correct abnormal parts of the body. Francisco Amoros, of Spain, believed that practicing gymnastics not only makes one brave and firm, but also brings good health and a long life, and improves the functions of the body. Phakion Clias, of Switzerland, studied the therapeutic gymnastics particularly and made up a set of gymnastics to develop one's body and mind in an all-round way. In the late 19th century and the early 20th century, Sechenov I.M., of Russia, put forward the idea that a person was a whole being. Taking exercises could strengthen man's muscles as well as his endurance, while, the blood circulation and respiration of the body changed accordingly, Ling gymnastics specially mentioned above exerted a great influence as it spread all over Europe, the America and Japan. Many sports historians, however, believed, that Ling gymnastics found its basis on ancient Chinese therapeutic gymnastics (Pan Hua, 1989). Another example is that an English doctor who translated a book into English as described by Gao Lian in "Zun Sheng Ba Jian". This book included eight essays on the importance

of health preservation in Ming Dynasty (A.D. 1368-1644). The translation spread in the West as time went on (Zhou Shi Rong, 1980). Thus it can be seen that the view on keeping fit as described by Daoyin Illustration appearing long before 2000 years had quite a reliable scientific basis and was formulated much earlier than those in the West, and had a great influence on the development of modern sport.

The modern concept of the mechanism of building up health

With the accumulation of research achievements of social and natural sciences, people have thorough knowledge of what exercise can do for keeping fit and why taking exercises can build up physical and mental health? We put forward the following mechanism of keeping fit and want to discuss about it with others.

The general theory of keeping the internal homeostasis

The human body consists of cells whose structures and functions are highly differentiated. However, the human body lives in the environment as a whole not as a single cell or a sub-unit. There must be interaction among the cells and the cells are certainly in contact with the environment in which they live. The cells have to get nutrition from the environment and eliminate metabolite at same time, but the cells cannot be in direct contact with the external environment. The extracellular fluid appears in an animal's body with biological evolution and the fluid environment in which the cells life begins to form. The cells exchange materials with the fluid environment and then the fluid environment exchanges materials with the external environment. It means the extracellular fluid is a medium between cells of the body and external environment to maintain the homeostasis of chemical composition in the cells. The physical and chemical features of the extracellular fluid, e.g. osmotic pressure, pH, nutrient and metabolite, etc. are at a stable level and change within a certain limit to maintain the life-activities of cells and the body. It was Claude Bernard, who noticed 100 years ago that the internal homeostasis was the first condition for free and independent life (Wu Xiang, 1996). The internal homeostasis is not fixed but a dynamic equilibrium because all materials continuously change, Cannon W.B. called the dynamic equilibrium "Homeostasis". Actually homeostasis is the description not only of the physical and chemical features of the internal environment but also of the functions of the cell, organ, system and body, whose activities often maintain the dynamic equilibrium with the internal and external environments. The functions of the human body, always as a whole, adapt to the changes of the internal and external environments. The adaptable reactions include two parts of activities, activities of the motor system and visceral

system which coordinate and condition each other because the activities of the motor system are bound to change the metabolism in the human body, thus affecting the internal homeostasis.

The maintenance of the internal homeostasis during exercise

The metabolism, oxygen requirement and consumption in the body increase during exercise. Around the provision of oxygen, the regulative activities of the internal organs are as follows: (1) Redistribution of blood flow. During exercise, the major portion of blood flow is diverted to the heart, lungs and active muscles, while that to the viscera, inactive muscles and skin is significantly decreased. The change of proportion of blood flow to organs is regulated by the vasodilatation and vasoconstriction, which are affected by the mechanical stretch, local metabolites and the autonomic nervous system. (2) The change of cardiac output and pulmonary ventilation. Owing to the increase in exercise intensity, the minute oxygen requirement increases so that cardiac output, ventilation and tissue capacity of using oxygen have to be improved, which are affected by many factors and are regulated by complicated mechanisms. Besides the conditioned reflex before exercise, the outputs of the cerebrum to the hypothalamus and lower brain stem enhance the activities of the cardiovascular and respiratory centers when exercise starts. The depressor reflex, chemoreceptor reflex, hormones and local metabolites also participate in the regulation. In addition, the feed-back inputs of proprioceptors can regulate the activities of the central nervous system (CNS). (3) The higher intensities of exercises can result in the accumulation of lactate in the body and the decrease in pH. Thus the physical and chemical features of internal environment undergo changes. The body has to restrict the decrease in pH by buffering, eliminating and oxidizing lactate. The temperature, inorganic salts and fluid have a lot of changes during exercise. The temperature has to be regulated by the increase in the heat loss and sweating, and inorganic salts and vitamin should be supplemented. Nervous and neural-humoral control mechanisms also play their parts in the course of the regulation.

Integrative action of CNS

The scientific research in neurophysiology indicated that the upper parts of the brain, broadly speaking, were a collection of a lot of upper neurons which dominated the neurons that directly received the excitation from the receptors and effective apparatus, including mid-brain and cerebellum. Their functional activities can change and conjoin the variant reflexes, and determine the new types of reflexes. The functional activities of these parts normally connect the action of cerebra.

Thalamus, corpus geniculatum and pulvinar are the structures that conduct the stimuli from all sensational systems to cerebra.

Hypothalamus can receive the excitation from the thalamus and the cerebra and then acts on the autonomic nervous system. In general, because of participation of the tween-brain in reflective action, harmony of visceral reflective activities or between visceral and motorial reflexes becomes complicated. For example, sham rage reflex has a series of coordinative activities among motorial, cardiovascular and gastroenteric reflexes, elements of blood, eractoes pili, and adrenosecretion. More and more activities and functions of the human body should be controlled by the cerebral cortex along with the evolution of the brain. The cerebral cortex is the controller and manager of all activities of the body. In the 1950, it was in the book "Cerebral Cortex and Visceral Organs" that Bykov K.M, a Russian physiologist, testified to availability of forming conditioned reflexes of visceral activities according to the fundamental theory about forming conditioned reflex. The CNS receives the inputs from all tissues and organs to the upper parts of nervous system and inputs are just the information about functional status of the body and regulations of physiological processes. The information influences each other in the CNS. Interoceptive information not only arouses a change of vegetative function, but also affects a change in somatic motion. For example, stimulation gastoreceptors and intestinoreceptors can lead to the contraction of limbs' muscles. The facts about the interrelation between somatic and visceral functions continued to be certified after the research of Bykov K. M. (Hua Guang 1955). Stimulating anterior area of cerebra which relates to motion can arouse the contraction of muscles, meanwhile it can change the cardiovascular activity. The pyramidal system has directive routes from cerebra to parasympathetic and sympathetic nervous system. That the action of sympathetic vasodilative fibers can be aroused by motive area of cerebra was approved. It is also certified by experience that when muscles contract, some receptors in muscles input the information of movements by myelinated fibers and unmyelinated fibers to the nervous center and arouse the sympathetic vasoconstrictive center and respiratory center to exciting. After exercise the heart rates extraordinarily depresses within 1-2 minutes because of the sudden decrease and disappearance of inputs from the muscles.

At the end of the 1960s and the beginning of the 1970s Chang Hsiang-Tung(1973) promoted a hypothesis about the interaction of various inputs in the CNS by studying the mechanism of acupuncture for analgesia, which had been used to explain why acupuncture could ease pain. The inputs (by thicker afferent nervous fibers) from the deep tissues of the body (muscles) inhibit the inputs (by thinner afferent nervous fibers) from the pain source areas in the CNS. The pain integrative function proceeds at thalamus. The interaction between thinner fibers and thicker fibers not only can inhibit the pain, but also can regulate the visceral functions to keep the physiological homeostasis. According to many years of studies (David P.C), the information from contractions and stretches of muscles and tendons input

by thicker afferent fibers could inhibit and adjust the activities of internal organs controlled by thinner nervous fibers. All inputs interact with and condition each other in the CNS to decide the final reflections so that the human body can fit in with the changes in external and internal environments and be in harmony with them. This is the process of the central integration. This hypothesis happened to coincide with the theory of Bykov K.M. Both can provide some modern neurophysiological scientific bases for the treatable effect of Daoyin Illustration. Besides the relative activities of the CNS, the chemical regulative way is not ignored. During exercise, the metabolism rises, the oxygen consumption increases and the carbon dioxide accumulates so that the internal chemical environment have to be changed, which can be adjusted by the automatic control mechanism of chemoreceptors to change the respiration, heart rates and activities of endocrine system in order to maintain the internal homeostasis.

The above-mentioned modern viewpoint on building up health has been shown in Daoyin Illustration. That is exactly the important worth of Daoyin Illustration in building up health. For example, there is one posture on Daoyin Illustration, a woman holds a long stick and bends to the right side, extending her arms as far as possible. There some words beside this posture: "Communication of Yin and Yang". The words have been thus explained: "the stick pointing to the sky means Yang, and its pointing to the ground means Yin". That is merely a superficial explanation. We presume that the real meanings of Yin and Yang are hypofunction and hyperfunction. "Communicatin of Yin and Yang" means that the visceral functions can be regulated by the movements of the body and limbs. The hyperfunctions are inhibited and the hypofunctions, on the other hand, are excited to keep the balance of Yin and Yang. It just means those movements of body and limbs drawn in "Communication of Yin and Yang" posture are of use for keeping homeostasis and for correcting the deviations of body functions. Explaining from this viewpoint the regulation of blood pressure, the patients of either hypotension or hypertension can take the slow and mild exercises to make their blood pressure stable.

From the viewpoint of neurophysiology, the claims of Daoyin Illustration unearthed from the Western Han Dynasty tomb III at Mawangdui in Hunan Province, China, and of other DaoyinShu, writings in ancient Chinese medicine books "to be able to regulated the Yin and Yang and build up health and wellness" simply means that the proper movements of body and limbs can affect the visceral activities and regulate the internal homeostasis, so as to build up health and treat diseases.

Conclusion

From the viewpoint of neurophysiology, probing into the

values of Daoyin Illustration in building up health and giving treatment we would like to explain that traditional Chinese Daoyin Illustration and other ancient exercises, developed from Daoyin Illustration, such as Wuqinxi, Baduanjin, Yijinjing and Taijiquan, were created from the Chinese people's long-time practice in life and labour. All of them have two purposes: building up health and treating diseases. They are a part of excellent cultural heritage of Chinese nation. Daoyin Illustration is not only the earliest building up Illustration of all traditional Daoyinshu discovered so far, but also a precious physiological and historical document on building up health, that is well worth exploring.

The discovery of Daoyin Illustration indicated that the ideas of building up health and physiotherapy had budded in the land of China a long time ago. It should not be limited to treating diseases and rehabilitating the disabled just as the physiotherapy of the West (Yan Shao Lu, 1992). Let us substantiate and develop the precious cultural heritage through using advanced means and modern research achievements in order to guide and promote the body-building sports for the entire population.

Notes:

Yin: quiet, internal, downward, descending, cold, dark, fading, depressive, inhibiting, visible.

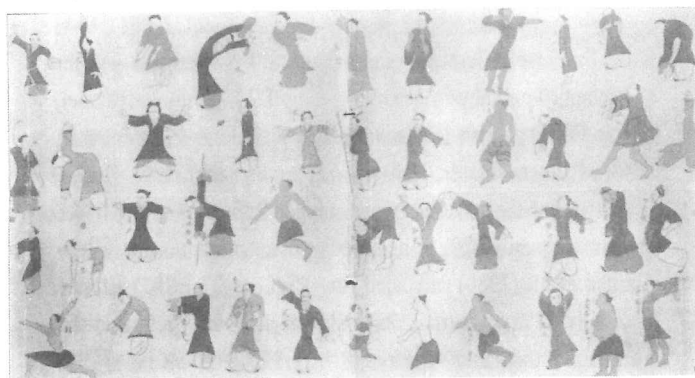
Yang: motive, external, upward, ascending, hot, bright, growing, exciting, invisible.

Qi: it is a kind of essential and minute substance with powerful activities, which constitutes the human bodies and maintains the vital activities of human beings.

Gong: exercise, dynamic or static exercise.

DaoyinShu: general term of traditional Chinese body-building sports.

Figure 1. Daoyin Illustration.



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