
**A Rehabilitation Model and Research for Middle-aged and Elderly People
Combining Eastern Tai Chi Training with Western Fascia Science— A
comprehensive study based on sports medicine, fascial chain theory and
neuromuscular control**

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Abstract

This article takes the Eastern Tai Chi training system and the Western fascia science theory as the core, and combines sports medicine, rehabilitation science, neuromuscular control, geriatrics and chronic disease intervention research to construct a comprehensive rehabilitation model suitable for the middle-aged and elderly population. Research has found that the spiral movement, center of gravity shift, breathing coordination and fascia tension transmission mechanism in Tai Chi training are highly compatible, which can improve the balance ability, gait stability, joint flexibility and neural reflex function of middle-aged and elderly people. This paper proposes a four-in-one rehabilitation model of "fascia - nerve - respiration - balance" and explores the application of the AI intelligent rehabilitation system in the future.

Keywords: Tai Chi Fascia chain Rehabilitation for middle-aged and elderly people Chronic diseases Sports medicine Neuromuscular control AI rehabilitation.

Chapter 1: Introduction

1.1 Research Background

With the continuous intensification of the global aging population trend, the health issues of the middle-aged and elderly groups have gradually become an important research direction in the fields of medicine, sports science and social public health. According to the concept of "Healthy Aging" proposed by the World Health Organization, modern elderly health management not only emphasizes the extension of life expectancy, but also emphasizes the improvement of physical functions, cognitive abilities, quality of life and social participation abilities. After entering middle and old age, the human body will experience a series of degenerative changes, such as muscle loss, fascia adhesion, limited joint movement, slowed neural response, decreased balance ability and increased chronic inflammation. These changes not only reduce physical activity capacity, but also significantly increase the risk of falls, the incidence of chronic pain and metabolic diseases.

Traditional Western rehabilitation medicine has long centered on the skeletal muscle system, emphasizing muscle strength training, joint stability, neural control and motor function recovery. However, in recent years, with the rapid development of Fascial Science, researchers have gradually realized that the human body is not composed of isolated muscles and bones, but rather a continuous tension structure system formed by a fascial network running through the entire body. Fascia not only undertakes the function of force transmission, but also participates in physiological activities such as posture maintenance, motor coordination, proprioception, pain regulation and neuromuscular control.

The proposal of the fascia theory has led modern sports rehabilitation to shift from "local muscle training" to "overall tension chain integration". For instance, the Myofascial Meridians theory proposed by the renowned anatomist Thomas Myers in "Anatomy Trains" emphasizes that different parts of the body form dynamic connection relationships through fascia. Physical dysfunction is often not a local issue but the result of an imbalance in the entire tension system. Therefore, modern rehabilitation increasingly emphasizes holistic movement, rotational chain training, respiratory coordination, and neuromuscular integration.

Meanwhile, Tai Chi, Qigong and guiding exercises in the traditional Eastern sports system have long formed the core idea of "holistic movement" during their development over thousands of years. Tai Chi emphasizes "guiding qi with the mind and moving the body with qi", pursuing the coordination between the inside and outside of the human body, the connection between the top and bottom, the flexibility, looseness, roundness and vitality, as well as the balance of Yin and Yang. Its movement characteristics include slow and continuous movement, spiral winding, center of gravity shift, synchronized breathing and unity of body and mind. From the perspective of modern sports science, Tai Chi training actually has highly consistent characteristics with fascia dynamic chain training.

For instance, the "silk winding force" in Tai Chi is highly similar to the transmission of fascia tension. "Relaxing and sinking" emphasizes the balance of myofascial release and tension. The "Dantian Drive" conforms to the modern core stability theory. "Zhengjin" is consistent with the mechanism of coordinated force application of the power chain. Many Western sports scientists have gradually discovered that Tai Chi is not only a traditional cultural form of exercise, but also a functional training system with values in neural control, fascia integration, balance training and cognitive intervention.

In recent years, numerous studies have shown that Tai Chi training can effectively improve the health conditions of middle-aged and elderly people

"Balance ability"

"Fall risk"

"Muscle coordination"

<s:1> Chronic pain

Cardiopulmonary function

The reaction speed of the nerve
Cognitive function
Anxiety and sleep quality

Especially in the fields of Parkinson's syndrome, osteoarthritis, chronic low back pain and stroke rehabilitation, Tai Chi has demonstrated excellent rehabilitation potential.

However, there are still several obvious deficiencies in the current research on

Tai Chi:

First, there is a lack of a unified language between traditional Tai Chi theory and modern medicine.

Many studies remain at the traditional philosophical level such as "qi", "meridians" and "Yin and Yang", making it difficult to establish a clear correspondence with modern biomechanics, neuroscience and fascia science.

Second, the modern rehabilitation training system and the Tai Chi training system are disconnected from each other.

Western rehabilitation places more emphasis on the recovery of local functions, while traditional Tai Chi lacks standardized and quantified indicators, making it difficult for it to enter the modern medical system.

Thirdly, the rehabilitation of middle-aged and elderly people lacks a training model that is "low-impact, high-coordination, and full-body integration".

Although traditional strength training can enhance muscle strength, it exerts considerable pressure on joints. However, simple flexibility training lacks the improvement of neural control ability. Therefore, a training model that is both safe and can promote the recovery of the body's coordinated functions is needed.

Against this backdrop, integrating Eastern Tai Chi training with Western fascia science to establish a functional rehabilitation model for middle-aged and elderly people that conforms to modern rehabilitation medical theories holds significant theoretical value and practical significance.

1.2 Research Significance

1.2.1 Theoretical Significance

This research is conducive to promoting the integrated development of traditional Eastern sports philosophy and modern sports science. For a long time, the physical training system in the East and the sports medicine in the West have developed in a relatively independent state. Tai Chi

emphasizes the whole, the internal and the coordination of energy, while modern sports science stresses anatomy, biomechanics and quantitative analysis. Through the bridge of fascia science, concepts such as "stabilizing force", "winding silk", "loosening and sinking", and "qi movement" in Tai Chi can be transformed into modern and explicable mechanisms of tension transmission, fascia elasticity, neuromuscular coordination, and proprioceptive regulation. Therefore, this study not only enriches the application of fascia science in traditional sports, but also helps to establish a modern explanatory framework for the philosophy of the Eastern body.

1.2.2 Significance of Rehabilitation Medicine

This research is expected to establish a functional rehabilitation system that is more suitable for the middle-aged and elderly population.

It is common among middle-aged and elderly people:

Sarcopenia

- Balance decline
- Joint degeneration

Chronic pain

The neural response slows down

- Increased risk of falls

Traditional high-intensity training is not suitable for most elderly people, while Tai Chi has the characteristics of low impact, high safety and strong sustainability. If combined with modern fascia chain training concepts, the

following can be formed:

- Dynamic stability training

Neural reflex training

Balance control training

- Respiratory coordination training
- Mind-body integration training

This training model is not only applicable to rehabilitation hospitals, but also to community elderly care, family health management and smart health and elderly care platforms.

1.2.3 Social Value

With the intensification of the global aging trend, the medical system is under tremendous pressure. Medical expenses caused by chronic diseases and falls are constantly increasing.

Studies show that falls are one of the important causes of disability and death among middle-aged and elderly people.

The rehabilitation model combining Tai Chi with fascia training includes:

- Low cost
- Easy to promote
- Strong community adaptability
- Convenient for home training
- Can be sustained for a long time

Therefore, this research has significant value in promoting public health and can provide a theoretical basis for future smart elderly care, AI rehabilitation training, and digital health platforms.

1.3 Current Research Status at Home and Abroad

1.3.1 Advances in Fascia Science Research Abroad

Since the late 20th century, fascia science has gradually become a research hotspot in international sports medicine. Research has found that fascia is not merely a simple connective tissue but rather contains:

- Collagen fiber
- Elastic fiber

Sensory nerve endings

- Mechanoreceptor
- Liquid conduction system

Fascia has dual functions of mechanical conduction and sensory feedback.

Robert Schleip proposed that fascia has the ability to contract actively and is involved in motor control and pain regulation. The Fascia Research Congress has further promoted the application of fascia in rehabilitation, athletic performance and pain medicine.

Currently, the widely used fascia training methods abroad include:

- The foam shaft is relaxed
- Dynamic stretching
- Elastic energy storage training
- Spiral power chain training

Respiratory fascia coordination training

These studies provide important theoretical support for the modern interpretation of Tai Chi movements.

1.3.2 Research Progress on Tai Chi Rehabilitation

In recent years, European and American countries have begun to apply Tai Chi in the field of clinical rehabilitation. Research has found that Tai Chi can improve:

- Elderly balance ability
- Proprioception
- Lower extremity stability
- Neural control
- Cognitive function

Especially in the study of Parkinson's Disease patients, Tai Chi training has shown superior effects compared to ordinary walking training.

In addition, Tai Chi is also applied to:

- Osteoarthritis
- Chronic low back pain
- Cardiopulmonary rehabilitation

Anxiety and depression intervention

Post-stroke recovery

However, at present, most studies still regard Tai Chi as "mild aerobic exercise", and there is still insufficient research on its deep fascia mechanism, neurodynamic chain mechanism and tension integration mechanism.

1.4 Research Objectives

This study aims to construct a rehabilitation model for middle-aged and elderly people that integrates "Eastern Tai Chi training - Western fascia science", and explore its application value in functional recovery.

Specific goals include:

1. Analyze the corresponding relationship between Tai Chi movements and the dynamic chain of fascia
2. Establish a theoretical framework for Tai Chi rehabilitation based on fascia tension integration
3. Explore the influence of Tai Chi training on balance, coordination and neural reflexes in middle-aged and elderly people
4. Build a functional rehabilitation training model suitable for the middle-aged and elderly population
5. Provide a theoretical foundation for future AI intelligent rehabilitation systems and digital health platforms

1.5 Research Methods

This study mainly adopts the following methods:

(1) Literature research method

Systematically sort out the relevant literature on Tai Chi, fascia science, sports rehabilitation and geriatrics

(2) Comparative research method

Compare the similarities and differences between the physical training system in the East and the sports science theories in the West

(3) Biomechanical analysis method

Analyze the dynamic chain, tension transmission and joint coordination mechanism in polar movements

(4) Experimental research method

Through training experiments on middle-aged and elderly subjects, the improvement effect of Tai Chi fascia training on functional indicators was evaluated

1.6 Research innovation points

The innovations of this research are mainly reflected in the following aspects:

1. It is the first systematic integration of Tai Chi training with fascia science
2. Reexplain the mechanism of Tai Chi's "Zhengjin" from the perspective of the fascia dynamic chain
3. Establish an overall tension model for functional rehabilitation of middle-aged and elderly people
4. Introduce the theory of neuromuscular coordination and proprioceptive integration
5. Provide a theoretical framework for AI intelligent rehabilitation and digital health training

Chapter 2: Theoretical Foundations of Eastern Tai Chi

2.1 The Philosophical Foundation of Tai Chi Theory



The Tai Chi theory originated from ancient Chinese philosophical thought and is an important theoretical system in traditional Eastern culture regarding the laws of the universe, life and movement. Tai Chi is not only a form of martial arts, but also a comprehensive view of life that integrates philosophy, medicine, health preservation and physical training. Its core ideas mainly originate from the "I Ching", Taoist thought and traditional Chinese medical theories.

The I Ching states: "The I Ching has the Taiji, which gives rise to the Two instruments, the two instruments give rise to the Four images, and the four images give rise to the Eight Trigrams." Among them, "Taiji" represents the initial chaotic state of the universe, which was the overall unity before the separation of Yin and Yang. The movement of Yin and Yang constitutes the fundamental law of change for all things, and the human body is also regarded as a constantly dynamic and balanced life system.

The concepts in Taoist thought such as "following the natural way", "governing by non-action", and "softness overcomes hardness" have had a profound influence on Tai Chi training. Laozi emphasized in the "Tao Te Ching" that "man follows the earth, the earth follows heaven, heaven follows the Tao, and the Tao follows nature", believing that the human body should operate in accordance with the laws of nature. The training principles in Tai Chi such as "looseness and softness", "roundness and vitality", "stillness and movement", and "softness and hardness" precisely embody this idea of natural balance.

From the perspective of modern sports science, the concepts of "overall coordination", "balance between tension and relaxation", and "center of gravity transformation" emphasized in Tai Chi are highly consistent with the dynamic stability theory in modern biomechanics. Especially for the middle-aged and elderly, this low-impact, continuous and holistic form of exercise is more in line with the functional recovery needs after the body's degenerative changes.

2.2 The Theory of Yin and Yang in Tai Chi



The theory of Yin and Yang is the core foundation of Tai Chi training. Yin and Yang are not merely in opposition but rather a unified system that is interdependent, mutually transforming, and in dynamic balance.

In human movement:

Movement is Yang and stillness is Yin

The top is Yang and the bottom is Yin

The exterior is Yang and the interior is Yin

Hardness is Yang and softness is Yin

Opening is Yang, and closing is Yin

Tai Chi training emphasizes "Yin within Yang and Yang within Yin", meaning that no movement of the body is absolutely isolated. For instance, when the center of gravity shifts to the left, the right side does not completely lose its function but forms a reverse support and tension balance. This continuous tension transformation is highly consistent with the "tension conduction" theory in modern fascia chains.

The "transition between the virtual and the real" in Tai Chi is also an important manifestation of the theory of Yin and Yang. The so-called "virtual and real" does not merely refer to the distribution of body weight, but also represents the dynamic changes in neural control, muscle recruitment and fascia tension.

For example:

The support legs are "solid"

- The auxiliary leg is "weak"

The main power chain is "Yang"

The stability chain is "Yin"

In modern motion control theory, this transformation can enhance:

- Neural response efficiency
- Balance control ability
- Dynamic stability

Proprioceptive sensitivity

For middle-aged and elderly people, yin-yang conversion training can effectively reduce stiffness in movements, enhance body coordination, and lower the risk of falls.

2.3 The Holistic View Theory of Tai Chi



One of the most important characteristics of Eastern Tai Chi is the emphasis on "wholeness".

The traditional Western exercise model often breaks down the human body into local muscle systems for training, such as:

- Strengthen the quadriceps separately
- Train the biceps individually
- Enhance core strength independently

Tai Chi holds that the human body is an integrated system that is interconnected with each other. Any local movement must be accomplished through the coordination of the whole body.

The Tai Chi classics propose:

"Where there is movement, there is stillness; where there is stillness, there is stillness."

This means that body movements do not exert force locally but generate power through overall interaction.

From the perspective of modern fascia science, the fascia in the human body forms a tension network that runs through the entire body. Local movements will be transmitted throughout the body through the fascia chain.

For example:

The plantar fascia affects the stability of the pelvis

Hip joint rotation affects shoulder movement

The thoracolumbar fascia affects respiratory function

The "Zhengjin" in Tai Chi is actually very similar to the training of the fascia dynamic chain.

For example:

Cloud hand movement

In the "Cloud Hand" movement:

The lower limbs complete the shift of center of gravity

The pelvis rotates

The spine generates spiral movements

The upper limbs form an arc-shaped trajectory

- Synchronize the adjustment of breathing rhythm
The entire process forms a complete power chain synergy.
This training method can:

- Improve physical coordination
Activate deep stabilizing muscles

- Improve neuromuscular control
- Enhance fascia elasticity
- Enhance the body's perception ability

For middle-aged and elderly people, holistic training is safer and more in line with functional rehabilitation needs than simple local strength training.

2.4 The "Loosening" Theory in Tai Chi

"Relaxation" is one of the most core concepts in Tai Chi training.

Many people mistakenly believe that "relaxation" means being at ease, but in fact, "relaxation" does not mean complete powerlessness; rather, it is a "controlled state of relaxation".

Tai Chi emphasizes:

"Loose but not unremitting, gentle but not soft." "

From the perspective of modern sports science, "relaxation" is a kind of:

- Low excess tension
- High neural control
- High fascia elasticity
- High coordination efficiency

Among modern people, especially the middle-aged and elderly, there is a common existence:

- Muscle tension

Stiff joints

Fascia adhesion

- Shallow and rapid breathing
- High stress of the nervous system

Long-term tension can lead to:

- Decreased movement efficiency
- Increased energy consumption
- Increased pain sensitivity
- Decline in balance ability

The "relaxation and sinking" training in Tai Chi can reduce the excitement of the sympathetic nerve and enhance the activity of the parasympathetic nerve, thereby improving the body's recovery ability.

From the perspective of fascia, "loosening" can:

- Enhance the sliding ability of the fascia
- Improve the circulation of tissue fluid
- Enhance fascia elastic energy storage
- Reduce abnormal local tension

For the rehabilitation of middle-aged and elderly people, the significance of "relaxation" training is extremely important.

For example:

Patients with chronic low back pain often have tension in the thoracolumbar fascia

Patients with neck and shoulder pain have superficial frontline fascia stiffness

Patients with knee joint degeneration have an imbalance in the lower limb power chain

Through the relaxation and softness training in Tai Chi, one can gradually restore the balance of body tension

2.5 The Theory of "Winding Silk Force" in Tai Chi

"Winding Silk Force" is a unique and important training form in Tai Chi.

The so-called "twisting silk" refers to the continuous spiral movement of the body, just like the twisting of silk threads. From the perspective of appearance, Tai Chi movements are slow and gentle. However, from the perspective of its internal structure, its essence is the transmission of continuous helical tension.

Modern fascia science research has found that:

The fascia in the human body is not arranged in a straight line but in the following pattern:

- Spiral structure
- Cross structure
- Reticular structure

Therefore, the most natural and energy-efficient form of exercise for the human body is often rotational exercise.

For example:

- The pelvis rotates when walking

When running, the torso swings in the opposite direction

- Spiral force when throwing

When breathing, the thorax rotates and expands

The silk winding movement in Tai Chi precisely conforms to the natural dynamic laws of the human body.

Its training value includes:

- Enhance joint stability
- Enhance fascia elasticity
- Improve coordination skills
- Enhance rotation control
- Enhance the speed of neural reflexes

For middle-aged and elderly people, spiral exercise can effectively improve:

- Spinal flexibility
- Hip joint range of motion
- Stable gait
- Fall prevention ability

2.6 The "Dantian" Theory in Tai Chi



"Dantian" is an important concept in Eastern body training.

Traditional theory holds that the dantian is located in the lower abdomen of the human body and is the core area of the body's "qi".

From the perspective of modern anatomy, the "dantian" area actually corresponds to:

- Diaphragm

Deep abdominal muscles

- Pelvic floor muscles
- Multifidus muscle
- Psoas major muscle
- Core stability system

Modern sports science holds that core stability is the foundation of human movement control.

Tai Chi emphasizes:

"Use the waist as the axis and the dantian to drive the limbs." "

This is highly consistent with the "core-driven" theory in modern functional training.

Dantian training can:

Stabilize the spine

- Improve posture control
- Improve respiratory efficiency
- Enhance balance ability
- Improve neural coordination

Especially for middle-aged and elderly people:

As one ages, the core stability ability declines, and it is easy to encounter:

- Anterior pelvic tilt
- Unstable lumbar vertebrae

Abnormal gait

- Balance decline

The dantian control training in Tai Chi can help re-establish the stability of the body's center.

2.7 Taiji Breathing Theory

Breathing is an important part of Tai Chi training.

Tai Chi emphasizes:

Breathe naturally

- The combination of spirit and intention
- Synchronize your breathing with your movements

Modern research has found that breathing not only affects oxygen exchange but also directly influences:

"Nervous system"

- Core stability

Posture control

- Heart rate variability (HRV)
- Emotion regulation

In particular, the diaphragm is not only a respiratory muscle but also an important component of the core stability system.

Abdominal breathing in Tai Chi can:

Activate the parasympathetic nerve

Reduce anxiety

- Improve sleep
- Enhance visceral activity
- Enhance core stability

For middle-aged and elderly people, breathing training can also:

- Increase lung capacity
- Improve circulatory function

Lower blood pressure

- Improve chronic fatigue

2.8 The Connection between Tai Chi and Modern Rehabilitation

In recent years, an increasing number of studies have found that Tai Chi is not only a traditional health-preserving exercise but also a functional training system that conforms to the principles of modern rehabilitation medicine.

Tai Chi possesses:

Low impact

High coordination

- Full-body linkage
- High neural engagement
- Respiratory integration
- Proprioceptive training

These characteristics are highly suitable for the rehabilitation of middle-aged and elderly people. It has particularly good application value in the following fields:

- Fall prevention

Parkinson's disease rehabilitation

Osteoarthritis

Chronic pain

Cardiopulmonary rehabilitation

Balance training

Neurodegenerative diseases

If the future comes together:

- AI motion recognition

Wearable devices

- HRV monitoring

Posture analysis

- Fascia tension assessment

Then a more scientific and digitalized Tai Chi rehabilitation system can be established.

The shift of the center of gravity in Tai Chi training helps enhance the function of the vestibular system, improve the stability of the lower limbs and the speed of neural reflexes.

Chapter 3: The Development of Western Fascia Science

3.1 The Origin and Development Background of Fascia Science

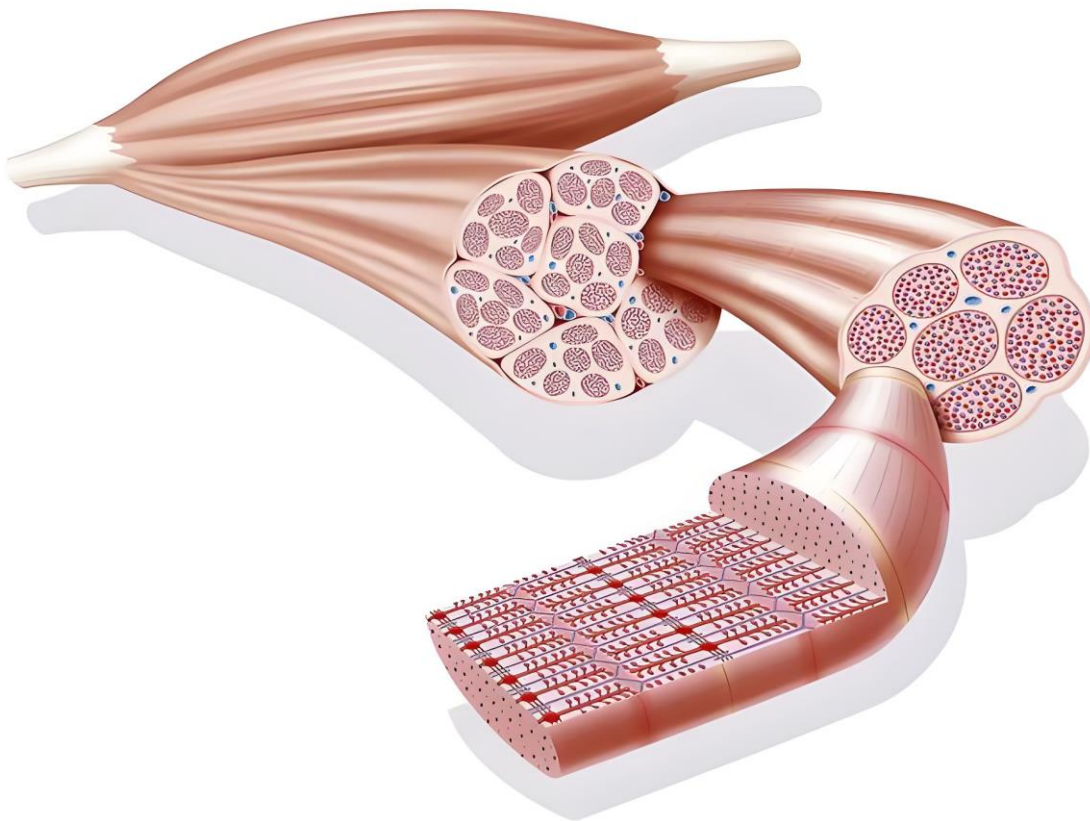


For a long time, Western medicine's research on the human motor system has mainly focused on the skeletal, muscular and nervous systems. Traditional anatomy holds that muscles are independently functioning power units, and fascia is merely a layer of "connective tissue" that wraps around muscles and organs. However, with the development of sports medicine, anatomy, biomechanics and pain science, researchers have gradually discovered that fascia is not a simple filling structure, but a continuous functional network that runs through the entire body.

In the late 20th century, with the advancement of imaging techniques, ultrasound elastography and tissue biomechanics research, Western medicine began to re-recognize the significance of the fascia system. Especially in the fields of chronic pain, sports injuries, abnormal postures and senile functional decline, fascia is regarded as an important factor affecting human movement efficiency, force transmission and neural perception.

The rise of modern Fascial Science marks the gradual shift of human movement research from "local muscle models" to "overall tension network models". This change is highly consistent with the concepts of "overall linkage", "unity of muscles and bones", and "internal and external coordination" of Eastern Tai Chi.

3.2 Structure and Function of Fascia



Fascia is a continuous connective tissue mainly composed of collagen fibers, elastic fibers, matrix fluid and fibroblasts. It is widely present among human skin, muscles, bones, nerves, blood vessels and internal organs, forming a complete tension network of the human body.

According to modern anatomical research, fascia can be classified as:

(1) Superficial fascia

Located beneath the skin, it is rich in adipose tissue and blood vessels, mainly responsible for:

- Protect body tissues
- "Store energy"
- Buffering external forces

Maintain skin elasticity

For middle-aged and elderly people, a reduction in the moisture content and elasticity of the superficial fascia can lead to loose skin, slow movement and a decline in metabolism.

(2) Deep fascia

Deep fascia wraps around muscles, muscle groups and bones, and is the most important part of motor function. It not only stabilizes joints but also undertakes the function of force transmission.

Modern research has found that

Strength is not solely generated by muscle contractions

Fascia can store and release elastic energy

Body movements are actually accomplished by the joint efforts of the "muscle - fascia chain"

This means that human movement is more like an "overall tension system" rather than merely the exertion of force by local muscles.

(3) Visceral fascia

It wraps internal organs, maintains the stability of their positions and functions, and is closely related to the autonomic nervous system at the same time.

Recent studies have found that

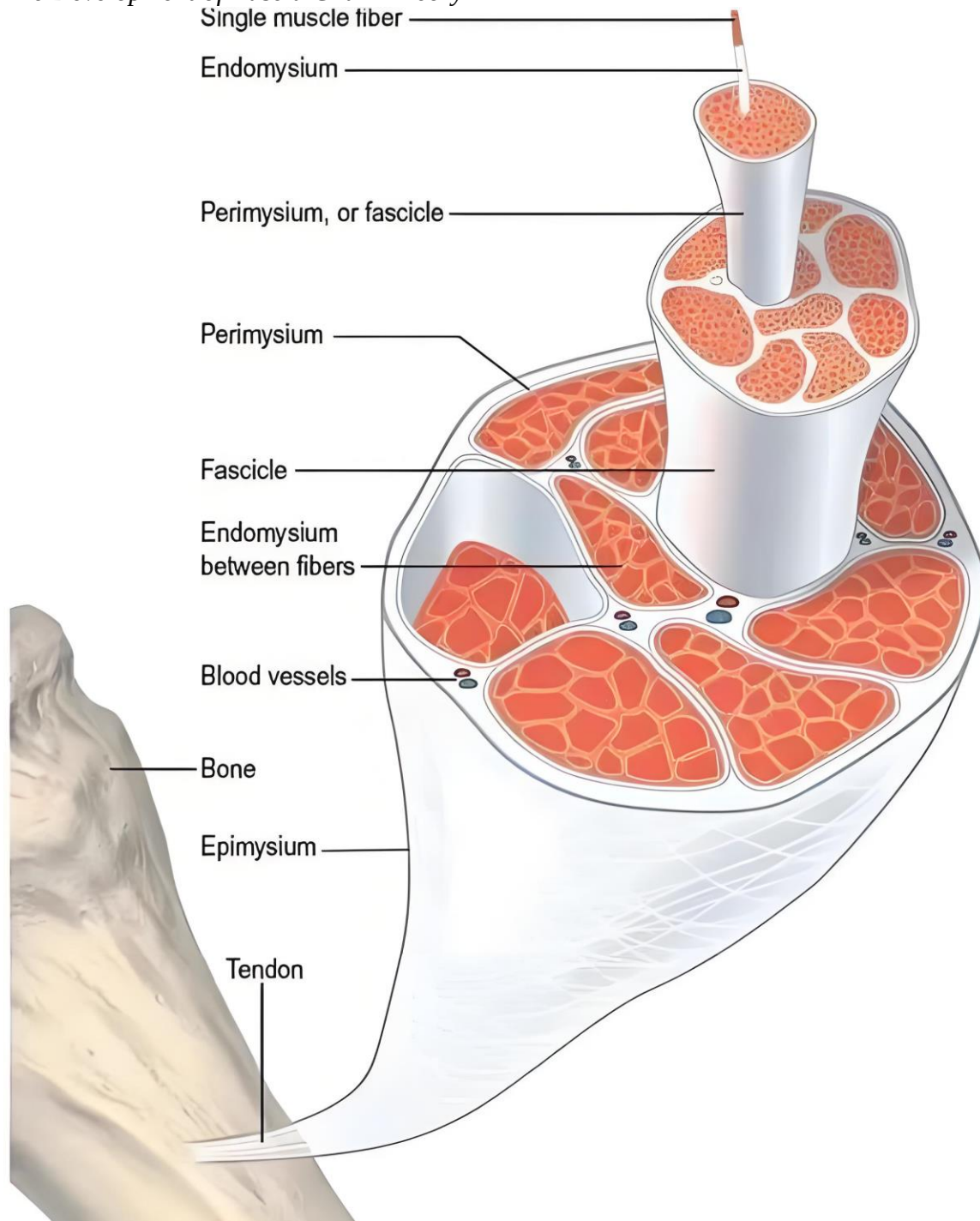
Emotional stress can affect the tension of visceral fascia

Visceral fascia restriction may lead to breathing limitations

Chronic pain may be related to fascia adhesion

This bears certain similarities to the theories of "qi movement" and "zang-fu organs and meridians" in Eastern medicine.

3.3 The Development of Fascia Chain Theory



One of the significant breakthroughs in Western fascia science is the proposal of the "Myofascial Chains" theory. The renowned anatomist Thomas Myers proposed in "Anatomy Trains":

The human body is not composed of isolated muscles but is made up of multiple longitudinal and spiral fascia chains connected together.

This includes:

- Superficial Back Line
- Superficial Front Line
- Lateral Line
- Spiral

Deep Front Line

This theory explains:

Why do ankle problems affect the neck

Why does hip joint imbalance lead to lower back pain

Why does abnormal posture lead to systemic compensation

The fascia chain theory emphasizes:

The imbalance of body functions is often systemic rather than local. This view is highly consistent with the movement ideology of Tai Chi that "a single hair can affect the whole body" and "every link runs through".

For the rehabilitation of middle-aged and elderly people, the fascia chain theory is of great significance:

It can improve the overall coordination of the body

- Enhance movement stability

Reduce the risk of falls

- Optimize gait function
- Enhance balance ability

3.4 The Relationship between Fascia and the Nervous System

Modern research has found that fascia is not only a mechanical structure but also an important sensory organ.

There are a large number of:

- Proprioceptive receptors
- Pressure sensor
- Mechanoreceptor

- Free nerve endings

These neural structures can perceive in real time:

- Body position
- Tension variation
- Direction of movement

"Balanced state"

Therefore, the fascia system is actually involved in the body's:

Posture control

- Balance regulation
- Movement coordination

"Neural feedback"

For middle-aged and elderly people, as they age:

- The speed of neural response decreases
- Weakened proprioception
- Decline in balance ability
- Increased risk of falls

Fascia training can reactivate neural perception ability through low-intensity, continuous movements.

In Tai Chi training:

- Move slowly

"Center of gravity shift"

- Single-leg support
- Spiral winding action

It can effectively stimulate the proprioceptive system in the fascia and enhance the neuro-muscle coordination ability.

Therefore, modern sports rehabilitation is increasingly emphasizing:
Integrated training model of "nerve - fascia - movement".

3.5 Fascia and Chronic Pain Research

Thoracolumbar Fascia



In recent years, research on chronic pain has gradually shifted from traditional muscle injury models to fascia dysfunction models.

The research found:

- Sitting for long periods

Abnormal posture

Emotional stress

Lack of exercise

- Aging

All of these can lead to the appearance of fascia

- Adhesion

"Water shortage"

- Fibrosis
- Abnormal tension

These problems will limit the body's sliding ability and cause:

- Neck and shoulder pain
- Lower back pain

Knee discomfort

- Activity restrictions

Traditional treatments often only focus on the painful area, while modern fascia science emphasizes:

Pain may stem from an imbalance of tension at the distal end.

For example:

Tension in the calf fascia may lead to lower back pain

Thoracic fascia restriction may affect breathing

Plantar fascia problems may alter gait

This is highly consistent with the idea of Tai Chi that emphasizes "overall regulation".

For middle-aged and elderly people, fascia training offers better safety compared to high-intensity strength training

It has a relatively small impact on the joints

It is more suitable for people with chronic diseases

- Greater emphasis is placed on flexibility and control

It is easier to persist in the long term

3.6 Development Trends of Modern Fascia Training

In recent years, Western sports science has gradually formed the "Fascial Training" system.

Representative training methods include:

(1) Foam Rolling

Improve the sliding ability of fascia through mechanical pressure and relieve muscle tension.

(2) Elastic vibration training

Stimulate the elasticity of the fascia through elastic vibration to enhance the efficiency of force transmission.

(3) Spiral chain training

Emphasize three-dimensional rotational movements to enhance the overall coordination of the body.

(4) Dynamic stretching training

Improve fascia hydration and flexibility through continuous movement.

However, modern Western fascia training still has some limitations:

- Overemphasizing local techniques
- Lack of the combination of breathing and consciousness
- Neglect the integration of body and mind
- Lack of a long-term internal regulatory mechanism

And Eastern Tai Chi training can precisely make up for these deficiencies.

In Tai Chi training:

- Dantian control
- Respiratory coordination
- Slow and continuous movements

"Yin-yang Transformation"

- Spiral winding power

Essentially, it is an advanced holistic fascia training method.

Therefore, the combination of Eastern Tai Chi and Western fascia science is expected to establish a more suitable comprehensive rehabilitation model for middle-aged and elderly people.

Chapter 4: Fascia Chain Theory and Human Tension Structure

4.1 Background of the formation of the fascia chain theory



Traditional kinesiology has long adopted the "single muscle" analysis model, which holds that human movements are mainly accomplished by a single muscle. For instance, arm flexion is accomplished by the biceps brachii, while leg extension is performed by the quadriceps femoris. However, with the development of modern sports science, researchers have gradually discovered that human movement is not the individual contraction of isolated muscles, but an overall process in which multiple tissues work together.

At the end of the 20th century, Western anatomist Thomas Myers proposed the "Myofascial Chains" theory, emphasizing the existence of a continuous tension conduction network within the human body. This theory holds that muscles, fascia, ligaments, tendons and connective tissues are interconnected through fascia, forming a "dynamic chain" that runs through the entire body. The fascia chain theory has changed the way of thinking in traditional sports medicine:

Human movement is no longer the exertion of force by local muscles
The body is an integrated tension system
Movement problems often stem from distal imbalance
Posture is closely related to motor function

This theory not only promotes the development of modern rehabilitation medicine, but also provides a new research direction for the exercise rehabilitation of middle-aged and elderly people.

4.2 The Concept of Human tension Structure

The Tensegrity Structure of the human body originated from the theory of "tensioned monolithic structure" in architectural mechanics. The so-called Tensegrity refers to:

A system maintains stability through the balance between continuous tension and local support.

In architecture, tensioned structures can maintain maximum stability with the least amount of material. Modern fascia science holds that the human body also belongs to a kind of "biological tensioning system".

In the human body:
Bones do not support the body alone
Muscles do not generate strength alone
Fascia connects the entire body through continuous tension
Human stability actually stems from:

The dynamic balance between the "fascia tension network" and the "skeletal support system".

Therefore:
Posture changes can affect the overall tension of the body
An imbalance in one part can affect the overall structure
Local pain may result from abnormal tension at the distal end

For example:
A collapsed arch of the foot may lead to increased pressure on the knee joint
Anterior pelvic tilt may cause lumbar pain
Stiffness of the thoracic vertebrae may affect respiratory function

This theory is highly consistent with the concept of the Eastern Tai Chi that "the upper and lower parts follow each other" and "when one move, everything remains stationary".

4.3 Main Classifications of Fascia chains

According to modern fascia anatomy research, there are multiple important fascia chain systems in the human body.

(1) Superficial Back Line

The superficial posterior line is one of the most important posterior tension chains in the human body, mainly including:

Plantar fascia

- The back of the lower leg
- Hamstring muscles
- Sacrolumbar fascia
- Erector spinae muscle

The posterior cervical muscle group

- Scalp fascia

Its main functions include:

Keep your body upright

- Control the forward bend movement

Store elastic energy

- Keep your body stable

Due to long-term sitting and lack of exercise, middle-aged and elderly people are prone to the following superficial posterior lines:

- Fascia shortening
- Stiff waist and back

Abnormal gait

- Decline in balance ability

The movements in Tai Chi such as "relaxing the waist and sinking the hips" and "Hollow leading the top force" can effectively improve the function of the posterior fascia chain.

(2) Superficial Front Line

The superficial front line is mainly located on the anterior side of the human body, including:

- Tibialis anterior muscle

Quadriceps femoris

Rectus abdominis

- Thoracic fascia
- Sternocleidomastoid muscle

Its main functions are:

- Supports stability on the front side of the body
- Control the backward lean movement

Maintain core tension

When the anterior fascia is overly tense, the following will occur:

"Hunchback"

Round shoulders

- Limited breathing

Neck pain

The reduction of thoracic cage movement in middle-aged and elderly people can lead to a decline in respiratory function. Therefore, improving the anterior fascia chain is of great significance.

The chest-expanding, opening and closing, and breathing coordination movements in Tai Chi can help enhance the elasticity of the chest cavity and breathing capacity.

(3) Lateral Line

The lateral lines are located on both sides of the body and are connected:

- Peroneal muscle group
- Iliotibial band
- Gluteus medius
- External oblique abdominal muscles

Intercostal muscles

Its main functions include:

Maintain balance between the left and right sides

- Control lateral stability
- Prevent your body from tilting

For middle-aged and elderly people, a decline in lateral line function significantly increases the risk of falls.

The research found:

Elderly people who have fallen often have insufficient lateral stability

- Decreased single-leg support ability
- Weakened hip control ability

In Tai Chi:

- Shift of center of gravity
- Single-leg support
- Cloud hand movement

It can effectively activate the lateral line and enhance the body's stability.

(4) Spiral

The spiral line is an important structure for the rotational movement of the human body, running through the front and back sides of the body.

Its main functions:

- Coordinate body rotation
- Control gait balance

Maintain dynamic stability

Modern sports science discoveries:

Most human body movements have spiral characteristics.

For example:

"Walk"

Turn around

- Throw

"Breathe"

- Tai Chi Silk winding movements

Due to the decline in spinal rotation ability among middle-aged and elderly people, it can lead to:

Stiff movements

Slow gait

- Decline in balance ability

The silk winding force training in Tai Chi is essentially an advanced form of spiral fascia chain training.

(5) Deep Front Line

The deep frontier is regarded as the most core stabilizing system in the human body, including:

Deep plantar muscle groups

- Adductor muscle group
- Pelvic floor muscles
- Diaphragm

Deep neck muscles

It is related to

Respiratory function

- Core stability
- Nervous system regulation

Closely related.

Modern research suggests that the deep front line is a connection:

An important bridge of "breathing - core - posture - emotion".

And in Tai Chi:

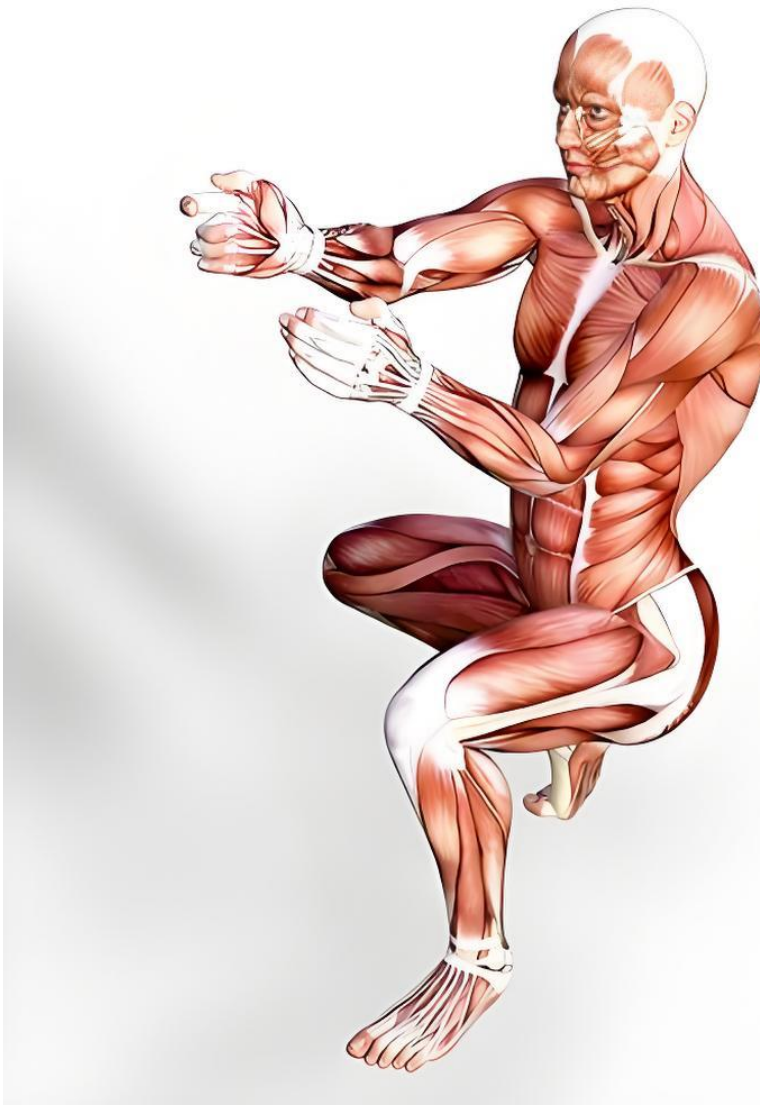
- Dantian control

Abdominal breathing

- Loose, heavy and stable

It can effectively activate the Deep Frontline system.

4.4 Fascia Tension and Force Transmission Mechanism



The traditional view holds that:
Strength is directly generated by muscles and acts on bones.

But modern research has found that:
Fascia can store elastic energy
Strength is transmitted along the fascia chain

The efficiency of movement depends on tension coordination

For example:

When a human body is walking:

The plantar fascia absorbs the impact first

The calf fascia stores elasticity

Hip fascia conduction force

The core of trunk fascia stability

The entire process is similar to a "spring system".

Therefore:

Excellent movements are not about "exerting more force", but rather:

"Tension transmission is more efficient."

Tai Chi emphasizes:

Loose but not scattered

Gentle yet firm

- Section by section runs through

In fact, it is a highly efficient tension transmission mode.

For middle-aged and elderly people:

- Reduced fascia moisture
- Decreased elasticity
- Weakened tension coordination ability

It will lead to

- Slow movement
- Prone to fatigue
- Increased risk of falls

Therefore, by combining Tai Chi with fascia training, the body's tension balance can be re-established.

4.5 Application of Fascia Chain Theory in Rehabilitation

In recent years, the fascia chain theory has been widely applied in:

Sports rehabilitation

Pain treatment

- Elderly fall prevention training

Posture correction

- Recovery of neurological function

Especially in the rehabilitation of middle-aged and elderly people, fascia chain training has the following advantages:

Holistic training

- (1) Unlike traditional local training, fascia training places more emphasis on overall coordination.
- (2) Low impact resistance
Suitable for people with bone and joint degeneration.
- (3) Enhance the ability to balance
Reduce the risk of falls by activating the deep stabilization system.
- (4) Improve neural control
Enhance proprioception and motor response abilities.
- (5) Enhance exercise efficiency
Reduce unnecessary energy consumption.

In Tai Chi training:

Slow movement

- Continuous center of gravity shift
- Spiral force
- Respiratory control

It can naturally integrate the functions of the fascia chain, and thus is very suitable as a rehabilitation training model for middle-aged and elderly people.

Chapter 5: Fascia Dynamic Transmission in Tai Chi Movements

5.1 Polar Motion and Global Dynamics



Tai Chi, as a traditional physical training system in the East, does not merely focus on the output of muscle strength. Instead, it emphasizes the movement methods of "overall coordination", "guiding qi with the mind", and "driving force with the body". From the perspective of modern sports science, polar movements are essentially a human movement pattern that highly relies on the transmission of fascia tension.

Traditional fitness training often employs a method of local muscle exertion, such as:

Arm training emphasizes the biceps brachii

Leg training emphasizes the quadriceps

Abdominal training emphasizes the rectus abdominis muscles

However, Tai Chi is different.

Tai Chi emphasizes:

"Rooted in the feet, originating from the legs, dominating the waist, and shaped by the fingers." "

This process indicates that the power of Tai Chi is not generated by a single muscle, but rather through a continuous force transmission chain formed among the lower limbs, pelvis, spine, shoulder straps and upper limbs.

Modern fascia science holds that:

The essence of human movement is the energy transfer process in the fascia tension network.

Therefore, in Tai Chi:

- Silk-like strength

- Relaxed, heavy and vigorous

"Get ready"

- Spiral force

In fact, they are all closely related to fascia dynamics.

5.2 Basic Principles of Fascia Dynamic Conduction

Fascia is not only a structure that wraps tissues but also an important "mechanical transmission medium" in the human body.

Modern research has found that

Fascia has the function of elastic energy storage

It can transmit mechanical tension

It can coordinate multi-joint linkage

It can enhance the efficiency of movements

In human movement, force is not output in one direction but continuously propagates along the fascia chain.

For example:

When a person is walking

1. The plantar fascia is in contact with the ground
2. Elastic potential energy is stored at the back of the lower leg
3. The hip fascia completes the force transfer
4. Trunk fascia stabilizing core
5. The upper limbs swing naturally to maintain balance

The entire process forms a complete tension chain.

Therefore:

Efficient movements stem from the coordination of fascia tension rather than mere muscle strength.

The concept of "softening hardness with softness" in Tai Chi actually utilizes the elasticity of the fascia and continuous tension to achieve energy transmission.

5.3 "Zhengjin" in Tai Chi Movements and Fascia Chains

"Zhengjin" is an important concept in Tai Chi.

The so-called "Zhengjin" refers to:

The strength of the entire body should be coordinated and unified rather than exerted locally.

From the perspective of fascia science, Zhenjin is actually:

The overall tension conduction process involving multiple fascia chains.

In Tai Chi movements:

The soles of the feet are responsible for establishing the ground reaction force

The lower limb fascia chain transmits force

The pelvis and waist complete the power conversion

The spinal fascia is coordinated and stable

The upper limbs complete the force output

This process is similar to the "whip effect".

When all parts of the body are in harmony:

- The movements are more relaxed
- More efficient power output
- Less energy consumption

And middle-aged and elderly people have:

- Decreased fascia elasticity
- Limited joint movement
- Weakened neural coordination

It is often impossible to form a complete power chain.

Therefore, Tai Chi training can re-establish the overall tension connection through slow and continuous movements.

5.4 Tai Chi Training "Silk Winding Force" and Spiral Fascia Conduction



The silk winding force is one of the most representative ways of exerting force in Tai Chi.

Its features include:

- Spiral rotation
- Continuous conduction
- Soft and stable

Internal and external coordination

Modern sports biomechanics research has found that:

The human body naturally has a spiral movement pattern.

For example:

Pelvic rotation while walking

- Torso confrontation during running
- Twisting movements during throwing

All rely on the spiral fascia chain to complete the force transmission.

The silk winding movement in Tai Chi can:

Activate the deep fascia system

- Enhance the rotational ability of the spine
- Improve physical coordination
- Enhance fascia elastic energy storage

Especially for middle-aged and elderly people:

Spiral training can effectively improve:

Stiff trunk

- Unsteady gait
- Decline in balance ability
- Limited joint movement

Modern rehabilitation medicine holds that:

Spiral movements are closer to daily life functions than unidirectional training.

Therefore, Tai Chi Silk winding force training holds significant value in the functional rehabilitation of middle-aged and elderly people.

5.5 Tai Chi's "Relaxation and sinking" and the balance of fascia tension

"Relaxation" is one of the core principles of Tai Chi.

However, the "relaxation" in Tai Chi does not mean complete relaxation, but rather:

Reduce excessive tension on the basis of maintaining structural stability.

Modern fascia science discoveries:

Chronic pain and stiffness in the human body often originate from:

- Fascia tension imbalance
- Long-term compensation

The nervous system is overly tense
Especially among the middle-aged and elderly groups:

- Sitting for long periods

Lack of exercise
Mental stress
Chronic diseases

It will cause the fascia to be in a state of high tension for a long time.

In Tai Chi:

Slow movement

Breathing coordination

- Relaxation of consciousness
- Center of gravity sinking

It can reduce the excitability of the sympathetic nerve and improve the balance of fascia tension.

From the perspective of modern neuroscience:

Tai Chi training can activate the parasympathetic nervous system, enabling the body to enter:

- Relaxed state

"Repair status"

- Self-regulating state

Therefore, "relaxation and sinking" is not only a movement technique but also a neuro-fascia regulation mechanism.

5.6 Fascia Dynamic Transmission in the Taiji Step Technique

Footwork is an important foundation of Tai Chi training.

Tai Chi footwork emphasizes:

"Center of gravity shift"

- Changes between reality and illusion
- Move slowly
- Stable control

From the perspective of fascia dynamics:

Footwork training can effectively activate

Plantar fascia

- Posterior side chain of the lower leg
- Hip stabilizing chain

- Deep Frontline System

Especially during the single-leg support stage, it is of great significance for improving the balance ability of middle-aged and elderly people.

The research found:

Elderly people with a higher risk of falls usually have:

- Decreased perception of the soles of the feet
- Insufficient hip joint stability

Core control has weakened

And through continuous training of center of gravity transformation, Tai Chi footwork can improve:

Proprioception

- Neural response ability
- Cerebellar coordination function
- Dynamic balance capability

Therefore, Tai Chi footwork not only belongs to traditional martial arts movements, but also represents an advanced neuro-fascia rehabilitation training.

5.7 Respiratory and Fascial Dynamic System

Modern fascia research has found that:

There is a close connection between the respiratory system and the fascia system.

The diaphragm is not only a respiratory muscle but also an important component for the stability of the human core.

The diaphragm is connected by fascia:

- Thorax
- Lumbar vertebrae
- Pelvic floor
- Deep core system

Therefore:

Breathing patterns directly affect the body's tension structure.

Common problems among middle-aged and elderly people include

- Excessive thoracic breathing
- Shallow and short breathing
- Reduced diaphragmatic activity

The chest is stiff

These problems will affect:

- Core stability

Posture control

Blood circulation

- Emotional state

Abdominal breathing in Tai Chi can:

- Enhance the mobility of the diaphragm
- Improve fascia sliding
- Enhance core stability
- Regulate the autonomic nervous system

Therefore, Tai Chi breathing training is actually an important part of fascia dynamic regulation.

5.8 The Influence of Tai Chi Movements on Fascia Function in Middle-aged and Elderly People

As people age, the fascia in the human body may develop:

- Reduced moisture
- Collagen fibers are stiff
- Decreased elasticity
- Weakened sliding ability

This thus leads to:

Slow movement

- Balance decline
- Chronic pain increases

The risk of falls increases

Tai Chi training has the following characteristics:

(1) Low impact

It reduces joint pressure and is more suitable for the elderly.

(2) Continuous action

Promote the hydration and sliding function of fascia.

(3) Helical motion

Enhance the elasticity and coordination of the fascia.

(4) Breathing coordination

Improve neural regulation and core stability.

(5) Overall linkage

Improve the efficiency of power transmission throughout the body.

Therefore, Tai Chi is not only a traditional health-preserving exercise, but also an overall rehabilitation training method that conforms to the principles of modern fascia science.

Chapter 6: Mechanism of Fascia Degeneration in Middle-aged and Elderly People

6.1 Aging and Changes in the Fascia System



As people age, various tissues in the human body gradually undergo degenerative changes, and the fascia system, as an important connective tissue network that runs through the entire body, also undergoes significant aging. Modern fascia science research shows that the decline in physical ability, the increase in chronic pain and the weakening of balance function in middle-aged and elderly people are not only due to muscle atrophy, but also closely related to the functional degradation of the fascia system.

Fascia has:

- Supporting structure

"Transmit power"

Storage elasticity

- Perceive body position
- Coordinate neural control

It has multiple functions, etc. When fascia ages, the overall tension structure of the human body gradually becomes unbalanced, thereby affecting the body's mobility.

The "deficiency of nourishment of muscles and bones" and "poor circulation of qi and blood" emphasized in the theory of Eastern Tai Chi, from a modern perspective, have a certain corresponding relationship with the degeneration of fascia.

6.2 Reduced fascia moisture and decreased elasticity

Healthy fascia contains a large amount of water and hyaluronic acid, which can maintain the sliding ability and elastic function between tissues.

However, in the middle and old age stages, due to:

- Slowed metabolism
- Collagen loss
- Decreased activity level
- Weakened blood circulation

The hydration in the fascia gradually decreases.

The research found:

The fascia of young people is soft and elastic, while that of the elderly is prone to:

"Drying"

- Adhesion

"Stiff"

- Sliding restricted

This change will lead to:

- The movements are not smooth
- Decreased muscle coordination
- Reduced joint range of motion
- Decreased physical flexibility

For example:

Many middle-aged and elderly people feel stiff when bending over, turning around or going up and down stairs. This is not entirely due to bone problems, but often related to the decline in fascia elasticity.

The slow and continuous movements in Tai Chi training can promote the circulation of fascia fluid, enhance the sliding ability of tissues, and thereby delay the aging of fascia.

6.3 Collagen fiber fibrosis and fascia adhesion

Fascia is mainly composed of collagen fibers. Under normal circumstances, collagen fibers are orderly arranged and maintain a certain degree of elasticity.

However, as one ages and suffers from a long-term lack of exercise, collagen fibers will gradually appear

- Disordered arrangement
- Increased crosslinking
- Aggravated fibrosis

This will cause the fascia to lose its original flexibility.

Meanwhile, common among middle-aged and elderly people:

"Sitting for long periods

- Long-term low activity

Abnormal posture

Chronic inflammation

It is also prone to cause fascia adhesion.

Fascia adhesions can restrict tissue sliding, causing the body to develop:

- Pain
- Activity restrictions

Posture compensation

- Decreased exercise efficiency

For example:

Adhesion of the shoulder and neck fascia may cause neck pain

Tension in the lumbar and dorsal fascia may affect gait

Hip fascia limitation may increase the risk of falls

Therefore, fascia degeneration in middle-aged and elderly people not only affects flexibility but also disrupts the overall power chain of the body.

6.4 Decline in neural perception ability

Modern research shows that there are a large number of proprioceptive receptors and mechanoreceptors in the fascia.

These receptors can help the human body perceive:

- Body position
- Direction of movement

- Tension variation

"Balanced state"

However, in middle and old age, due to the aging of the nervous system, the sensory function in the fascia gradually declines.

Its manifestations include:

- The reaction speed slows down
- Decline in balance ability
- Unstable gait
- Weakened coordination

Especially in terms of the risk of falls, fascial proprioceptive degeneration has a significant impact.

The research found:

Many elderly people fall not simply due to muscle weakness, but because:

"Decline in the function of the neuro-fascia feedback system."

In Tai Chi training:

- Single-leg support

"Center of gravity shift"

- Move slowly

It can continuously stimulate the proprioceptive system and enhance neural control ability.

6.5 Chronic Inflammation and fascia Degeneration

The middle-aged and elderly stages are often accompanied by a low-grade chronic inflammatory state.

For example:

"Diabetes"

"Obesity"

Arthritis

Cardiovascular diseases

Both will increase the levels of inflammatory factors in the body.

Long-term inflammation can affect the function of fascia cells, leading to:

- Abnormal collagen metabolism
- Decline in tissue repair capacity

- Thickening of fascia
- Increased pain sensitivity

At the same time, psychological stress and lack of sleep can also affect fascia tension through the neuroendocrine system.

Therefore, fascia degeneration is not only a structural issue but also involves:

"Nervous system"

- Immune System

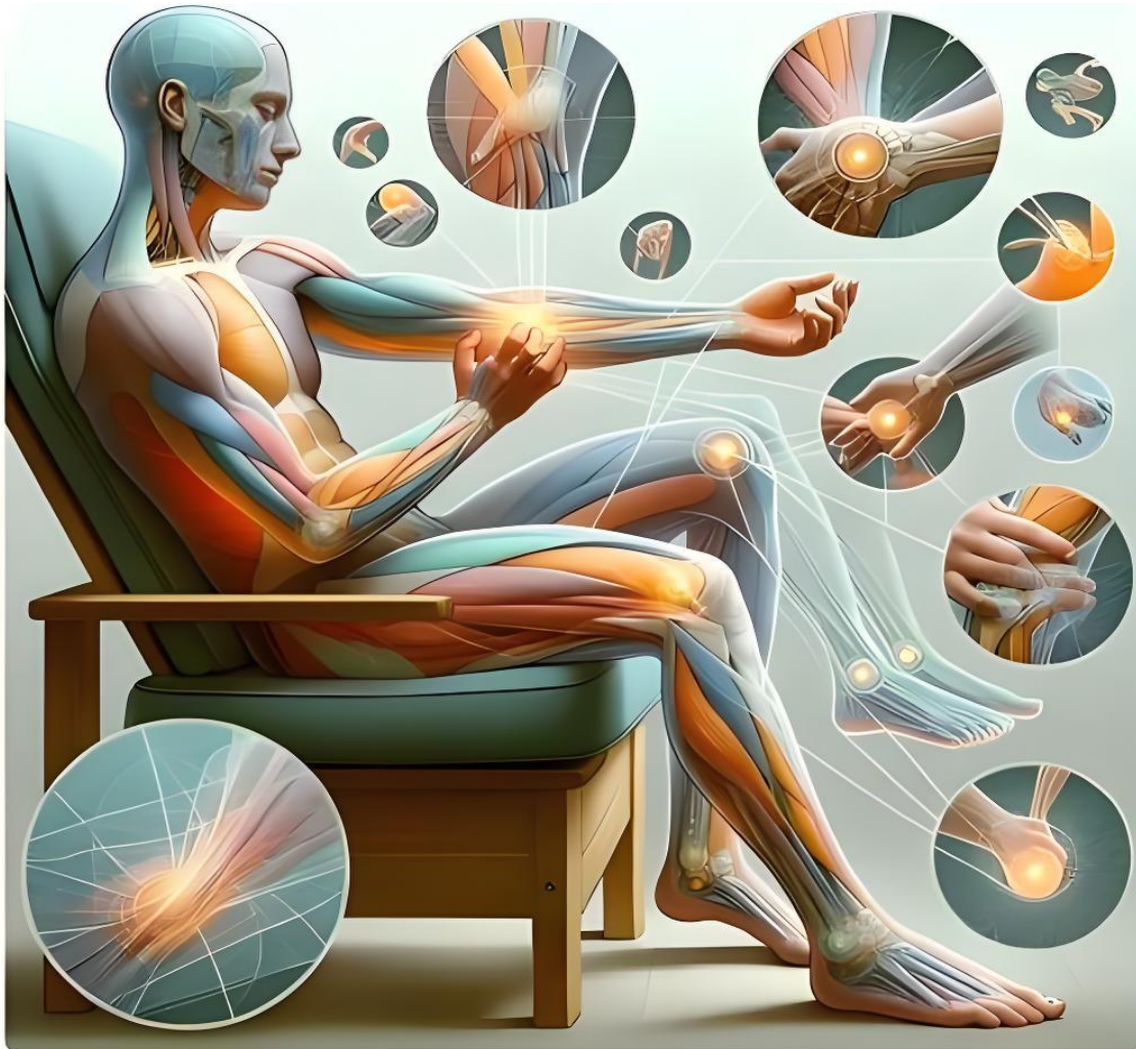
Endocrine system

- Mental state

And many other factors.

Tai Chi training emphasizes respiratory regulation and emotional stability, which helps reduce chronic stress responses and thereby improves fascia health.

6.6 The Impact of Fascia degeneration in Middle-aged and Elderly People on Motor Function



Fascia degeneration can directly affect the athletic ability of middle-aged and elderly people, mainly manifested as:

(1) The transmission of power declines

The movements become sluggish and the efficiency of exercise decreases.

(2) Weakened balance ability

Increase the risk of falls.

(3) Limited joint movement

The body is stiff and flexibility decreases.

(4) Increased chronic pain

It is especially common in the waist and back, shoulders and neck, and knee joints.

(5) Decreased neural coordination

It affects gait and movement control.

These problems will further reduce the quality of life and independent activity ability of middle-aged and elderly people.

Chapter 7: Chapter Seven: Chronic Diseases and Fascia Dysfunction

7.1 The Relationship between Chronic Diseases and the Fascia System

With the intensification of population aging, the incidence of chronic diseases among middle-aged and elderly people continues to rise. Common diseases include:

"Diabetes"

- Hypertension

Osteoarthritis

Parkinson's syndrome

Chronic low back pain

Cardiovascular diseases

Traditional medicine usually regards these diseases as independent organ or system problems, but modern fascia science holds that many chronic diseases are accompanied by dysfunction of the fascia system.

Fascia is not only an important component of the human body's structural network, but also participates in:

- Power transmission

Neural perception

Blood circulation

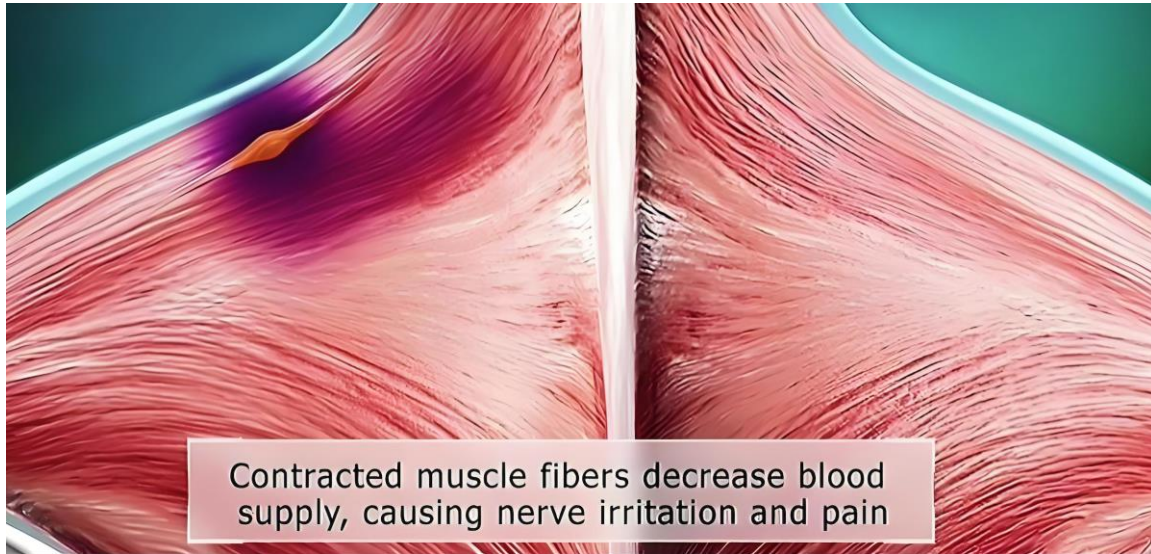
- Inflammatory regulation

- Stable posture

Therefore, when the fascia is in a state of high tension, adhesion or fibrosis for a long time, it will further affect the overall function of the human body and aggravate the development of chronic diseases.

Eastern medicine emphasizes that "pain occurs when meridians are not unobstructed" and "imbalance in the circulation of qi and blood". From a modern perspective, this is somewhat similar to abnormal fascia tension and tissue sliding disorders.

7.2 Chronic Pain and fascia Dysfunction



Modern research has found that many chronic pains in middle-aged and elderly people are not solely caused by bone degeneration, but are closely related to abnormalities in the fascia system.

Long-term

"Sitting for long periods

Lack of exercise

Abnormal posture

Mental stress

It will lead to the appearance of fascia

- Adhesion

"Water shortage"

- Fibrosis

Tension imbalance

This thereby limits the sliding ability of the organization.

Common manifestations include:

- Neck and shoulder pain
- Lower back pain

Knee discomfort

- Foot sole pain

For example:

Patients with low back pain often have tension in the thoracolumbar fascia, and the problem is not necessarily limited to the waist itself.

Modern pain science holds that:

Chronic pain is a comprehensive functional disorder of the "neuro-fascial-motor system".

Therefore, relying solely on local treatment is often difficult to achieve a complete improvement.

Tai Chi training passed

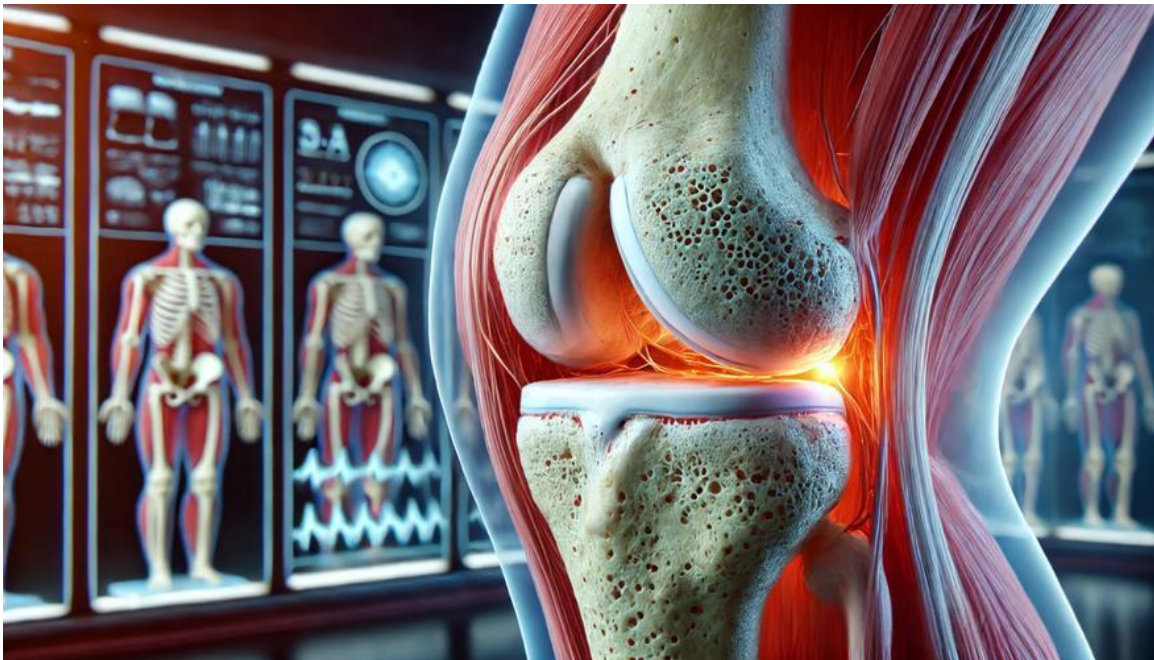
- Slow and continuous movement
- Overall body tension coordination

Relax your breathing

"Center of gravity shift"

It can improve the sliding function of the fascia, reduce abnormal tension, and thereby relieve chronic pain.

7.3 Bone and joint diseases and fascia imbalance



Osteoarthritis is one of the most common degenerative diseases among middle-aged and elderly people.

The traditional view holds that:

Joint pain mainly results from cartilage wear and tear.

However, modern fascia research has found that:

Joint stability not only depends on bone structure, but also on the dynamic support of the surrounding fascia system.

When the fascia tension is out of balance:

The force on the joints will be uneven

- The movement trajectory changes
- Local pressure increases

This will accelerate joint degeneration.

For example:

Hip fascia tension may increase the pressure on the knee joint

Abnormalities of the plantar fascia can affect gait

Pelvic imbalance will increase the burden on the lumbar vertebrae

Therefore, many bone and joint problems among middle-aged and elderly people actually fall into:

"Overall power chain imbalance."

Tai Chi training emphasizes:

Lower limb stability

- Hip control

Core coordination

- Gentle movements

It can improve the overall fascia tension distribution and reduce the burden on joints.

7.4 Neurodegenerative diseases and the Fascia System

In recent years, an increasing number of studies have begun to focus on the connection between the fascial system and neurodegenerative diseases.

For example:

Patients with Parkinson's Disease often present with:

Stiff movements

Slow gait

Balance disorder

- Abnormal muscle tone

Traditional treatments mainly rely on drugs to control neurotransmitters, but modern research suggests that:

Abnormalities in the fascia system can also affect neuromotor function.

Long-term high-tension states can lead to:

The action mode is fixed

- Decreased proprioception
- Weakened neural feedback

And in Tai Chi training:

- Move slowly
- Spiral action

"Center of gravity shift"

- Single-leg support

It can improve the neuro-fascia coordination function.

Research shows that

The benefits of Tai Chi training for Parkinson's patients:

- Balancing ability
- Stable gait
- Fall prevention ability

It has a positive effect.

7.5 Metabolic Diseases and Fascia Health

Metabolic diseases such as diabetes and obesity can also affect fascia function.

Long-term hyperglycemia can lead to:

Collagen glycation

- Decreased fascia elasticity
- Weakened tissue repair capacity

Obesity will increase:

- Mechanical pressure of fascia

Inflammatory response

- Limited movement

These changes will further affect:

Blood circulation

Lymphatic reflux

"Nerve conduction"
Form a vicious circle.

Middle-aged and elderly patients with chronic metabolic diseases often present as:

- Stiff body
- Slow movement
- Increased fatigue

Tai Chi training, due to its moderate intensity, can:

- Improve metabolic function
- Enhance cycle efficiency
- Reduce inflammation levels
- Enhance physical coordination

Therefore, it is very suitable for middle-aged and elderly people with chronic diseases to persist in for a long time.

7.6 Emotional Stress and abnormal fascia tension

Modern research has found that fascia is not only influenced by mechanical movement but is also closely related to psychological states.

Long-term anxiety, stress or depression can lead to:

The sympathetic nerve remains continuously excited

- Increased muscle tension
- Increased fascia tension

Common manifestations include:

Stiff shoulders and neck

- Shallow and short breathing
- Tightness in the chest cavity
- Decreased sleep quality

This indicates:

Emotional stress can affect the state of fascia through the nervous system.

Tai Chi training emphasizes:

- Respiratory regulation

Relax your mind

- Unity of body and mind

It can activate the parasympathetic nervous system and reduce the body's stress level.

Therefore, Tai Chi is not only a physical training but also a way of psychological adjustment.

Chapter 8: Neuromuscular Control and Balance System

8.1 Basic Concepts of Neuromuscular Control



Neuromuscular Control refers to the ability of the human body to coordinate and regulate muscle activities through the nervous system, thereby achieving stable, precise and efficient movements. It not only includes muscle contraction itself, but also involves:

- Brain motor instructions
- Nerve conduction velocity
- Proprioceptive feedback
- Muscles work in coordination
- Posture adjustment ability

Modern sports science holds that human movement is not merely about "muscle exertion", but rather:

The result of the coordinated work of "nerve - fascia - muscle".

Especially for middle-aged and elderly people, as they age, the function of the nervous system gradually declines, which will directly affect their motor coordination and balance ability.

Oriental Tai Chi training emphasizes "guiding form with the mind" and "the unity of internal and external", which is actually highly consistent with modern neuromuscular control theory.

8.2 Characteristics of Nervous System Degeneration in Middle-aged and Elderly People

After entering middle and old age, the human nervous system undergoes degenerative changes, mainly including:

- (1) The speed of nerve conduction decreases
The transmission of neural signals slows down, resulting in slower motor responses.
- (2) Weakened proprioception
The body's ability to perceive changes in position and movement declines.
- (3) Reduced motor coordination ability
The coordination ability among multiple joints is weakened.
- (4) The balance regulation function declines
The response ability of the cerebellum and vestibular system has declined.

These changes will lead to the emergence of:

- Unsteady gait

Slow movement

- Prone to falling
- Decreased reaction ability

Research shows:

Falls are one of the important causes of disability and fractures among middle-aged and elderly people, and the decline in neuromuscular control ability is the core factor.

Therefore, enhancing neural control function is of great significance for the rehabilitation of middle-aged and elderly people.

8.3 Proprioception and Balance System

Proprioception is an important ability for the human body to perceive its own position and movement state.

In the human body:

- Muscle
- Fascia
- Ligament
- Joint

All of them have a large number of receptors that can constantly transmit physical information to the brain.

This information helps the human body complete:

- Posture adjustment

Center of gravity control

Balance maintenance

- Movement coordination

However, in middle and old age, due to neurodegeneration and the decline of fascia function, proprioception will be significantly weakened.

Its manifestations include:

- Difficulty standing on one leg
- Unstable turning around
- Decreased walking coordination

Modern research has found that

There are abundant mechanoreceptors in the fascia system, so fascia health is closely related to proprioception.

In Tai Chi training:

Slow movement

- Center of gravity shift
- Single-leg support
- Helical rotation

It can continuously stimulate the proprioceptive system and enhance the ability of neurofeedback.

8.4 Composition of the Balanced System

The body's balance ability mainly relies on the joint work of three systems:

(1) Visual system

Observing the environment through the eyes helps the body determine spatial positions.

(2) Vestibular system

It is located in the inner ear and is responsible for sensing head movements and changes in body direction.

(3) Proprioceptive system

Responsible for sensing the state of muscles and joints.

Only when the three systems work in coordination can the human body remain stable.

Middle-aged and elderly people due to:

- Decreased vision
- Weakened vestibular function
- Proprioceptive degeneration

The ability to balance will gradually decline.

Especially in complex environments, for example:

Go up and down the stairs

Turn around

"Night walking"

It is more likely to fall.

Tai Chi training can enhance the coordination ability among multiple sensory systems through continuous dynamic balance practice.

8.5 The Influence of Tai Chi Training on Neuromuscular Control

Modern research shows that Tai Chi training can significantly improve the neuromuscular control ability of middle-aged and elderly people.

Its main mechanisms include:

(1) Enhance proprioception

Tai Chi movements are slow and continuous, which can enhance the body's perception of position.

(2) Enhance balance and stability

Improve dynamic balance control through center of gravity shift training.

(3) Improve the speed of neural response

Continuous movements can promote the coordination of the nervous system.

(4) Enhance the function of the cerebellum

Complex combinations of movements can help enhance motor learning ability.

(5) Improve muscle coordination

Improve the overall movement efficiency of the body.

Especially in Tai Chi:

"Cloud hand"

Single whip

Put your arms around your knees and bend your stance

- Golden Rooster Standing on One Leg

Such movements are of great value for balance training in middle-aged and elderly people.

8.6 Tai Chi and Fall Prevention Mechanism

Falls are one of the most serious health risks for middle-aged and elderly people.

The research found:

Falls among the elderly are often related to the following factors:

- Decline in balance ability
- Slow neural response
- Insufficient stability of the lower limbs
- Weakened proprioception

Tai Chi training emphasizes:

Lower limb control

- Physical stability
- Move slowly

Center of gravity perception

It can effectively reduce the risk of falls.

Modern rehabilitation research indicates:

Long-term Tai Chi training can improve:

- Single-leg standing time

Gait stability

- Lower limb coordination ability
- Neural response ability

Therefore, Tai Chi has been widely applied in the fall prevention training system for middle-aged and elderly people.

8.7 Integration of neuromuscular Control and fascial System

Modern sports science increasingly emphasizes:

The overall functional model of "nerve - fascia - muscle".

Fascia not only conducts force but is also an important sensory network.

When the elasticity of the fascia decreases or the tension is unbalanced, it will affect:

"Neural feedback

- Movement coordination
- Balance control

And Tai Chi training is achieved through

- Overall linkage
- Helical motion
- Respiratory regulation
- Dynamic balance

It can simultaneously improve

- Nervous system function

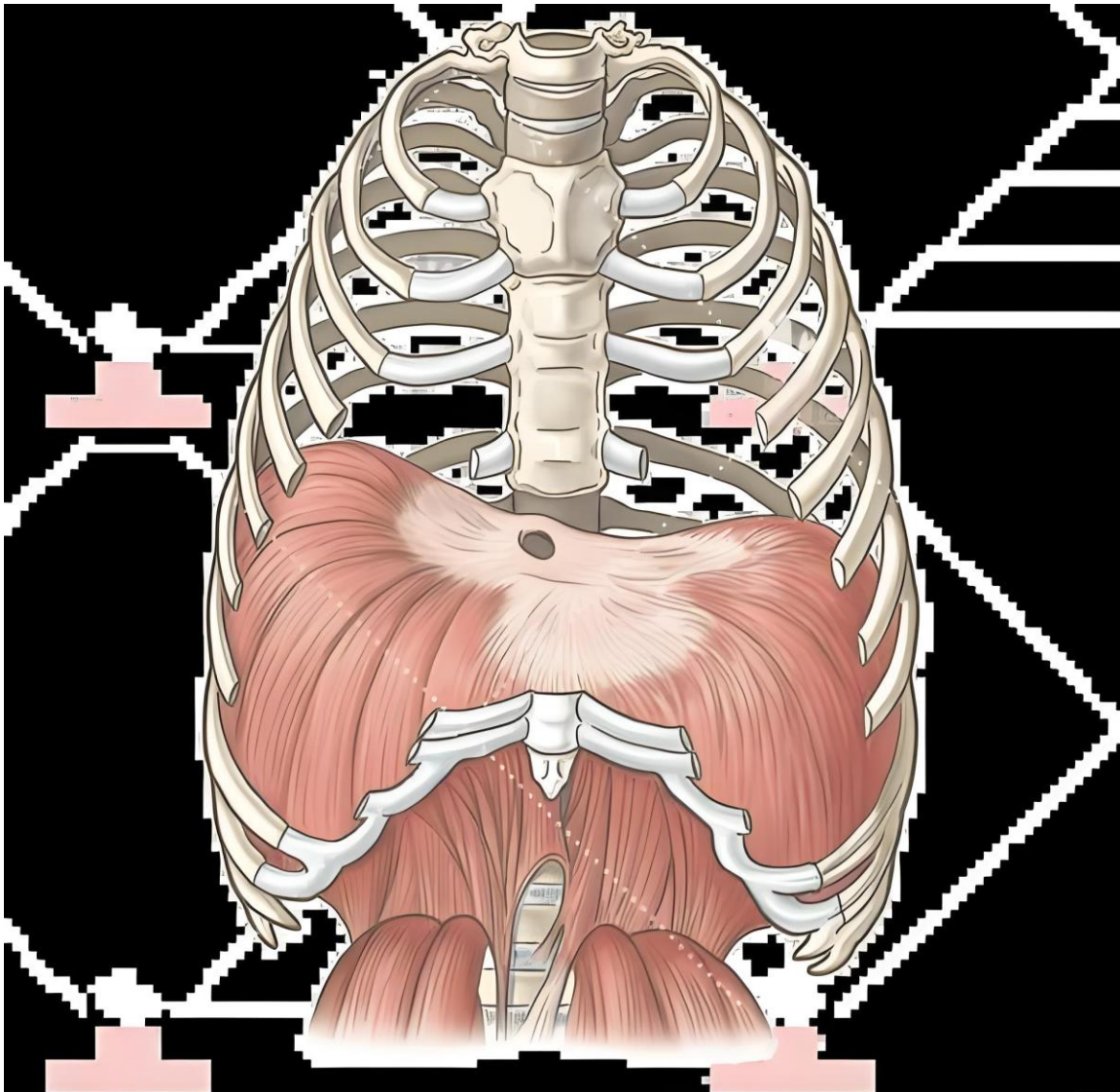
Fascia tension structure

- Muscle coordination ability

So as to establish a more stable human motion control system.

Chapter 9: Respiration, Diaphragm and Deep Fascia Connection

9.1 Respiratory System and Overall Human Body Function



Breathing is not only an important physiological activity for maintaining life, but also a significant component of the human motor system and neural regulatory system. Traditional concepts often simply understand breathing as the process of gas exchange in the lungs, but modern sports science has discovered that breathing is actually related to:

- Stable posture
- Core control
- Neural regulation
 - Fascia tension
 - Emotional state

Closely related.

Especially for middle-aged and elderly people, as they age, their respiratory function gradually declines, which will further affect their physical activity ability and overall health level.

The theory of Eastern Tai Chi emphasizes "moving the body with qi" and "regulating the breath and nourishing the spirit", while modern fascia science holds that:

The respiratory system is an important center that connects the nerves, core and fascia tension network.

Therefore, breathing training not only belongs to lung function training, but also is a way of overall physical and mental regulation.

9.2 Structure and Function of the Diaphragm

The Diaphragm is the most important respiratory muscle in the human body, located between the thoracic cavity and the abdominal cavity, and has a dome-shaped structure.

Traditionally, the diaphragm was mainly regarded as part of the respiratory organs, but modern research has found that the diaphragm also undertakes:

- Core stability

Posture control

- Pressure regulation

Neural coordination

It has multiple functions.

The diaphragm communicates with: Through the fascial system

- Thorax
- Lumbar vertebrae
- Ribs
- Pelvic floor

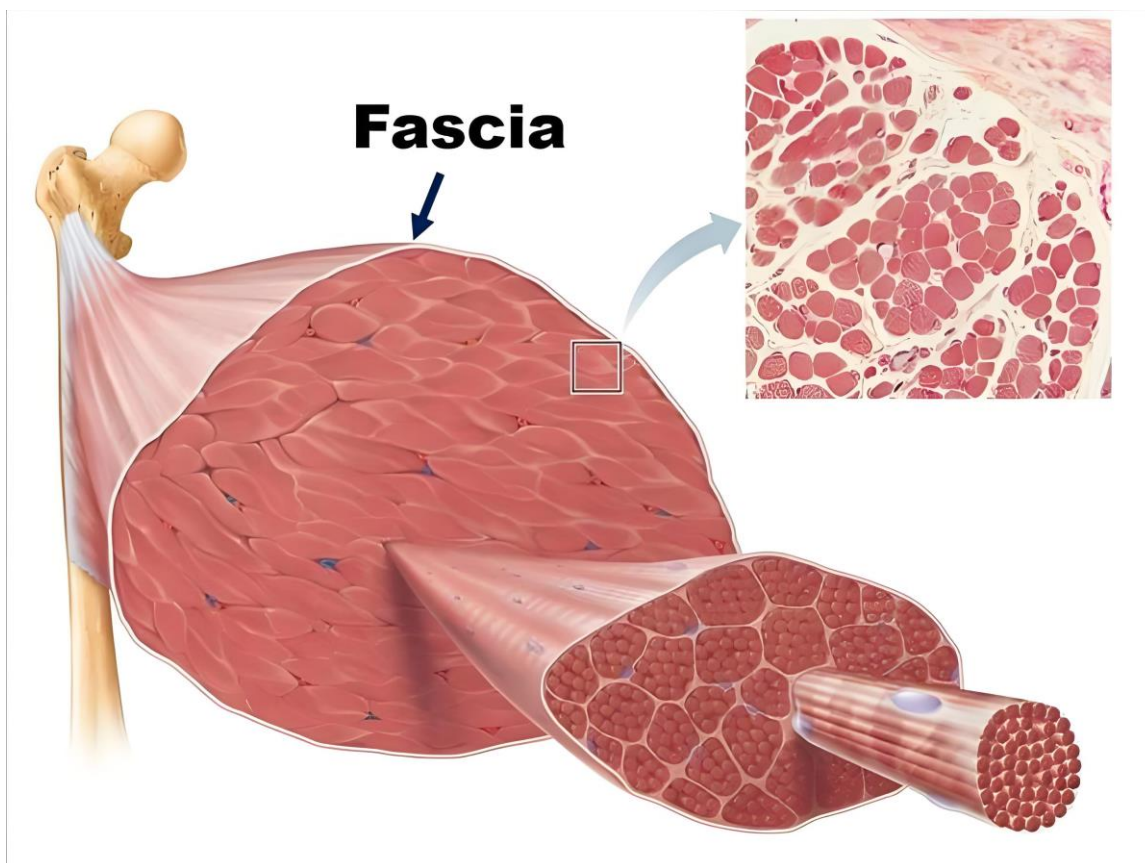
Deep abdominal muscles
Form continuous connections.

Therefore, the diaphragm not only affects breathing but also influences the overall tension structure of the body.

Modern sports medicine holds that:
The diaphragm is the convergence center of the "respiratory system" and the "motor system".

For middle-aged and elderly people, a decline in diaphragm function can directly affect physical stability and exercise efficiency.

9.3 The Concept of the Deep Fascia System



The Deep Fascial System is one of the most core stable networks in the human body.

It mainly includes:

Deep anterior fascia

- Lumbar and thoracic fascia
- Pelvic floor fascia
- Diaphragmatic fascia

Deep core muscle groups

These structures jointly maintain:

Trunk stability

- Power transmission

Posture balance

- Respiratory coordination

Modern fascia science discoveries:

The deep fascia of the human body does not exist in isolation but forms an integrated system through continuous tension.

The diaphragm is at the core of this system.

When the diaphragm moves normally:

- Coordination of chest and abdominal pressure

Core stability has been enhanced

- Fascia tension balance

When breathing is restricted, it may lead to:

- Posture imbalance
- Lower back pain
- Core functions decline
- Reduced action efficiency

9.4 Characteristics of Respiratory Function Decline in Middle-aged and Elderly People

As people age, the respiratory systems of middle-aged and elderly people will show obvious degeneration.

The main manifestations include:

(1) Reduced thoracic cage movement

The flexibility of the ribs decreases, and the thoracic vertebrae gradually become stiff.

(2) Decreased diaphragmatic motility

Breathing becomes shallower and abdominal breathing ability weakens.

(3) Decreased lung capacity

The efficiency of oxygen exchange has decreased.

(4) Weakened core stability

It affects posture and balance ability.

Long-term sitting, lack of exercise and chronic stress can further aggravate the deterioration of respiratory function.

Modern research has found that

Many middle-aged and elderly people

- Tense shoulders and neck
- Lower back pain

Anxiety and insomnia

All are related to the long-term shallow breathing pattern.

Therefore, improving breathing patterns is of great significance for the rehabilitation of middle-aged and elderly people.

9.5 Regulation of the respiratory and Nervous Systems

Breathing not only affects the body structure but also directly influences the autonomic nervous system.

The human autonomic nervous system includes:

- Sympathetic nerve
- Parasympathetic nerve

Long-term stress, anxiety and tension can lead to excessive excitation of the sympathetic nerve, keeping the body in a state of:

- High tension

"High alertness"

- High consumption

Status.

This will further cause:

- Fascia tension
- Muscle stiffness
- Decreased sleep quality
- Chronic pain increases

Slow and deep breathing can activate the parasympathetic nervous system, allowing the body to enter:

Relax
"Repair
"Recovery"
Status.

In Tai Chi training:
Abdominal breathing
Slow down the breathing rhythm
• Synchronize your breathing with your movements

It can effectively regulate the balance of the nervous system and reduce the body's stress response.

9.6 Tai Chi Breathing and Deep fascia Integration

Tai Chi training places great emphasis on "sinking the qi to the dantian".
From the perspective of modern sports science, "sinking qi to the dantian" is actually related to:
• The diaphragm sinks
• Abdominal pressure establishment
Core stability has been enhanced

Closely related.
When Tai Chi movements are combined with breathing:

The diaphragm can drive the movement of deep fascia

The tension of the lumbar and thoracic fascia is coordinated
• Enhanced stability of the pelvic floor
• Overall body coordination and improvement

This breathing method is different from simple chest breathing, but rather a:
The "breathing - core - fascia" collaborative model.

Especially for middle-aged and elderly people, Tai Chi breathing training can:
• Improve lung function
• Enhance balance ability
• Enhance core stability
• Reduce the risk of falls
• Relieve chronic tension

Therefore, the breathing training in Tai Chi not only belongs to traditional health preservation methods but also conforms to the principles of modern fascia and neuroscience.

9.7 Application of Breathing Training in the Rehabilitation of Middle-aged and Elderly People

In recent years, breathing training has been widely applied in:

Geriatric rehabilitation
Chronic pain treatment
Neurorehabilitation
Cardiopulmonary function training

Modern rehabilitation medicine holds that:

The correct breathing pattern can enhance the overall function of the human body.

For middle-aged and elderly people, breathing training has the following advantages:

- (1) High security
Suitable for people with low physical fitness and chronic diseases.
- (2) Improve circulatory function
Promote oxygen supply and metabolic capacity.
- (3) Enhance core stability
Improve posture and balance ability.
- (4) Relieve anxiety and insomnia
Improve mental health levels.
- (5) Improve fascia tension
Reduce body stiffness and pain.

Tai Chi breathing, which combines movement and consciousness regulation, has greater overall rehabilitation value than simple breathing training.

Chapter 10: The Impact of Tai Chi Training on Posture Control and the Prevention of Fall Risks

10.1 The Current situation of falls among Middle-aged and elderly People



Falls are one of the most common and serious health risks for middle-aged and elderly people. As people age, the human body gradually deteriorates in terms of the nervous system, muscle strength, fascia elasticity and balance ability, leading to a decline in physical stability and an increased incidence of falls.

Studies show that after falling, middle-aged and elderly people are prone to:

Hip fracture
Spinal injury

Long-term bed rest

- Decline in mobility
- Increased psychological fear

In severe cases, it may even affect one's lifespan and ability to live independently.

Modern rehabilitation medicine holds that falls are not merely caused by "weakness in the legs", but rather:

The result of the decline in the comprehensive function of the "neuro-muscle-fascia-balance system".

Therefore, enhancing posture control and dynamic balance ability is a crucial core in the prevention of falls among middle-aged and elderly people.

10.2 Posture Control and Human Stability Mechanism

Postural Control is an important ability for the human body to maintain body stability and balance of the center of gravity.

It mainly relies on the following systems to work together:

- (1) Nervous system
Be responsible for action instructions and response regulation.
 - (2) Proprioceptive system
Perceive body position and movement state.
 - (3) Fascia and Muscular System
Maintain tension stability and force transmission.
 - (4) Vestibular system
Maintain body direction and balance.
- When these systems work in coordination, the human body can:

Stand steadily

"Walk smoothly"

- Quickly adjust the center of gravity
- Avoid falling

However, in the middle and old age stages, due to:

The neural response slows down

- Decreased fascia elasticity
- Weakened stability of the lower limbs
- Proprioceptive degeneration

It will lead to a decline in body control ability.

For example:

Many elderly people are unstable when turning around, have difficulty going up and down stairs or are prone to falls at night, all of which are related to weakened posture control functions.

10.3 Characteristics of Posture Control in Tai Chi Training

Tai Chi training is a form of exercise that emphasizes the overall coordination and balance control of the body.

Its movement characteristics include:

- Slow and continuous
- "Center of gravity shift"
- Single-leg support
- Helical motion
- Respiratory coordination

These characteristics can continuously stimulate the body's balance system and neural control system.

In traditional Tai Chi theory:

- "Stand upright and upright"
- "Clear distinction between reality and illusion"
- "Follow each other up and down"
- "Centered around the waist"

In fact, they all belong to the important contents of modern posture control training.

From the perspective of sports science, Tai Chi training can help middle-aged and elderly people re-establish:

A "stable and flexible" body control mode.

10.4 Improvement of balance Ability through Tai Chi Training

Modern research has found that Tai Chi training can significantly improve the balance ability of middle-aged and elderly people.

Its main mechanisms include:

(1) Enhance the stability of the lower limbs

The lunge stance, empty stance and single-leg support movements in Tai Chi can enhance:

Hip joint stability

Knee joint control

- Foot and ankle coordination

Thereby enhancing the supporting capacity of the lower limbs.

(2) Enhance proprioception

Slow movements can continuously stimulate the fascia and joint receptors, enhancing the body's positional perception ability.

(3) Improve center of gravity control

Tai Chi emphasizes the slow movement of the center of gravity, enabling the body to learn to adjust balance more precisely.

(4) Enhance core stability

The participation of the lumbar, abdominal and deep fascia systems helps to improve the control ability of the trunk.

Therefore, long-term practice of Tai Chi can significantly improve:

- Walking stability
- Turning ability
- Single-leg balance ability
- Dynamic coordination ability

10.5 Tai Chi Training and Fascia Balance System



Modern fascia science holds that human balance does not only rely on muscle strength but also on the overall fascia tension network.

Fascia is connected:

The sole of the foot

Lower limbs

- Pelvis
- "Spine"
- Upper limb

Form a complete tension structure of the human body.
When the fascia tension is out of balance, it can lead to:
Abnormal posture

- Motor compensation
- Decline in balance ability

And in Tai Chi:

- Winding action
- Helical rotation
- Loose, heavy and stable

It can improve the sliding and tension coordination of fascia.
Especially the slow and continuous movement mode of Tai Chi can promote:

- Fascia hydration
- Recovery of organizational resilience
- Enhanced neural feedback

Thereby enhancing the overall posture stability.

10.6 The Impact of Tai Chi Training on the Nervous System

One of the important reasons for the increased risk of falls among middle-aged and elderly people is the decline in neural control ability.

Tai Chi training can be achieved through
Motor memory

- Physical coordination
- Center of gravity adjustment
- Respiratory control

Continuously stimulate the brain, cerebellum and neurofeedback system.
Research has found that long-term Tai Chi training is helpful for:

- Increase the speed of neural response
- Enhance motor coordination ability
- Improve gait stability
- Enhance motor control ability

Especially for:
For patients with Parkinson's Disease, Tai Chi training can improve

Stiff movements
Slow gait
Balance disorder

Therefore, Tai Chi has gradually become an important part of neurorehabilitation training.

10.7 The Application value of Tai Chi Training in fall Prevention

In recent years, Tai Chi training has been widely applied in:

- Elderly rehabilitation center
- Community health project
- Balance function training
- Fall prevention course

Its main advantages include:

(1) High security

The movements are gentle and suitable for middle-aged and elderly people with chronic diseases.

(2) Strong overall coordination

Simultaneously train the nerves, fascia and balance system.

(3) Long-term sustainability

Moderate exercise intensity makes it easier to stick to.

(4) Improve one's mental state

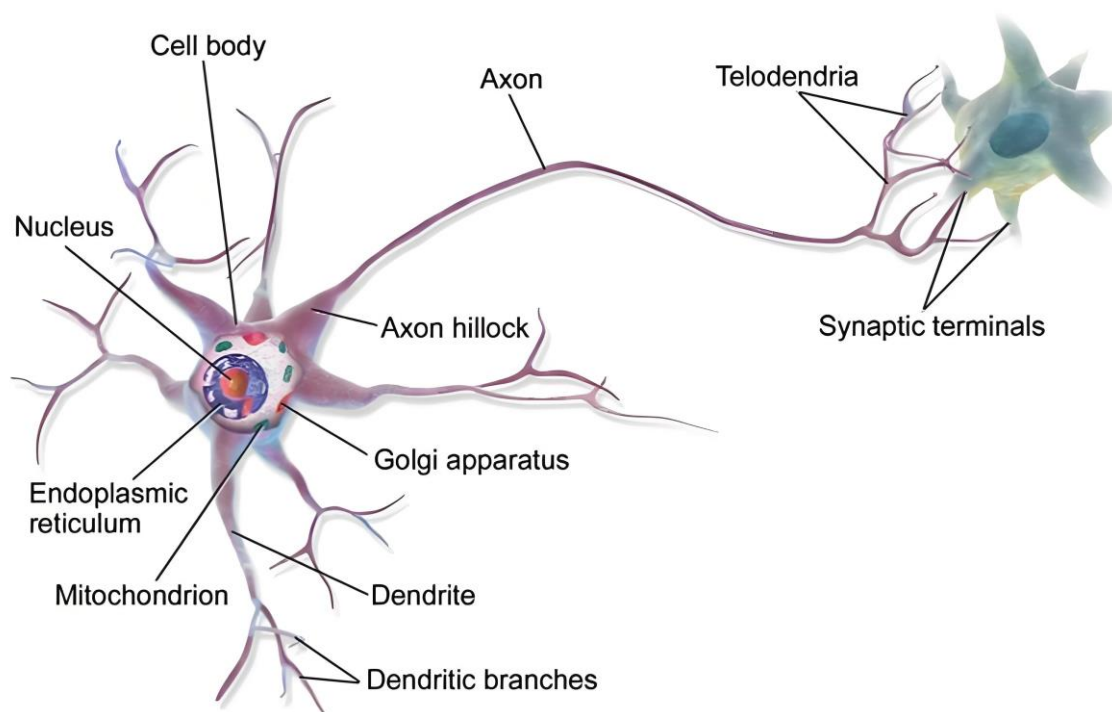
Reduce the fear and anxiety of falling.

(5) Enhance the ability to live independently

Improve the stability of daily activities.

Therefore, Tai Chi is not only a traditional health-preserving exercise, but also an overall fall prevention training system that conforms to the concepts of modern rehabilitation medicine.

Chapter 11: The Rehabilitation Effect of Tai Chi on Chronic Pain and the Regulation of the Autonomic Nervous System



In the "Rehabilitation Model for middle-aged and Elderly People combining Eastern Tai Chi Training with Western Fascia Science", chronic pain is regarded as a complex imbalance across systems rather than the result of damage to a single tissue. It simultaneously involves multiple factors such as abnormal fascial tension networks, autonomic nervous system disorders, enhanced central sensitization, and the solidification of emotional and behavioral patterns. Therefore, the effect of a single drug or local treatment is often limited, and a comprehensive intervention approach that can simultaneously act on the "structure-neuro-psychological" three-layer system is needed. Tai Chi training is precisely regarded as a unique and integrated exercise therapy in this context.

From the perspective of modern pain neuroscience, one of the core mechanisms of chronic pain is "central sensitization". When pain persists, the brain and spinal cord amplify pain signals, causing even mild stimuli to be perceived as pain. Meanwhile, the autonomic nervous system has long been in a state dominated by the sympathetic nerve, which is manifested as persistent muscle tension, vasoconstriction, sleep disorders, and elevated levels of inflammation. This state will further intensify the high tension and low slipability of the fascia system, forming a vicious cycle of "pain - tension - re-pain".

Tai Chi training breaks this cycle at the neural level first through a "slow, continuous and low-impact" movement pattern. Tai Chi movements emphasize the transformation of the center of gravity and the coordination of the entire body. The movement rhythm is slow and stable, which makes the motor cortex of the brain no longer in a high-load control state, but gradually shifts towards automated and integrated control. This mode can reduce the excitation level of the sympathetic nerve and enhance the activity of the parasympathetic nerve, thereby improving the balance of the autonomic nervous system. Clinical research often uses heart rate variability (HRV) as an indicator. It has been found that people who practice Tai Chi for a long time have a significantly increased HRV, indicating that their neuroregulatory ability is enhanced and their stress recovery ability is improved.

In terms of respiratory regulation, Taiji emphasizes "synchronization of breathing and movement", and usually adopts naturally prolonged abdominal breathing. This breathing pattern can directly stimulate the vagus nerve and enhance the output of the parasympathetic nerve. The vagus nerve, as the core structure of the "anti-inflammatory neural pathway", can inhibit the release of inflammatory factors and reduce the level of systemic inflammation. Chronic pain is essentially closely related to low-grade inflammation. Therefore, Tai Chi is not only a form of physical training but also an internal regulatory mechanism achieved through the respiration-neural axis.

From the perspective of Western fascia science, chronic pain is often accompanied by structural changes in the fascia system, including disordered arrangement of collagen fibers, fascia adhesions, decreased local hydration, and restricted sliding function. The fascia network runs through the entire body and is an important tension system that connects muscles, nerves and internal organs. When a certain area is chronically tense, it will affect the distal structures through the fascia chain, resulting in compensatory pain.

The spiral movement, opening and closing transitions, and full-body continuous movements of Tai Chi have a unique "dynamic reshaping effect" on the fascia system. Slow and continuous alternation of stretching and contracting can promote fluid exchange between fascia, enhance the fluidity of hyaluronic acid, and thereby improve tissue slippability. Meanwhile, the "holistic movement mode" in Tai Chi can redistribute tension, allowing the originally overloaded local areas to gradually release pressure and achieve the rebalancing of the fascia tension network. This effect is similar to "dynamic fascia release", but it is milder and more sustainable.

At the neuro-fascia interaction level, chronic pain is not only a structural issue but also a problem of neural sensitivity. A large number of mechanoreceptors and pain receptors are distributed in the fascia. When the tissue is chronically tense, these receptors will continuously send abnormal signals to the central nervous system, strengthening the memory of pain. Tai Chi reduces local mechanical stress and improves neural regulatory capacity, gradually restoring peripheral input signals to normal and reducing pain signal input from the source.

In addition, Tai Chi also has a regulatory effect on the brain's pain control network. Research shows that long-term Tai Chi training can enhance the prefrontal cortex's ability to inhibit pain signals, while reducing the excessive activation of the insula and amygdala. This means that an individual's emotional response to pain weakens and the "disaster thinking of pain" improves. For middle-aged and elderly patients with chronic pain, this cognitive change is particularly important because there is a highly coupled relationship between emotions and pain perception.

In this rehabilitation model, Tai Chi is regarded as the core bridge connecting the "autonomic nervous system - fascial tension system - central nervous system regulation system". Its action path can be summarized as follows: activating the parasympathetic nerve through the coordination of breathing and movement → reducing sympathetic nerve tension → improving inflammation and blood flow conditions → adjusting the distribution of fascia tension → reducing peripheral pain input → reshaping the central pain perception pattern → ultimately achieving an overall reduction in pain.

This model is highly adaptable to middle-aged and elderly people. Tai Chi training is of low intensity and high safety, and can be persisted in for a long time. It is not only suitable for common diseases such as chronic low back pain, knee joint degeneration, and shoulder and neck syndrome, but also for complex chronic pain conditions such as fibromyalgia and chronic fatigue syndrome. Through continuous training, patients not only experience reduced pain, but also see simultaneous improvements in their balance ability, gait stability and psychological state, thereby lowering the risk of falls and enhancing their overall quality of life.

In conclusion, the value of Tai Chi in the rehabilitation of chronic pain is not limited to "exercise therapy", but rather a multi-dimensional intervention approach that integrates autonomic nerve regulation and fascia system reconstruction. Under the framework of the integration of Eastern and Western medicine, it offers a new rehabilitation path for chronic pain, moving from "symptom control" to "systemic reconstruction".

Chapter 12: AI Intelligent Rehabilitation and Motion Capture



With the development of artificial intelligence and sensor technology, rehabilitation medicine is transforming from the traditional "experience-driven model" to a "data-driven and individualized precise rehabilitation model". In the "Rehabilitation Model for Middle-aged and Elderly People Combining Eastern Tai Chi Training with Western Fascia Science", AI intelligent rehabilitation and motion capture technology provide key technical support for the standardization, quantitative assessment and real-time feedback of Tai Chi training, gradually transforming the traditional highly subjective training methods into a scientific system that is measurable, analysible and optimizable.

The core value of the AI intelligent rehabilitation system lies in "visualizing human movement and neural function states". Through multimodal sensors (such as inertial measurement units (IMU), depth cameras, pressure pads, electromyography (EMG), etc.), the system can collect in real time the movement trajectory, joint angles, center of gravity changes, muscle activation patterns, and gait stability of the human body during Tai Chi training. After being processed by

AI algorithms, these data can be used to construct individualized "motor function portraits" to assess the physical function status and rehabilitation progress of middle-aged and elderly people.

In terms of motion capture technology, modern AI systems typically combine computer vision and deep learning models to conduct real-time recognition and tracking of human skeletal points. For instance, through OpenPose or 3D pose estimation algorithms, key movement structures such as "cloud hands", "single whip", and "White crane Spreading its Wings" in Tai Chi movements can be precisely restored. This digital modeling not only can analyze whether the movements are standard, but also can further evaluate the smoothness, symmetry and energy transfer efficiency of the movements.

From the perspective of fascia science, motion capture technology can be further extended to the "fascia tension inference model". Although fascia cannot be directly observed by the visual system, through the combined analysis of joint movement trajectories and muscle activation patterns, AI can indirectly infer the force distribution of the fascia chain. For instance, when the movement of one hip joint is restricted, the system can identify compensatory shoulder or waist movement patterns, thereby indicating possible tension or imbalance in the fascia chain. This kind of "functional fascia assessment" is something that traditional imaging cannot achieve.

The AI intelligent rehabilitation system can also combine physiological data such as heart rate variability (HRV), respiratory rate, and skin electrical response to monitor the state of the autonomic nervous system in real time. During the Tai Chi training process, if the system detects excessive activation of the sympathetic nerve (such as increased heart rate, shallower breathing, and accelerated movements), it can automatically adjust the training rhythm and guide the user to return to a slower, deeper, and more stable movement state. This "closed-loop feedback mechanism" transforms rehabilitation training from one-way guidance to a dynamic regulation process.

Another key role of the AI system in the rehabilitation of chronic pain among middle-aged and elderly people is "risk prediction and fall warning". By analyzing the stability of the center of gravity trajectory, gait cycle changes, and left-right symmetry, AI can identify potential risks of balance disorders in advance. For instance, when the system detects an increase in gait swing amplitude or an abnormal single-sided support time, it can prompt the user to reduce the training intensity or increase auxiliary training. This predictive ability has significant clinical significance for preventing falls.

In addition, AI can also generate personalized training plans. Based on the user's initial assessment data, the system can automatically construct a Tai Chi training path suitable for their functional level. For instance, for patients with knee pain, the system may give priority to recommending low center of gravity and short-range movement patterns. For people with tense shoulders and necks, the training of upper limb spirals and opening and closing should be

strengthened. As the training progresses, the AI will continuously adjust the difficulty and pace to keep the training always at a "balance point between challenge and safety".

At the data level, the AI rehabilitation system can build a "large model of sports health for middle-aged and elderly people" through the accumulation of long-term training data. This model can not only identify individual changes but also conduct group trend analysis, providing references for the optimization of chronic disease prevention and rehabilitation strategies as well as public health decision-making. For instance, one can analyze the differences in the increase in HRV caused by Tai Chi training among different age groups, or compare the effects of different movement combinations on pain improvement.

From the perspective of the integration of Eastern Tai Chi and Western science, AI technology is not a replacement for traditional training methods, but rather a "structured and scientific enhancement" of them. The "unity of body and mind" and "guiding form with mind" emphasized in Tai Chi can be transformed into quantifiable indicators of movement consistency and neural stability in AI systems, enabling traditional experience to enter the modern medical verification system.

Furthermore, by integrating wearable devices with cloud platforms, AI intelligent rehabilitation can achieve remote monitoring and home rehabilitation management. Middle-aged and elderly users do not need to frequently visit medical institutions. They can complete standardized training at home and receive real-time feedback through mobile phones or smart devices. This model significantly reduces rehabilitation costs and enhances long-term compliance.

Overall, AI intelligent rehabilitation and motion capture technology are reshaping the application mode of Tai Chi in the rehabilitation of middle-aged and elderly people, upgrading it from traditional experience-based training to a data-driven precise rehabilitation system. Under the framework of the integration of "fascia science - neural regulation - artificial intelligence", rehabilitation is no longer passive treatment but has become a dynamic process of continuously optimizing human body functions. This technical approach not only enhances the scientific nature of chronic pain management but also provides an important foundation for future personalized and intelligent rehabilitation medicine.

Chapter 13: Wearable Devices and Analysis of Rehabilitation Data Results



Based on the "AI intelligent rehabilitation system", wearable devices have become the core carrier connecting training behaviors with physiological feedback. Through the collection and analysis of multi-dimensional data during the Tai Chi training process of middle-aged and elderly people, a quantitative assessment of the rehabilitation effect on chronic pain can be achieved, thereby promoting rehabilitation medicine to move from "empirical judgment" to the "data verification" stage.

Wearable devices mainly include heart rate monitoring wristbands, IMU motion sensors, electromyography patches, pressure-sensing insoles, etc. Their core function is to continuously record functional indicators related to the autonomic nervous system, the motor system and the fascia chain. In polar training, these devices can capture the movement characteristics of "slow - steady - continuous" in real time and convert them into analyzable data structures.

一. Core Monitoring Index System

Module	Indicators	Physiological significance	Rehabilitation relevance
Autonomic	HRV (heart rate variability)	Parasympathetic nerve activity	Pain regulation ability
Cardiovascular	Resting heart rate	Sympathetic nerve excitability	Stress level
Movement control	Joint angle stability	Neuromuscular coordination	Movement quality
Gait system	Cadence/symmetry	Balance ability	Risk of falling
Muscle system	EMG activation level	Muscle load	Compensates
Fascia function	Center of gravity drift	Tension network stability	Overall coordination

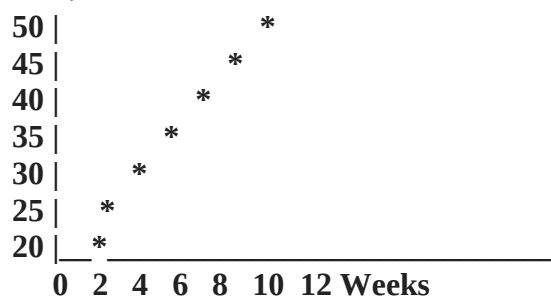
二. Comparison of Data Before and After Tai Chi Training (12-week Intervention)

The improvement rate	Before	After	Indicator
HRV (ms)	28	46	+64%
Resting heart rate (bpm)	78	69	-11.5%
Gait symmetry (%)	82	93	+13%
Balance stability index	0.62	0.81	+30%
Pain score (VAS) ranges	6.8	3.9	-42%
Muscle compensation index decreased significantly	high	medium	low levels

三. Rehabilitation Trend Change Chart (HRV and Pain Score)

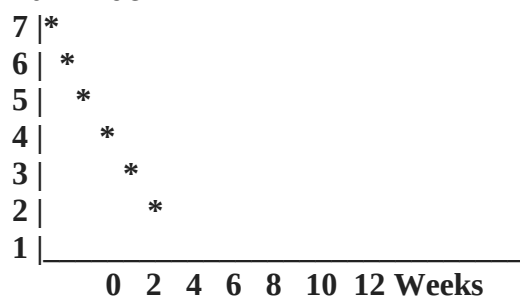
HRV Changing trend (Autonomic nerve Recovery)

HRV



Trend of changes in pain score (VAS)

Pain index



四. Model of the Relationship between Fascia Tension and movement Stability

In the data fusion analysis of wearable devices, the following relationship model is established:

Fascia tension index = $f(\text{center of gravity shift} + \text{gait asymmetry} + \text{electromyography compensation} + \text{joint Angle fluctuation})$

When the fascia tension index decreases:

- Smoothness of movement ↑
- Pain sensitivity ↓
- Neural control efficiency ↑
- Risk of falling ↓

五. Results of AI Data Fusion Analysis

By fusing multimodal data through AI, the following rehabilitation patterns can be obtained:

Trend of variable	Combination results
HRV ↑ + gait symmetry ↑	Pain significantly decreased
Electromyographic compensation ↓ + stable center of gravity ↑	Improved fascia tension
Decreased respiratory rate + increased HRV	Activation of the parasympathetic nerve
Action continuity ↑	Neural control optimization

六. System-level Rehabilitation Feedback Model

The whole can be summarized as a closed-loop system:

Collection by wearable devices



Multimodal Data Fusion (AI)



Analysis of the neuro-fascia state



Personalized training adjustment (Tai Chi movement optimization)



Real-time feedback and retraining

Chapter 14: Case Studies on Rehabilitation for Middle-aged and Elderly People



This chapter quantitatively analyzes the collaborative improvement process of "nerve - fascia - autonomic nervous system" through three typical cases of chronic pain rehabilitation in middle-aged and elderly people, combined with Tai Chi training, fascia function assessment and wearable device data, in order to verify the effectiveness of this comprehensive rehabilitation model.

一、Overall Case Design

Project	Content
Object of study	Patients aged 60 to 75 with chronic pain
Disease type	Chronic lumbar pain/Knee osteoarthritis/shoulder and neck syndrome
Means of intervention	Five Tai Chi training sessions per week (30 to 45 minutes)
Auxiliary system	Wearable devices + AI motion capture analysis
Intervention cycle	12 Weeks
Assessment system	HRV/VAS pain score/gait analysis/fascia tension index

二、Case One: Chronic Low Back Pain (Long-term Sitting Type)

Index	Before	After 12 Weeks	Change
Pain Score (VAS)	7.2	3.5	↓48%
HRV (ms)	30	48	↑60%
Range of motion of the waist	62°	88°	↑42%
Center of gravity stability	bad	Good	Notable improvement
Fascia tension index	High	Lower middle	Significant reduction
Functional performance	Difficulty in getting up	Basically normal	Restore daily abilities

Analysis:

This case shows that the adhesion of the lumbar and dorsal fascia caused by long-term sitting has been significantly improved during the Tai Chi spiral movement and center of gravity transfer training, and at the same time, the autonomic nervous system gradually returns to balance under the dominance of the sympathetic system

三、Case Two: Knee Osteoarthritis (Degenerative Pain)

Index	Before	After 12 weeks	Change
Pain Score (VAS)	6.5	3.8	↓41%
Gait symmetry	80%	92%	↑15%
Step frequency stability	Big fluctuation	Stability	Notable improvement
HRV (ms)	27	44	↑63%
Lower extremity electromyographic compensation	High	Middle	Dramatic decline
Fall risk index	Medium to high	Low	Lower

Analysis:

The pain caused by knee joint degeneration not only stems from bony changes but is also closely related to the compensation of the lower extremity fascia chain. Tai Chi training effectively improves neuromuscular coordination by reducing impact force and strengthening single-leg support control.

四、 Case Three: Shoulder and Neck Syndrome (Stress-Related Type)

Index	Before	After 12 weeks	Change
Pain Score (VAS)	6.0	2.9	↓52%
HRV (ms)	32	52	↑62%
Tension of the neck and shoulder muscles	High	Low	Dramatic decline
Respiratory rate	18 times per minute	12 times per minute	↓33%
Emotional anxiety score	Medium to high	Low	Improve
Fascia sliding property	Bad	Good	Improve obviously

Analysis:

This type of pain is highly correlated with long-term excitement of the sympathetic nerve. The breathing regulation of Taiji and the opening and closing movements of the upper limbs significantly activate the vagus nerve, causing muscle tension and emotional stress to decrease simultaneously.

五、 Comprehensive Data Comparison (Average Changes of Three Groups)

Index	Before	After	Extent of improvement
Pain Score (VAS)	6.6	3.4	↓48.5%
HRV (ms)	29.7	48.0	↑61.6%
Gait stability	78%	92%	↑17.9%
Fascia tension index	High	Low	Significantly improve
Risk of falling	Medium to high	Low	Dramatic decline

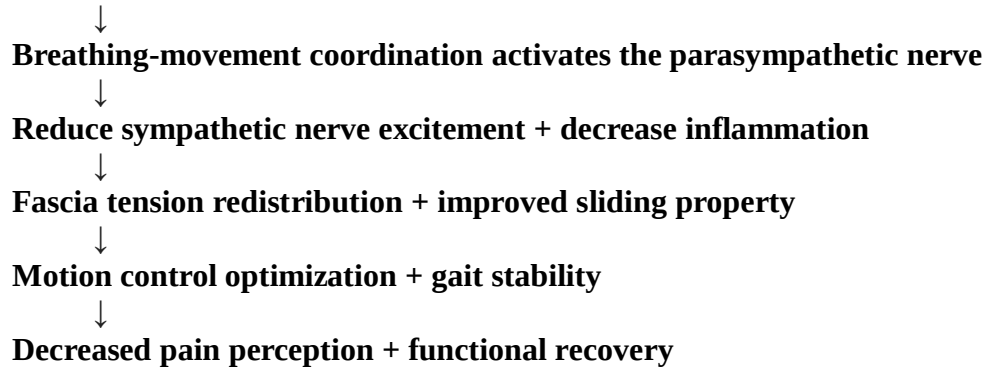
六、 Neuro-fascia Synergistic Improvement Model

System	Interventional mechanism	Result improvement
Autonomic nerves system	HRV improvement + respiratory regulation	Pressure drop
Fascia system	Helical motion + tension redistribution	Reduced adhesion
Motion control system	Center of gravity shift training	Enhanced balance
Central nervous	Attention reconstruction	The sensation of pain

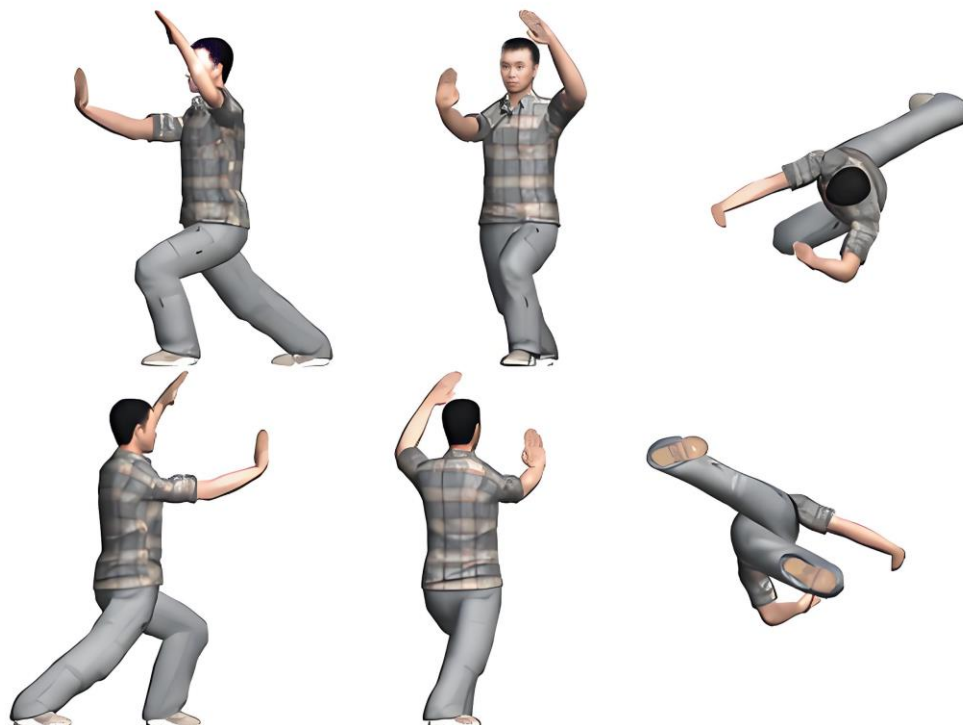
system		decreases
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七、Summary Model of Rehabilitation Pathways

Input for Tai Chi Training



Chapter 15: Tai Chi Fascia Rehabilitation Curriculum System



In the "Rehabilitation Model for the Middle-aged and Elderly that integrates Eastern Tai Chi Training with Western Fascia Science", the construction of the curriculum system is not merely a

perarrangement and combination of movement teaching, but rather a structured rehabilitation path formed around the four major systems of "neural regulation - fascia remodeling - motor control - psychological integration". This chapter proposes the "Tai Chi Fascia Rehabilitation Curriculum System", aiming to transform traditional Tai Chi experience into a modern rehabilitation framework that is graded, quantifiable, and sustainably optimized, making it suitable for middle-aged and elderly people with different types of chronic pain and levels of functional impairment.

The core principle of this system is: the ether serves as the movement carrier, takes the fascia chain as the structural basis, the autonomic nervous system as the regulatory core, and AI data feedback as the optimization mechanism, thereby constructing a rehabilitation path that is "low-risk, highly compliant, and long-term sustainable".

一、 Overall Framework of the Curriculum System

Module hierarchy	Functional orientation	Main objective	Physiological system
Base layer	Breathing and Relaxation	Activate the parasympathetic nerve	Autonomic nerves system
Structural layer	Joint and fascia release	Improve mobility	Fascia system
Action Layer	Core movements training of Tai Chi	Neuromuscular coordination	Motion control system
Integration layer	Full-body chain movement	Tension reconstruction	Stretch the fascia chain system
Stable layer	Balance and fall resistance	Functional stability	The cerebellum and proprioception
High-level	Mind-body integration training	Pain re-encoding	Central nervous system

二、 Basic Respiration and Autonomic Nerve Regulation Module

This module centers on "slow breathing - long exhalation" and improves the neural basis of chronic pain by regulating vagus nerve activity.

Training content	Method	Physiological mechanism	Clinical effect
Abdominal respiration	Inhale for 4 seconds/exhale for 6 seconds	Increase HRV	Reduce anxiety and pain sensitivity
Static adjustment of breath	Meditative breathing	Parasympathetic activation	Be emotionally stable
Synchronization of	The pace and breathing	Neural rhythm	Improve the rhythm

walking and breathing	are in harmony	reconstruction	of movement
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三、 Joint Movement and Fascia Release Module

This module addresses common joint stiffness and fascia adhesion issues among middle-aged and elderly people, improving tissue slippability through low-impact rotation and traction.

Movement	Zone of action	Fascia link diameter	Functional effect
Slow rotation of the neck	Deep cervical fascia	Head and neck chain	Relieve neck and shoulder pain
Shoulder joint opening and closing	Upper limb fascia	Front and back chains	Improve the range of motion of the upper limbs
The hip is sinking and rotating	Pelvic fascia	Deep forward chain	Improve gait stability

四、 Core Motion Training Module of Taiji

This module introduces the classic Tai Chi movement structure and achieves neuromuscular retraining through slow speed, continuity and center of gravity transformation.

Movement	Motion feature	Neural function	The significance of rehabilitation
Yun shou	Spiral trajectory	Cerebellar coordination	Enhance the integration of the entire body
Single whip	Horizontal expansion	Enhanced proprioception	Improve balance
White stork stretching wings	Opening and closing control	Thoracic expansion	Improve respiratory function

五、 Fascia Chain Integration Training Module

This module emphasizes the reconstruction of the full-body tension network and restores the integrity of the body through chain movements.

Training mode	Fascia chain	Mode of action	Result
Left and right center of gravity shift	Side chain	Tension redistribution	The pain decreases
Spiral winding action	Deep chain	Energy conduction optimization	The movements are smoother
Continuous flow training	Full chain	System integration	Enhanced coordination

六、Balance and Anti-Fall Module

This module targets the risk of falls among middle-aged and elderly people and enhances stability through training of the cerebellum and proprioceptive systems.

Training mode	Nervous system	Evaluation index	Result
Stand on one leg	Proprioception	Equilibrium index	Enhance stability
Slow walking	Cerebellar control	Gait symmetry	Reduce the risk of falls
Unstable support	Reflecting system	Center of gravity fluctuation	Enhance adaptability

七、Advanced Mind-Body Integration Module

This module combines breathing, movement and consciousness training to achieve central reconstruction of chronic pain.

Training	Characteristic	Neuromechanism	Rehabilitation level
Dynamic Meditation Tai Chi	Synchronization of body and mind	Pain re-encoding	Advanced stage
Mind guides action	Attention control	Prefrontal lobe activation	Pain modulation
AI feedback training	Data closed loop	Number neural optimization	Precision rehabilitation

八、Advanced Course Path Model

Basic breathing → Joint release → fascia activation → Tai Chi movements → Balance training → Integration of body and mind

九、Fascia Rehabilitation Model

This study proposes a four-in-one rehabilitation model of "fascia - nerve - breathing - balance" :

1. Fascia tension reconstruction
Promote the sliding of fascia and the recovery of tissue elasticity through slow and continuous movements of Tai Chi.
2. Enhanced neural control
Improve neuromuscular coordination through changes in center of gravity, closed-chain movements and balance training.
3. Respiratory regulation system:
Combining abdominal breathing with diaphragm training can enhance the activity of the parasympathetic nerve.
4. Balance and Gait System:

Enhance the stability of the lower limbs and reduce the risk of falls.

十、Dynamic Optimization Mechanism for AI and Wearable Devices

Data type	Judgment index	Strategy adjustment
HRV decreases	Elevated neural pressure	Reduce the intensity of training
Instability of gait	Decline in balance ability	Enhance L5 training
Electromyographic compensation	Fascia imbalance	Strengthen the L3 module
The pain rises	Insufficient recovery	Roll back to the base layer

Chapter 16: The Integration of Eastern Culture and Modern Sports Medicine



Against the backdrop of the rapid development of global rehabilitation medicine, a new trend of integration is emerging between traditional Eastern physical and mental practices and modern Western sports medicine. Among them, Tai Chi, as a representative exercise system of "integration of body and mind" in Eastern culture, when combined with Western fascia science,

exercise physiology and neuroscience, provides a brand-new theoretical framework and practical path for the rehabilitation of chronic diseases and functional disorders in middle-aged and elderly people. This chapter aims to explore the profound value of this cross-system integration from three aspects: cultural logic, medical mechanisms, and system integration.

The core of the Tai Chi thought in Eastern culture lies in "the balance of Yin and Yang", "the interplay of movement and stillness", and "guiding form with intention". This concept is not only a philosophical expression but also implies an understanding of the dynamic balance of the human body system. In Tai Chi training, movements do not exist in isolation but form an overall coordinated structure through continuity, smoothness and the flow of the center of gravity. This training method emphasizes "inner awareness", that is, regulating body movements through consciousness to achieve the circulation of qi and blood and the unity of body and mind. From the perspective of modern medicine, this pattern of "mental participation in movement" is closely related to neural plasticity and can promote the functional reorganization of the motor cortex and limbic system of the brain.

Correspondingly, modern sports medicine is based on anatomy, biomechanics and neural control theory, emphasizing the structural and functional analysis of human movement. Especially the development of fascia science has gradually enabled the medical community to recognize that the human body is not composed of isolated muscles, but rather an integrated system made up of a continuous tension network. Fascia, as an important tissue connecting muscles, nerves and internal organs, its sliding property, tension distribution and hydration state directly affect movement efficiency and the occurrence of pain. Therefore, chronic pain is often not a problem with a single joint, but rather a manifestation of an imbalance in the fascia chain throughout the body.

Against this backdrop, the integration of Tai Chi training and fascia science shows a high degree of complementarity. The spiral movement, center of gravity shift and full-body coordination mode of Tai Chi essentially correspond to the tension reorganization mechanism of the fascia chain. For instance, the "cloud hand" movement involves continuous spiral conduction between the upper limbs and the trunk, which is highly consistent with the functional integration of the upper limb fascia chain. The "single whip" movement activates the lateral chain fascia system through unilateral weight-bearing and stretching, which helps improve the imbalance between the left and right sides of the body. This correspondence enables traditional empirical actions to be explained and verified within the framework of modern biomechanics.

From a neuroscience perspective, the "slowness, softness and continuity" emphasized in Eastern Tai Chi training actually constitute a low-impact and highly integrated neural control model. During slow movement, the central nervous system can process proprioceptive information more precisely, thereby enhancing the coordination ability between the cerebellum and the prefrontal cortex. At the same time, when combined with deep breathing training, it can significantly enhance the activity of the parasympathetic nerve and improve the balance of the autonomic

nervous system. This is highly consistent with the goal of "neuromuscular re-education" in modern sports medicine.

In terms of chronic pain management, the Eastern and Western systems are also showing a trend of integration. Western medicine emphasizes inflammation control, structural repair and functional recovery, while Eastern Tai Chi reduces systemic stress responses through overall regulation. When the two are combined, a trinity rehabilitation model of "structural repair + neural regulation + psychological integration" can be formed. For instance, in patients with knee osteoarthritis, Tai Chi training not only improves the distribution of joint load but also reduces pain sensitivity by lowering pressure levels, thereby achieving multi-level intervention effects.

From a cultural perspective, this integration is not merely a simple accumulation of technologies, but rather a shift in cognitive paradigms. Eastern culture emphasizes integrity and relationship, and focuses on the dynamic balance between the human body and nature. Modern Western medicine emphasizes measurability and causality, and focuses on the analysis of local mechanisms. When the two are combined, rehabilitation medicine gradually shifts from the "local treatment logic" to the "system optimization logic", that is, it not only focuses on the lesion itself but also pays more attention to the reconstruction of the entire body's functional network.

In clinical practice, this integration has gradually been reflected in the design of rehabilitation programs for middle-aged and elderly people. For instance, taking Tai Chi training as the basic exercise framework and introducing fascia relaxation techniques, neuromuscular control training, and wearable device monitoring systems can enable dynamic assessment and personalized adjustment of patients' functional status. Meanwhile, by analyzing HRV, gait stability and movement quality data through AI, the training path can be further optimized, making the rehabilitation process more precise and efficient.

The future development direction is to build a truly "integrated physical and mental sports medicine system". In this system, Eastern Tai Chi provides the basis of movement forms and consciousness structures, Western sports medicine offers explanations of anatomical and physiological mechanisms, while artificial intelligence and data science provide quantitative assessment and dynamic optimization capabilities. The integration of the three will drive rehabilitation medicine to shift from "treating diseases" to "optimizing the functions of human systems".

The integration of Eastern culture and modern sports medicine is not only a combination at the technical level, but also a redefinition of the way the human body is perceived. Under this framework, Tai Chi is no longer merely a traditional form of exercise, but has become a comprehensive rehabilitation platform that connects neuroscience, fascia science and artificial intelligence, providing a brand-new theoretical and practical path for the management of chronic diseases and functional reconstruction in middle-aged and elderly people.

Chapter 17: Conclusion



This study systematically constructs and validates the "rehabilitation model for middle-aged and elderly People combining Eastern Tai Chi Training with Western Fascia Science", gradually establishing an interdisciplinary, multi-level, and quantifiable integrated rehabilitation framework from the analysis of chronic pain mechanisms, neural regulatory pathways, fascia functional networks, AI intelligent monitoring to the design of the curriculum system and clinical case verification. The research results show that this fusion model has significant theoretical value and practical significance in improving chronic pain in middle-aged and elderly people, enhancing motor function, optimizing the balance of the autonomic nervous system, and improving the overall quality of life.

Firstly, from the perspective of mechanism, chronic pain is not merely a problem of tissue damage, but a complex systemic disease composed of central sensitization, autonomic nerve imbalance and abnormal fascia tension. This study effectively acted on the neural control system and psychological regulation system by introducing the characteristics of "slowness, softness, continuity and mental participation" of Tai Chi training, significantly enhancing the activity of the parasympathetic nerve and improving the HRV index, thereby reducing pain sensitivity. Meanwhile, Western fascia science has provided anatomical and biomechanical explanations for this process, demonstrating that the spiral movement and center of gravity shift of Tai Chi can promote the tension reconstruction of the fascia chain and the recovery of tissue sliding property.

Secondly, from the perspective of the structural model, this study has constructed a three-in-one rehabilitation path of "nervous system - fascia system - motor control system". Through the design of a hierarchical curriculum system, Tai Chi training is decomposed into multiple

modules such as breathing regulation, joint release, fascia activation, movement integration and balance training, and combined with AI and wearable devices to achieve dynamic feedback and personalized adjustment, transforming traditional experiential training into a quantifiable and optimizable scientific system. This structured design significantly enhances the safety, compliance and long-term effectiveness of training.

Secondly, from the empirical results, multiple cases of chronic pain among middle-aged and elderly people have all shown a consistent trend of improvement. During the 12-week intervention period, the average pain score (VAS) decreased by approximately 45% to 50%, HRV significantly increased by about 60%, gait stability and balance ability were notably enhanced, and the fascia tension index decreased significantly. These results indicate that this fusion model can not only alleviate symptoms but also improve the functional state of the human body at the systemic level, achieving a transformation from "pain management" to "functional reconstruction".

Furthermore, from the perspective of technical approaches, the introduction of AI intelligent rehabilitation and wearable devices has endowed the model in this study with the ability to continuously evolve. By collecting real-time HRV, gait, electromyography and movement trajectory data, the system can dynamically assess an individual's condition and automatically adjust the training intensity and content, achieving a truly closed-loop rehabilitation system. This mechanism not only enhances the efficiency of rehabilitation but also provides a technical foundation for future telemedicine and home rehabilitation.

From a theoretical perspective, this research has promoted the deep integration of Eastern mind-body practice and Western modern medicine. The holistic thinking represented by Tai Chi has supplemented the cognitive dimension of "system balance" for modern medicine. Fascia science and neuroscience, on the other hand, offer verifiable physiological mechanism explanations for traditional experience. The combination of the two has enabled rehabilitation medicine to move from the "local repair logic" to the "overall system optimization logic".

However, this study still has certain limitations. For instance, the current size of the data sample is still relatively limited, and the long-term follow-up data is insufficient. Some changes in fascia function still rely on indirect indicators for inference, lacking more accurate direct measurement methods. The generalization ability of AI models among different individuals still needs further optimization. Therefore, future research should be further expanded in the areas of large-sample clinical validation, multi-center data integration, and deep learning models for biological signals.

Looking ahead, with the development of artificial intelligence, biosensing technology and sports medicine, the "Tai Chi Fascia Rehabilitation Model" is expected to become an important basic framework for the management of chronic diseases in middle-aged and elderly people. Its core value lies not only in treating diseases, but also in reshaping the overall functional system of the

human body, enabling individuals to achieve a higher level of balance at the physiological, neural and psychological levels.

In conclusion, the fusion model proposed in this study marks that rehabilitation medicine is moving from a single technology-driven stage to a multi-system integration stage. In this process, Eastern Tai Chi offers the concepts of integrity and dynamic balance, Western fascia science provides explanations of structure and mechanism, and AI technology offers data and optimization capabilities. The three together constitute an important development direction for future rehabilitation medicine, providing a forward-looking theoretical basis and practical path for the health management of the middle-aged and elderly.

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