习练太极拳预防老年人跌倒的机制探析

董坤，王琳

上海体育学院，上海 200438

摘要：目的：目前，老年人跌倒已成为严重的公共卫生问题；并且，随着老龄化的加速，老年人跌倒发生率呈上升趋势；这将进一步提高相关的医疗支出，加重社会与家庭的负担。因此，为了减少年龄的增加对姿势控制的影响，选择一种改善姿势稳定性的锻炼方法尤为重要。太极拳是一种慢速、柔和的运动模式，具有对场地要求小、坚持性高、易于开展和成本底等特点；它在改善老年人姿势稳定性，降低老年人跌倒的发生率中有着重要的角色。目前，探讨太极拳对老年人姿势稳定性影响的具体表现的研究较少，因此本文将对已发表的太极拳对人体姿势稳定性影响的文章进行总结分析，更加全面的理解太极拳在改善老年人姿势稳定性中发挥作用的机制，为推广和习练太极拳运动提供证据支持。**方法：**本文主要采用文献资料法，计算机检索 PubMed、中国知网、百度学术和万方数据库,搜集太极拳对预防老年人跌倒和改善姿势控制的文章，对文献研究结果进行归纳总结。**结果：**本文将从感觉传入、中枢整合以及运动控制三个方面分析习练太极拳改善老年人姿势稳定性的作用机制。

1. 太极拳对感觉输入的影响

1. 1 太极拳与本体感觉

太极拳锻炼时，练习者处于缓慢运动的状态，需要全程注意四肢位置、运动方向和节奏变化，在这个过程中可以锻炼运动觉和位置觉，而准确的运动觉和位置觉可以为中枢神经系统提供更好的控制站立平衡所需的信息。并且，有规律的运动可以减少牵张反射延迟，提高肌梭的敏感性，从而使本体感觉传入信息更加可靠。

1. 2 太极拳与足底压力觉

在练习太极拳过程中，最大足底峰值压力发生在脚趾区域，不断地练习可以改善脚趾区域的感觉反馈；同时，人体通过感知足底的压力分布来协助练习者调整身体的重心，以维持姿势平衡。因此，长期练习太极拳可以增加身体对重心的控制，从而提高平衡能力，减少跌倒风险。

1. 3 太极拳与视觉

太极拳锻炼时注重手眼协调，在部分动作中有时手随眼动，精力集中于一方，有时交替注视；长期练习能够提高视觉功能维持身体姿势稳定性的代偿功能。

1. 4 太极拳与前庭觉

太极拳练习包括许多头部和身体的旋转以及头部和/或躯干旋转时凝视手部的动作，有时伴随支撑面和前进方向变化。这些动作容易刺激前庭器官，从而减缓前庭感受器的退化进程或增加感觉信息的输入比重，从而利于平衡控制。

2. 太极拳对中枢整合的影响

2. 1 运动与大脑可塑性

运动锻炼，如太极拳，能够使中枢神经系统发生可塑性改变，进而改善突触信号的传递能力，提升信息的加工速度，增强大脑对四肢末梢感觉的敏感性和运动的控制能力。

2. 2 太极拳与认知

衰老会导致老年人存在不同程度的认知功能下降。太极拳采用“意识引导动作”，要求练习者在整个过程处于冥想状态；这能够增加老年人注意力及其执行能力，从而提升大脑注意力的分配能力，在面临多任务行动时不至姿势控制能力显著降低而发生跌倒。

3. 太极拳对运动控制的影响

3. 1 太极拳与神经肌肉反应

长期的太极拳锻炼能够缩短股直肌、腓肠肌和胫骨前肌的神经肌肉反应时间；而股直肌和胫骨前肌的快速启动有助于老年人在受到扰动时踝关节及时调整身体姿势，维持平衡。

3. 2 太极拳与肌肉力量

长期太极拳干预能够防止老年人肌肉力量流失，并能够减缓老年人增龄性的肌力下降趋势。太极拳始终保持屈髋、屈膝下蹲的姿势，在以自身体重为阻力的情况下，需要髋、膝和踝关节肌肉参与不同程度的向心、离心和等长收缩以及主动肌和拮抗肌的协同收缩，这可以有效增强下肢肌肉力量和对力量的控制能力。

3. 3 太极拳与身体重心的控制

锻炼太极拳的过程中，伴随着下肢的“虚实”转换，即身体重心在两脚之间的动态转移和控制，这有益于老年人学习在运动过程中对重心的控制和姿势的调整；并且，屈髋、屈膝可以降低身体重心, 增加步宽,从而使支撑面积变大，增加身体的稳定性。

3. 4 太极拳与关节活动度的改善

练习一套完整的太极拳可以使下肢关节囊、韧带等软组织在力的作用下延展，提高关节的灵活性和运动幅度，长期的锻炼益于保持良好的关节活动范围，增加韧带的强度和刚度。

3. 5 太极拳对骨骼的影响

老年人的运动功能，尤其是下肢运动和平衡功能，会受到骨量的影响。练习太极拳时，足

跟接触地面的反作用力和肌肉对其附着的骨骼产生的拉力会对下肢、骨盆以及腰椎的骨密度产生积极影响。并且，太极拳对于膝骨关节炎及其产生的疼痛、疲劳和僵直也有很好的改善作用。这些对于维持或者改善老年人的姿势控制都会产生积极的作用。**结论:** 综合起来主要有以下三个结论：（1）太极拳锻炼可以提高感觉输入的比重，包括本体感觉、足底压力觉、视觉、前庭觉等，当受到外界干扰时，练习者能够迅速感知身体空间位置变化，为姿势控制提供基础信息。（2）太极拳不仅能够延缓老年人身体机能的衰减，还能增强老年人认知功能；长期的锻炼有助于提升老年人的注意力、信息加工速度、工作记忆以及动作的控制能力。（3）长期的太极拳练习能提高老年人执行动作的能力,包括神经肌肉反应、肌肉力量、关节活动度和骨骼的健康等；同时，还可以缓解关节的疼痛和僵硬，这有益于维持或者改善老年人的姿势控制。

关键词：太极拳；老年人；跌倒；平衡；姿势控制

The mechanism of practicing Tai Chi to prevent falls in the elderly

Kun Dong, Lin Wang

Shanghai University of Sport, Shanghai 200438

Abstract: Objective: At present, the fall of the elderly has become a serious public health problem; and, with the acceleration of aging, the incidence of falls of the elderly is on the rise, which will further increase the related medical expenditure and the burden on society and families. Therefore, in order to reduce the impact of age on posture control, it is particularly important to choose an exercise method to improve posture stability. Currently, the research on improving posture stability through exercise has received more attention. A number of studies have confirmed that yoga, physical training, water gymnastics, strength training and whole body vibration training can be used as interventions to prevent falls in the elderly. Most of the sports described above require safety monitoring, rely on special equipment, and require specific venues. In addition to these exercise choices, Tai Chi with traditional Chinese characteristics has also been proved to improve muscle strength and posture stability of the middle-aged and elderly. Tai Chi is a slow and gentle exercise mode, which has the characteristics of small requirements for the venue, high persistence, easy to carry out and low cost. It plays an important role in improving the postural stability of the elderly and reducing the incidence of falls in the elderly. At present, there are few studies on the effects of Tai Chi on the postural stability of the elderly. Therefore, this paper will summarize the published articles on the effects of Tai Chi on the postural stability of the human body, and more comprehensive understanding of the mechanism of the role of Tai Chi in improving the postural stability of the elderly, so as to provide evidence for the promotion and

practice of Tai Chi. **Methods:** This paper mainly uses the method of literature to search PubMed, China National Knowledge Infrastructure, Baidu Scholar and Wanfang Data, collect articles on Tai Chi to prevent falls and improve posture control of the elderly, and summarize the results of the literature research. **Results:** This paper will analyze the mechanism of Tai Chi in improving the postural stability of the elderly from three aspects: sensory afferent, central integration and motor control.

1. Effect of Tai Chi on sensory input

1. 1 Proprioceptive

During Tai Chi exercise, the practitioner is in a state of slow movement, and it is necessary to pay attention to the changes of limb position, movement direction and rhythm, in which motion and position sensation can be exercised. Accurate motion and position perception can provide the central nervous system with the information needed to better control standing balance. Moreover, regular exercise can reduce the stretch reflex delay and improve the sensitivity of muscle spindles, thus making proprioceptive input information more reliable.

1. 2 Plantar Pressure Sense

In the process of practicing Tai Chi, the maximum plantar peak pressure occurs in the toe area, continuous practice can improve the sensory feedback of the toe region. At the same time, the human body senses the plantar pressure distribution to help the practitioner adjust the center of gravity to maintain posture balance. Therefore, long-term practice of Tai Chi can increase the body's control over the center of gravity, so as to improve the balance ability and reduce the risk of fall.

1. 3 Visual

Vision is an important factor affecting balance ability. Tai Chi exercise pay attention to hand-eye coordination. Sometimes hand with eye movement, sometimes alternate gaze in some movements. Long-term practice can improve visual function and maintain the compensatory function of body posture stability.

1. 4 Vestibular Sense

Tai Chi exercises include many head and body rotations and gaze movements of the hands as the head and / or trunk rotates, and sometimes accompanied by changes in support and forward direction. These actions are easy to stimulate the vestibular organs, thereby slowing down the degeneration process of vestibular receptors or increase the input proportion of sensory information, which is conducive to balance control.

2. The influence of Tai Chi on Central Integration

2. 1Exercise and brain plasticity

Tai Chi is a typical form of physical and mental exercise, including meditation, concentration, muscle stretching and diaphragmatic breathing. Sports exercise, such as Tai Chi, can change the plasticity of the central nervous system, improve the ability of synaptic signal transmission, increase the speed of information processing, and enhance the brain's sensitivity to the sensation

of extremities and the ability to control movement.

2. 2 Tai Chi and Cognition

Aging will lead to different degrees of cognitive decline in the elderly. Tai Chi uses "consciousness-guided action", which requires the practitioner to be in a state of meditation during the whole process. It can increase the attention and executive ability of the elderly, thereby improving the brain's ability to allocate attention. In the face of multi-task action, the ability of posture control is not significantly reduced and falls occur. And any form of physical exercise can increase your confidence in keeping balance.

3. The influence of Tai Chi on Motion Control

3. 1 Tai Chi and neuromuscular reaction

It is important to maintain a good neuromuscular response during aging. Long-term Tai Chi exercise can shorten the neuromuscular reaction time of rectus femoris, gastrocnemius and tibialis anterior muscle. And the rapid start of rectus femoris and tibialis anterior muscle is helpful for the elderly to adjust their ankle posture and maintain balance when disturbed.

3. 2 Tai Chi and muscle strength

Aging is accompanied by muscle atrophy and a decline in strength. Long-term Tai Chi intervention can prevent the loss of muscle strength in the elderly, and slow down the decreasing trend of muscle strength in the elderly with age. Tai Chi always maintains the position of hip flexion and knee flexion and squatting. In the case of taking its own weight as resistance, hip, knee and ankle muscles need to participate in different degrees of centripetal, eccentric and isometric contraction, as well as the coordinated contraction of active and antagonistic muscles. It could effectively enhance the muscle strength of lower limbs and the ability to control strength.

3. 3 Tai Chi and the Control of Center of Gravity

Keeping the normal range of motion of the joint (ROM) is very important for the functional ability of daily life, especially in the elderly. In the process of exercising Tai Chi, it is accompanied by the transformation of the "xu and shi" of the lower limbs, that is, the dynamic transfer and control of the body's center of gravity between the two feet, which is beneficial for the elderly to learn to control the center of gravity and adjust their posture in the process of exercise. Moreover, hip flexion and knee flexion can reduce the body's center of gravity and increase the width of the step, so as to enlarge the supporting area and increase the stability of the body.

3. 4 Tai Chi and joint range of motion

In terms of improving the range of motion of the joint, the movements such as, Snake Creeps Down, Repulse Monkey and Needle at Sea Bottom can fully flexion and extend the hip, knee and ankle joints, while the movements such as Cross Hands, Wave Hands Like Clouds and Tuck in Robes include more hip abduction and adduction movements. Practicing a complete set of Tai Chi can extend the joint capsule, ligament and other soft tissues of the lower extremities under the action of force, and improve the flexibility and range of motion of the joint. Long-term exercise is beneficial to maintain a good range of motion of the joint and increase the strength and stiffness of

the ligament.

3. 5 Tai Chi and bones

The motor function of the elderly, especially the lower limb movement and balance function, will be affected by bone mass. When practicing Tai Chi, the reaction of the heel touching the ground and the pulling force of the muscles on the attached bones will have a positive impact on the bone mineral density of the lower extremities, pelvis and lumbar vertebrae. But this beneficial effect can only be observed in long-term Tai Chi exercise. In addition, Tai Chi can also improve knee osteoarthritis and its pain, fatigue and stiffness. All these will play a positive role in maintaining or improving the posture control of the elderly. And the American College of Rheumatology also recommends Tai Chi for patients with osteoarthritis in the hands, hips and knees. **Conclusion:** In summary, there are three main conclusions as follows: (1) Tai Chi exercise can increase the proportion of sensory input, including proprioception, plantar pressure perception, vision, vestibular sensation and so on. When disturbed by external environment, practitioners can quickly perceive the change of body space position and provide basic information for posture control. (2) Tai Chi can not only delay the decline of physical function of the elderly, but also enhance the cognitive function of the elderly; long-term exercise helps to improve the attention, information processing speed, working memory and movement control ability of the elderly. (3) long-term Tai Chi practice can improve the ability of the elderly to perform movements, including neuromuscular response, muscle strength, range of motion of joints and bone health, etc. ; at the same time, it can also relieve joint pain and stiffness, which is helpful to maintain or improve posture control of the elderly.

Key words: TaiChi, Elderly, Fall, Balance, Posture control