

# Practising martial arts develops balance

Hannu Leinonen MSc FIMAS PhD Student,

Esko Mälkiä PhD MSc PT and

Tomi Vänttinen PhD, Sport researcher at KIHU

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## Abstract

Tai Chi is known for its ability to enhance balance. Logical assumption is that if one martial arts style can improve balance, maybe others can too. Reviewed literature shows that all studied martial arts improve balance, but only few martial arts were studied. Martial arts improved balance by enhancing self-awareness and physical abilities. Also motor learning (skilfulness) improves balance. Best way to improve balance is to stay in good physical condition and continuously challenge own balance to improve it. It was surprising little research work published in English for martial arts and balance.

## Introduction

This article is third article in a series of martial arts research reviews published in IMAS IQ. Previous articles are martial arts and core strength and martial arts and bone strength. This review looks into balance.

Balance is interesting as it is taken for granted. Its importance is noticed when we lose balance. Increase of fall down accidents of older people has been recognized as a serious problem for some decades. One of martial arts - Tai Chi has been used in helping aging people to maintain and develop better postural control and balance, but what about other martial arts or younger generations? Imagine Karate Kid balancing on one leg waiting to execute his famous crane kick. It's a motion picture reference, but martial arts do require good balance to perform effective techniques – like reverse roundhouse kick or flying butterfly kicks or knocking over a sumo wrestler or a judoka. Definitely martial arts techniques have something to do with

balance. One rule in training is “what you do is what you get”. If you do something that demands good balance, assumption is that it will develop your balance. Other way of thinking is that people like to do things that they are good at. Does this mean that people who have a good balance start practising martial arts? If you have good balance when you are young, do you maintain it as you get older? These are some questions we are looking answers for from our review of Martial arts and balance related articles.

Our hypothesis is that martial arts enhance balance by martial arts ability to enhance physical abilities and self-awareness but gained results degenerate gradually if intervention is stopped.

The vestibular system is the first of the sensory systems to mature, being the only one that is ‘wired up’ before birth in the full-term infant. From the time we are born, our sense of balance is developed based on the correct functioning of the vestibular system. The vestibular system combines, transforms and co-ordinates information from the visual, proprioceptive, auditory and tactile systems. The vestibular system (in the ear) tells the nervous system where the body is in relation to gravitational pull, helping the body to correct itself and maintain balance.(Fundamentals of balance)

OVID Medline defines balance as “A POSTURE in which an ideal body mass distribution is achieved. Postural balance provides the body carriage stability and conditions for normal functions in stationary position or in movement, such as sitting, standing, or walking.”(Ovid: Scope Note Display). “The act of maintaining, achieving or restoring a state of balance during any posture or activity” is defined as postural control (Pollock, Durward et al. 2000). In research articles balance was described as static, dynamic, postural and functional balance or just as balance. Balance has many definitions.

One way of evaluating martial arts possible effects on balance is to view how postural control system works and try to analyze if martial arts training has any impact on the system. The continuous process of postural control is shown on Figure 1.

## Model of postural control

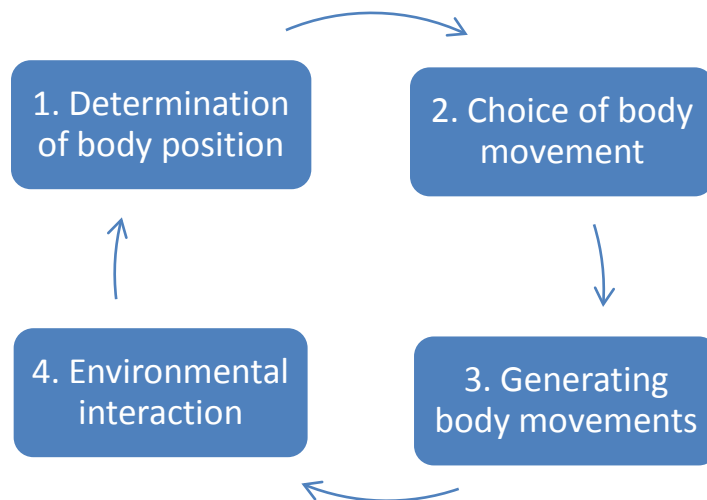


Figure 1. The process model of postural control (modified from Sihvonen 2004).

1. We build our understanding of our posture with our visual, vestibular and somatosensory systems. With this understanding we determine our body position. 2. We have an intention to move or we react to unpredictable events with the skills and abilities that we have. 3. Important components in our generating of body movement are muscles of lower and upper limbs, trunk muscles and neck muscles. 4. We interact with our environment. For example aging affects our senses, proprioception and muscle strength making postural control more demanding.(Sihvonen 2004) If aging reduces postural control, can we somehow prevent it or even increase balance by training? How do martial arts enhance our postural control? What does latest research have to say about it?

### Outline of our review process

We started our search for articles from OVID MEDLINE and Web of Science with keywords “balance” and “martial arts” with 41 hits from both databases. Most of the articles were excluded, because balance was only a minor issue or did not refer to postural control, but other aspects of balance. Systematic review as a research method changed to random search of various databases for relevant research papers. We found eight review articles and eighteen other articles. Most of the other articles were included in review articles.

Review articles:

Human balance and posture control during standing and walking (Winter 1995)

Efficacy of Progressive Resistance Training on Balance Performance in Older Adults (Orr, Raymond et al. 2008)

A Review of the Effects of Martial arts Practice on Health (Woodward 2009)

Tai Chi as an Intervention to Improve Balance and Reduce Falls in Older Adults: A Systematic and Meta-analytical Review (Leung 2011)

Tai Chi research review (Field 2011)

Balance Ability and Athletic Performance (Hrysomallis 2011)

Physical activity improves strength, balance and endurance in adults aged 40–65 years (Ferreira, Sherrington et al. 2012)

Review of Tai Chi as an Effective Exercise on Falls Prevention in Elderly (Schleicher 2012)

## **Balance in different forms of martial arts**

In our search we found 3 review articles and seven studies about Tai Chi. All the studies were about elderly subjects over 60 years. All three review articles are recent from 2011 – 2012 and they include over 24 unique studies (total amount of studies in three reviews is 56, but some studies are included in several reviews). It looks like doing Tai Chi is better than not doing anything. Most of the studies show that if control group does not have an intervention, Tai Chi group has better results in balance. In case that Tai Chi is compared to other activities “the results based on 13 RTCs indicated that Tai Chi was effective in improving balance of older adults but may not necessarily be superior to other interventions”. Tai Chi is recommended as an alternative treatment for improving balance. (Field 2011, Leung 2011, Schleicher 2012)

(Balance is a complicated subject to study and it is measured in various ways and Tai Chi as an exercise is not always defined. Tai Chi has 5 styles and each has multiple forms and also Chi Gung movements are included in some cases.)

Also Taekwondo has been studied as an intervention for healthy people over 40. Taekwondo improved balance and the suggestion is that age-adapted Taekwondo training can improve various aspects of balance control (Pons 2013). Subjects of other Taekwondo studies were young adults from 20 – 30 years. Leong compared relatively short Taekwondo training (1 - 3 years) to no training in a cross-sectional study and found that “Taekwondo subjects performed better during stance with eyes closed on a fixed support than the untrained group ( $p = 0.011$ ). For the drop tests, the untrained group was slower in postural correction as revealed by the longer time to stabilisation than the Taekwondo group after the operator-triggered drops ( $p = 0.018$ )” (Leong 2011). A second cross-sectional study where was added a more experienced group with over 5 years of training came to a similar conclusion that people who train Taekwondo have a better balance than untrained people (Fong, Cheung et al. 2012).

Three other studies for “kicking arts” were found; two for Karate and one for Kickboxing. Relative small experiment showed that group kickboxing can be helpful for individuals with MS to improve balance and mobility (Jackson 2012). Effect of 6 months Karate training was evaluated on 8 to 12 years old boys. Significant gains were found on balance with eyes closed (Violan 1997). Neural efficiency was studied in a cross-sectional study of elite karatekas, fencers and non-athletes. Standing on one leg elite athletes alpha rhythms is largely reduced (DeI Percio 2009). Neural efficiency means that if alpha rhythm is reduced, it leaves resources for other activities. An experienced athlete’s central nervous system does not have to work as hard as novice’s brain to maintain balance.

There were three articles about Judo and balance, all published at 2002. Paillard did not find any significant difference in static balance eyes opened or closed between regional level vs. national and international level judokas, but from further analysis concluded that high level judokas are more dependent on visual information than regional level judokas for balance (Paillard 2002). On the other hand in comparing elite

level judokas to ballet dancers, proprioceptive signals improved balance control. Judokas retained better stance eyes closed than ballet dancers (Perrin 2002). Heitkamp evaluated balance training effect on elite judokas and concluded by balance training alone can achieve strength in high level sports (Heitkamp 2002). So this was not about Judo developing balance, but an interesting observation about role of balance in physical abilities like strength.

Chinese internal Martial arts including Tai Chi, Pa-Koua, Hsing-Hi-Chuan was compared in a cross-sectional study with three other groups: junior sport group, senior sport group and non-sport group. Age of martial artists was  $36.3 \pm 11.6$  years. Groups were small; only 6 persons and causal conclusions are not possible, but otherwise result in the study strongly suggest that martial artists have a superior postural control. Difference increases in the no-vision conditions. Martial arts practitioners control their balance with the ankle joint strategy (Gorgy 2008).

“Finally, the hypothesis must be raised that the subjects we tested practised Judo or Classical Ballet because of their innate sensory abilities, and that we did not really measure the influence of their sport’s training and practice” (Perrin 2002). Point is that it’s not relevant to make causal assumptions from cross-sectional studies. Originally good balance can be independent selection criterion to choose martial arts.

## **How does martial arts training affect postural control**

Postural control model is divided in four sections and by enhancing one or many parts one can develop better postural control.

### **1. Determination of body positions**

We control our balance by visual information and by proprioception feedback. Most important is vestibular system (Fong 2012). Some article conclude that balance is developed by improving non-visual sensory information; Tai Chi (Gorgy 2008, Gyllensten 2010), Karate (Violan 1997), Judo (Perrin 2002), TDK (Leong 2011, Hio-Teng Leong 2011). Training of exact positions or slow Tai Chi gait demands sensing your body

movements and it develops proprioception. Often in Martial arts training you cannot visually adjust your posture, but stances are very controlled. In Judo also visual information may be important in higher level competitions (Paillard 2002). Development of body awareness is most often the reason why Martial arts enhance balance.

## 2. Choice of body movement

In postural control model second phase is the decision to move. In reviewed literature was not much comments on movement strategies. Long period of Tai Chi training (more than 6 years) might change the way person walks. Tai chi practitioners walk with shorter steps and more cautious than control group (Ramachandran 2007). Also change in balancing strategy could be classified here. Martial arts practitioners use ankle strategy in balancing. Other strategies are hip and stepping. Material does not include randomized controlled trials of possible change in balancing strategies, but cross-sectional studies show that experienced martial artists use an ankle strategy and non-athletes a hip strategy. One explanation is that ankle strategy is used for minor adjustments or easier tasks compared to hip strategy. (Gorgy 2008)

## 3. Generating body movements

To execute our movement we need neural control and muscle to move. Balance may get better by our neural control getting more efficient (Del Percio 2009). Better balance might come from more optimal control of joint stiffness and antagonist optimal tension. "Long-term Tai Chi exercisers also demonstrated different reflex modulation from a supine to standing position, and long-term Tai Chi practice may lead to a change of Paired Reflex Depression modulation as neuroadaptation." (Guan 2011) "Balance training may lead to task-specific neural adaptations at the spinal and supraspinal levels. It may suppress spinal reflex excitability, such as the muscle stretch reflex during postural tasks, which leads to less destabilizing movements and improved balance ability." (Hrysomallis 2011) Another way of saying the same thing is that we become more skilful.

Role of strength related to balance is not so clear. "Balance training may increase the rate of force development, which can increase muscular power and subsequent performance of motor skills such as vertical jump." (Hrysomallis 2011)

In a systematic review of progressive resistance training (PRT) only 50% of studies reported significantly better balance after progressive resistance training. "The limited evidence presented in currently published data has not consistently shown that the use of PRT in isolation improves balance in this population." (Orr, Raymond et al. 2008) Population in the study was age over 50 years.

Increase of strength is often reported in studies related to balance, but also there is a case where balance was not affected by increase of muscle strength. "The effects of the training program on balance control could not be related to an increase of legmuscle power as measured with a Biodex System 3 Pro dynamometer. We found no increase in either isometric or isokinetic measurement data of quadriceps or hamstring muscles, which suggests that changes rather took place at neural or vestibular level." (Pons 2013)

One interesting observation was that balance training alone can increase strength of knee-extensors (Heitkamp 2002). So there is a complicated interaction with balance and strength and nervous system.

#### 4. Environmental interaction

Determination of body positions is closely related to environmental interaction. We see and feel our environment. "Dancers train for long hours in a very stable environment (in front of a mirror, holding a ramp), then perform freely but in an unmoving space (either in the training room or on stage). They voluntarily generate their own imbalance during their complex chained dynamic choreographic figures. Conversely, both in training and in competition, judoists are constantly subjected to unexpected movements imposed by their opponent in order to make them fall on soft ground (tatami). Therefore, the good performances of judoists in unusual situations, could be due to the fact that training in martial arts develops sensorimotor adaptabilities transferable to posture control in other circumstances." (Perrin 2002)



Ballet dance is a closed skill like Tai Chi which is mostly represented in our review literature. Other closed skills include forms (katas) and basic techniques (kihon) in most martial arts. Most of martial arts also include an open skill element of sparring where techniques are modified and adjusted to unpredictable situations. (Combining open and closed skills might be an effective method of training balance – also taking martial arts training back to outdoor environment might increase variation and enhance balance.)

## **Discussion**

Our hypothesis was that martial arts enhance balance by martial arts ability to enhance physical abilities and self-awareness but gained results degenerate gradually if intervention is stopped.

Importance of body awareness or increase of general self-efficacy is fairly often noted (Tousignant 2012). Development of neuromuscular abilities is also well documented with the exception of strength. In martial arts related review literature was no comments about permanence of balance. In a study of former elite athletes age 45 – 68 had comparable dynamic balance to those 24 – 30 years younger control subjects (Räty 2002). We know by experience that physical abilities degenerate as we get older - maybe the skill element of postural control is more sustainable.

Our conclusion is that reviewed literature supports our hypothesis. Hypothesis cannot be verified because reviewed material is fragmented and sparse. Better designed randomized controlled trials are needed. The volume of studies about martial arts and balance is mostly focus on aging and Tai Chi. Other martial arts are studied very little. It would have been interesting to see results from aikido or other forms where circular movements are used like Korean or Chinese style kicks. Also wrestling or Brazilian Jiu-Jitsu would be interesting as balance is linked to agility and coordination. “there were some sports, such as rifle shooting, soccer and golf, where elite athletes were found to have superior balance ability compared with their less proficient counterparts, but this was not found to be the case for alpine skiing, surfing and judo.”(Hrysomallis 2011) Often the problem in this kind comparison is that one can compare only subjects that are studied and most of the disciplines do not have any research data to compare to or like in the case

of judo, conclusion is drawn from one article. It was surprising little research work done for martial arts and balance.

Postural control model has similar elements as model for indicating factors determining agility (Young 2002). Agility is a key element in many martial arts. It would be interesting to learn more about relations of balance and agility. Balance has many definitions which indicate that it is a complicated phenomenon to study.

To improve balance, you must continually challenge yourself. (Katagi 2013) “We therefore, suggest that a recommendation that all people undertake physical activities that challenge balance be considered for inclusion in future guidelines”(Ferreira, Sherrington et al. 2012).

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