

# Factors in Selection of Optimal Training Methods for Martial Arts (with specific reference to Tae Kwon Do)

Master Pat Donnelly  
PhD CEng MRAeS ARCS  
4th Dan Chung Do Kwan Great Britain



**Abstract.** *This paper considers the main elements of Tae Kwon Do (TKD) training in relation to current practices and developments in western sports science. A comparison with the methods used in traditional teaching of TKD is made and similarities and differences are discussed. A number of emerging training practices that can be adapted to the martial arts application and their associated benefits are included. [8 references]*

## **Foreword**

The author of this paper has practised the Korean martial art of Tae Kwon Do (TKD) for over twenty years. He has trained in a number of countries (UK, Korea, Hong Kong, Germany) and been privileged to be trained by some of the best and most experienced instructors in the world. He has been instructing TKD for approximately 12 years, and is now chief instructor of Powerhouse TKD and Portsmouth University TKD clubs, having in all about 150 students of all ages and abilities. Previously he has participated in competitive athletics (long and middle distance running) and trained with and been part of nationally recognised clubs and coaches.

By profession the author is a research scientist (not in sports science) and has used his experience in learning and teaching TKD together with an on-going interest in the development and potential of the human being through physical activity, together with a non-exhaustive literature search to perform this comparison.

## **Introduction**

This paper considers the requirements and optimal training strategies for development of martial arts athletes. Martial arts have been practised for many hundreds and indeed in some cases thousands of years. Initially these were often primarily for training of military forces, including both the unarmed combat skills of armed warriors, and for the general use of irregular forces to supplement the better trained and armed sectors of permanent armies. Simultaneously the use of martial arts to develop and enhance the physical and mental well being of individuals was recognised and included within the traditional physical and philosophical training syllabus of the particular art. Indeed in some arts most notably Tai Chi this has become the dominant rationale for its practise.

In modern times and with the global spread of martial arts together with reduced (but by no means negated) requirements for military actions at the hand-to-hand distance the martial arts have transformed to become more comparable to competitive sports with aspects of self-defence and as recreational activities for enhancing mental and physical well being. The balance between these regimens varies considerably with the martial arts style and individual club and instructors.

Tae Kwon Do is the Korean martial art, the ‘way of kicking and punching’, it is widely practised throughout the world and the sport form is now an Olympic discipline. It has two main forms ITF and WTF, the latter of which dominates and is governed by Kukkiwon the world headquarters in Seoul, Korea.

## **Requirements of the Martial Art**

The physical activities involved are, as suggested by the name, kicking and punching. There are a large number of kicks, but emphasising in this application the use of a certain robust part of the foot (e.g. heel, instep, ball of the foot) to a particular target area. Kicks may be from either front or back leg, driven straight or spun in either direction. Jumping kicks and flying kicks are also included. Hand techniques are not restricted to the closed fist, but include use of fingers and the edges of hands as well as elbows. Blocking primarily using bony parts of the forearm can also be considered as basic hand techniques. The basic moments are traditionally brought together into set patterns for development of movement and co-ordination, and these ‘poomse’ [1] feature highly in the traditional teaching of martial arts and in modern applications the recognition of advancement in proficiency through gradings. Freeform application of the techniques is the basis of free sparring (non-contact) and the sport form which are

developed through practice with partners to develop timing and distance, tactical awareness and ability to react. All the elements are designed to be performed in a natural manner that will develop the body's natural movements to allow the application and development of powerful techniques.

The complementary physical attributes that the instructor needs to develop include **strength, speed, endurance, balance, flexibility** as well as the activity specific **skill** associated with delivering effective techniques. The unique demands of the martial art also mean the instructor must maintain discipline and encourage self-discipline and mutual respect amongst his/her students.

The sport form of Tae Kwon Do involves the use of protective equipment to allow full contact sparring for two or three rounds of two or three minutes. The requirement varies with the level of competition.

### **Training Methods**

For the purpose of this paper the training methods under consideration have been divided into the commonly used elements; planning, injury prevention, mobility, endurance, strength, speed and agility and psychology [2].

### **Planning**

Planning can be considered on two levels, planning of individual training sessions (lessons) and the long term incremental development of students over the period of their martial arts careers. Considering the latter first, the problem facing the Tae Kwon Do instructor is the potential conflict between the structured progression of skill, assessed by periodic gradings (generally at an interval of 3 months) and the desire for peaking of students taking part in competitions. The competition lifecycle is normally over an annual basis with a specific major competition (e.g. national championship) as the goal. In order to obtain the maximum performance for a specific goal periodisation is used in many sports. Periodisation is the cycling of training intensity in blocks referred to as microcycles (up to 14 days), mesocycles (2 weeks to 6 months) and macrocycles (6 months – 4 years). The use of periodisation follows the training principles of specificity and reversibility, the time-honoured 'use it or lose it' saw. The first step for the instructor is to determine appropriate specific goals for particular students, these may be grouped into those looking for progression through to the next grading for those relatively junior students (in TKD terms), a longer term grading (6 months to few years) for more advanced students for higher or Dan gradings. In addition there may be separate group more focussed on the competition cycle or even students looking for gradings and an annual competitive cycle. Since all students will benefit from progressive improvement of the essential elements these may be trained to the whole class on an annual planning basis, with skills taught more in groups appropriate to the specific goal. In other words it is often necessary to split the class for skill specific learning whilst many of the physical performance attributes are appropriate for all. It may be beneficial for specific 'squad training' for those focussed on competition.

Consideration is now given to the suggested frequency of training and periodisation for optimal training for the particular elements involved

- Strength and power – research suggests this is best developed by specific training two to four times per week with little concurrent endurance work, and can be maintained for long periods with smaller amounts of regular. Short

specific periods to develop strength, focussed at sport specific muscle groups, in the early part of competitive season or grading cycle may be considered.

- Endurance – Aerobic fitness determines the how quickly the athlete recovers between high intensity efforts, and governs the overall capacity for workload in any given session. Anaerobic fitness is the ability to work repeatedly at high intensity. TKD requires an equal balance between the two (see later sections). Anaerobic fitness can be built up by specific training two or three times a week.
- Speed, agility – TKD requires both high maximal speeds but perhaps more important is acceleration, both for power and effectiveness of techniques, but also for footwork in sparring requiring both linear and lateral motion. It is considered that speed development involves training the neuro-muscular system and this is best performed if the system is not fatigued. Speed training, such as for sprinting, normally includes long rest periods and focus on quality. If intervals are too short the exercise will develop speed endurance but not develop maximum speed and acceleration.
- Balance, co-ordination and stability – These are central to many of the TKD and other martial arts techniques, and will be developed through the practise of traditional training of techniques and patterns. Additional specific training can be introduced within classes with dynamic exercises such as sit ups, but static bridging type exercises are highly beneficial. Traditional training often includes static leg raises, however this can cause excess pressure on the back, and bridging provides more broadly applicable exercise. Stability training should be carried out at least twice a week. The use of wobble boards to improve balance and stability is now used commonly in many sports and may be a useful supplemental exercise for martial artists.

In athletics the established standard training approach has been to progress from slower aerobic work to anaerobic speedwork during the course of the training macro-cycle. However recent trends, in particular suggested by Charlie Francis has suggested a more effective use of undulating periodisation to maximise the athletes competitive capability. This mixes and matches all the above ingredients into one training programme. The key to improved performance is to emphasise intensity and not volume [3.4]. Given the variation in periodisation requirements for the TKD instructor of a typical mixed class, this approach would appear to be a have value and perhaps one more in line with traditional martial arts, although the instructor may find benefit in enhancing anaerobic fitness in short periods (of say 5-6 weeks) prior to main competitions.

### **Injury Prevention**

Injury can prevent the development of athletes both temporarily and can prevent the full nurturing of potential. Causes of injury can be bad technique, overtraining, and of course in martial arts, injury through excessive contact. Many injuries are to the muscles and these can be caused by a number of factors

- Psychological – studies indicate a propensity for injury in athletes who are aggressive, tense and compulsive. Tension in particular can make the muscles taut and at greater risk of injury, attempting to engender relaxation of tension

is one key to removing a source of potential injury as well as allowing better concentration to develop good technique.

- Weak muscles – Resistance training on specific muscle groups that are stressed in training can be beneficial in injury prevention.
- Muscle imbalance – over emphasis of particular techniques or training practices that could lead to imbalance need to be avoided, this is good reason for the instructor to ensure that a full range of training is included.
- Muscle stiffness – This is the ratio of change in muscle resistance and change in muscle length, and is generally thought to be directly related to probability of injury. This can be alleviated and avoided by gradual and progressive warm-up. It is interesting for the martial arts instructor that current research indicates that only dynamic stretching, slow controlled movement through full range of motion, can reduce muscle stiffness, and that static stretching does not reduce muscle stiffness. This seems at odds to many of the traditional teaching methods used in martial arts, which places great emphasis on static stretching often as part of the warm-up and preparation phases of training. Current conventional western sports coaching therefore suggests dynamic stretching for warm-up and static stretching only being beneficial in the cool-down phase. [5.6] It should be noted that the author has observed radical changes in the approach of stretching when applied to athletics over the past decades, and may perhaps suggest that the influence of static stretching on subsequent performance is more subtle than currently understood. However it is clear that dynamic stretching is very beneficial in warm-up and preparation activities.

### **Mobility**

Mobility is the ability of the joint to operate through a full range of motion. This involves the joint and two groups of muscles (and the associated connective tissues), the protagonists which cause the movement, and the antagonists which oppose it. Stretching can be grouped into various types;

- Static – gradually moving the joints and muscles in question into a stretch position and holding it
- Dynamic (ballistic) – rapid movement into the required stretch position, such as leg swinging. Gradual increase of speed over a series of movements is necessary to avoid overstretching.
- Assisted and Partner stretching – being assisted by a partner, with a good understanding of the stretch position, to achieve and maintain it. The bodies 'stretch reflex' lasts about twenty seconds after which it may be possible to achieve slightly greater movement, this sort of stretching is therefore usually held for about 30 seconds.
- Proprioceptive Neuromuscular Facilitation (PNF or super-stretching) – This involves adopting the stretch position (possibly with partner assistance) then contracting the antagonist muscles to push against it for five to ten seconds, this is followed by increasing the stretch. The process can be repeated two to four times consecutively to increase the movement achieved.

In his classic treatment on flexibility training, Kurz [7] also discusses the importance of neuro-muscular adaptation for flexibility. For martial artists he recommends 10 minutes of dynamic (leg-swinging) type activities to be performed in the early morning, which will allow greater flexibility to be achieved in training later in the day. He also strongly advocates PNF stretching to increase both static and dynamic

flexibility but only to be conducted towards the end of the training session followed by relaxed stretching and cool-down activities. PNF stretching can lead to some short term contraction of the muscles and should therefore not be conducted prior to vigorous training. Most relevant to TKD are the leg swinging exercise, Kurz suggests using the opposite hand as a target for upwards leg swinging as it promotes greater movement. Performing the exercise in front of a mirror may also help to prevent the head from dropping down which is undesirable for good kicking technique.

### **Endurance**

The competitive element of TKD, based upon two minute rounds, is at the crossover point of aerobic and anaerobic performance demands. For TKD then this suggests that the instructor needs to equally emphasise aerobic and anaerobic fitness. Anaerobic fitness can be developed by relatively high-intensity repetitions with short recoveries. Anaerobic training is based on re-adaptation of both the adenosine triphosphate – phosphate creatine (ATC-PC) system, for short bursts, and the lactate system for more continuous high intensity periods. Martial arts are fairly unique in requiring fitness in all these systems in fairly equal proportion.

Aerobic fitness is measured by a quantity relating to oxygen uptake, known as  $VO_2\text{max}$  and is improved by performing specific training activities at a heart rate of 65% to 85% of the maximal for continuous periods of at least 20 minutes. Three to five training sessions a week are considered optimal for improving the fitness. Given that TKD training in the West is frequently only performed by individual students two or three times a week and that there are many specific skill specific aspects to cover, this may not be practical. Students who wish to improve aerobic fitness should be encouraged to supplement the specific TKD training with activities such as running, circuit training, boxercise etc. For elite students TKD specific aerobic training can be developed, along circuit training type principles but involving kicking and punching exercises.

Training for anaerobic fitness should generally be above 85% of maximal heart rate and for shorter intervals, this is covered in the next section on speed training.

### **Speed and Agility**

Speed can be considered any one of, or a combination of

- maximum speed
- elastic strength (power)
- speed endurance

depending on the different application. In TKD again we see that the broadness of the martial art means that all factors either individually or in combination are required in different phases (sparring, patterns, breaking techniques).

The anaerobic alactic energy pathway provides energy for absolute maximum speed, and can last to up to six seconds. It should only be trained when there is no muscle fatigue present (i.e. after a period of rest of at least 24 hours). The training should be progressive practising the movement at slower speed and then building up to the maximum. In athletics and other sports requiring rapid leg speed a number of techniques are used to improve acceleration and maximal speed. These include

- Plyometric exercises involved jumping movement
- Sprint starts
- Foot speed drills (Frappier drills)
- Resisted acceleration
- Over speed training (down-hill sprinting)

The first three can be readily adapted to TKD specific drills, consider

- Repeated standing jumping exercise (Chung Do Kwan leg technique number 4)
- Sudden accelerations in footwork exercises (three fast steps during jogging)
- Footwork exercises emphasising maximum numbers of foot contacts in short periods (fast small kicking out movement).

The fourth, resisted acceleration, can and is occasionally performed using partners to resist the acceleration, but is not used frequently due to restrictions on space and the need for well matched and responsible partners. Overspeed training is rarely used though examples of it have been seen by the author. It appears that many of the elements for maximum speed training are frequently used within TKD, which is unsurprising given it is one of the prime requirements. However these drills are often used more as warm-ups than part of a progressive training plan to maximise performance. Certainly for training elite squad players the use of structures training including more resisted acceleration and overspeed may be beneficial.



### **Strength and Power**

Power is the ability to exert force against resistance, elastic strength is the ability to overcome resistance with a fast contraction, and strength endurance is the ability to repeat the force expression a number of times. These two attributes are perhaps more important to TKD than maximum strength such as developed for weight-lifting. Strength is developed by working the muscle beyond its normal operation, i.e. when it is overloaded. Power is exerting power through distance. Maximum strength training generally involves use of weights, this is not explored further within this paper, other than to note that it is recommended (by John Shepherd in [1]) that athletes training for specific sports should do ‘muscle re-education’ immediately after the use of heavy weights. In the TKD context this would suggest spending a few minutes practising lightly basic techniques to ensure the re-coordination of the firing patterns of the muscles.

Elastic strength training is used for general sport conditioning, and is used widely in Europe for many decades for athletics and boxing, includes drills using medicine balls. These drills involve lifting, throwing and catching the medicine balls, and have been found to be very beneficial in developing elastic strength in the core muscles, surrounding the junction of trunk and legs. Since this area is also the focus of many traditional TKD exercises, and is central in providing the power for techniques, it would seem that medicine ball training may be useful adjunct the TKD instructor, to supplement the more standard exercises such as crunches and back extensions. They are also fun for the students and can be performed competitively to increase interest and effort.

Simultaneous development of speed and strength is highly desirable for improving the capability of TKD students, this combination together with good range of movement through flexibility is the essence of focussing power in techniques. Jumping, bounding and hoping exercises have been used in various ways for many years to enhance athletic performance, and specific methods of using these in recent years have become known as plyometrics and found to be very effective in increasing explosive power. It seeks to enhance the explosive reaction of the individual through powerful muscular concentric contractions (when a muscle shortens) immediately following rapid eccentric contractions (when the muscle lengthens). Any training needs to be sport specific, but general improvement of explosive movement capability can be improved by using drills, and examples that are used traditionally in TKD include the category known as standing leg jumps, in the form of bunny-hops, tuck jumps, double-footed hopping etc. More intense forms such as depth jumping, where the student jumps down from a box (40 to 100cm) and then immediately jumps up from the landing. Including bounding exercises, using over-sized strides and emphasising either distance covered or time in the air can be used to improve explosive forward movement. Bounding up slopes will improve both horizontal and vertical movement. Whilst a sub-set of these exercises are widely used in TKD training, and indeed some examples can be founding basic techniques themselves (jumping kicks) improvement and variation through increase use of plyometrics is attractive but must be used with caution in classes of wide abilities and ages. Many of the exercises can be potentially stressful on the joints especially if performed with poor technique due to lack of general fitness or mobility, and may be overly stressful for younger and older students. These may again be more for development of more advanced students.

### **Psychology**

TKD is a martial art, and its essence is self-defence in threatening situations as well as the beneficial enhancement of physical and mental condition. For self-defence and in the competitive arena, the student needs to be able to perform what they have been taught in the best manner they are able. However these very conditions cause increased stress and can negatively affect performance. Use of imagery to improve performance is now widely accepted and becoming more important in a number of performance sports. In TKD the use of imagery is a fundamental part of traditional training. Progression is measured through gradings, starting with a number of coloured belt grades (Kup grades, typically 10) followed by black belt Dan grades (also 10). For each grade a particular pattern (or more than one) is required to be performed. The pattern is pre-defined linked series of techniques, the length and complexity of the techniques increasing with grade. It is essential that the patterns are not just a sequence of movements, but are in essence a 'fixed fight' with each

movement and technique being meaningful and effective as defence, attack or counter. In teaching the patterns it is common practice for the student to be told to visualise an attacker and respond appropriately. In this way by bringing up the visualisation, correct focus, and hence application of power is developed in class and in competition or grading, the stress effects are reduced by concentrating on a now familiar image.

Additionally TKD lessons start with set formality, lining up in order of seniority and bowing to the flags (symbolising the spirit and practice of TKD rather than a specific nation) and then the instructor. This not only established a hierarchical structure for learning and conduct of the lesson, it also serves a division between the stresses and demands of every day life and allows concentration on training being given without distraction. This traditional practice can then be seen to be very beneficial in terms of modern sports psychology principles.

A recent report on imagery in sport [8] suggests the following benefits of imagery;

- Learning skills – using images rather than words in instruction has been shown to enhance learning. For a student recreating the image of a skilled performer can be useful in developing technique. Encouraging students to train with senior instructors and attend seminars should be integral as part of the instructors practice.
- Getting psyched-up – under-arousal can be performance limiting, especially in gradings and competition where there is little or no time for communal preparation before being called upon to make maximum effort (also an essential attribute for self-defence). Imagery can be used to get mentally prepared for the activity. Of-line imagery to form the required response can be pre-prepared and associated with a single key image or concept. This can allow the athlete to rapidly prepare for the activity.
- Capturing performance ‘in the zone’ – when performing at the top of an individuals game, it is suggested to be beneficial to try to capture the feeling, both of the mental and physical aspects to recreate the optimal mindset in future.
- Practising ‘what if’ scenarios – this is useful to prepare for events that may come up unexpectedly or not as planned in particular competition or event. By imagining a range of scenarios and dealing with them in the imagination will allow better ability to react if they do occur.

Traditionally TKD has included imagery as an important part of its (arguably) most important training aspect, patterns. The utility of imagery is far wider than this and sports psychology developments in many competitive sports suggests that greater specific emphasis of it for competition and grading training is likely to be beneficial.

### **Skill**

Much of the teaching practice of TKD is aimed at providing instruction in the specific skill to perform the techniques within the art and the development of understanding of the application within the elements such as patterns, sparring, self-defence etc. This is beyond the scope of this short paper. Here we restrict the observation to the methods of imparting skill to different levels of experience and expertise. For each the instructor has to concentrate on getting different forms of information across for the optimal development of the student at their particular stage.

It has been observed that there are three different stages of learning physical skills, these can be categorised as follows [1];

- Perceptual stage – the student is attempting to understand the basic element of the technique compared to other techniques. Too detailed information at this point will have a negative effect on learning. The learning is primarily by copying and determining that the technique is delivered with back leg or front leg etc
- Fixation stage – The basic technique is now understood, detailed instruction, such as foot position, arm position can now be assimilated and the technique improved.
- Automatism stage – the technique is now automatic and the instructor can now develop its use in the greater encompassing framework of timing and footwork.

The instructor needs to be able to distinguish the different stages in individuals and recognise that progression from one stage to another is geared to individual capability. This presents a challenge when teaching large groups of mixed ability and experience students, here flexibility of approach, being careful to evaluate the group needs, and splitting the group are all key to providing challenging and beneficial training for the whole class.

### **Summary**

This short paper has considered some of the basic principles and a small selection of modern sport science research findings in relation to the specific demands and traditional instruction of Tae Kwon Do. TKD instruction is very demanding in the broadness of its techniques, the physical attributes that need to be developed to perform it and the wide variety of the participants.

A restricted survey of current western sports science training practices has produced many parallels with the training methods used in traditional TKD teaching. It also suggests a number of areas that some techniques could be introduced or expanded to optimise the development of participants. Generally the great majority of standard TKD training follows currently accepted sports science principles. The use and benefit of static stretching as part of warm-up and preparation activities appears to be the area where recent research findings are at variance with accepted practice, however it has been noted that this is a particularly complex area that research findings have changed considerably in recent times.



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