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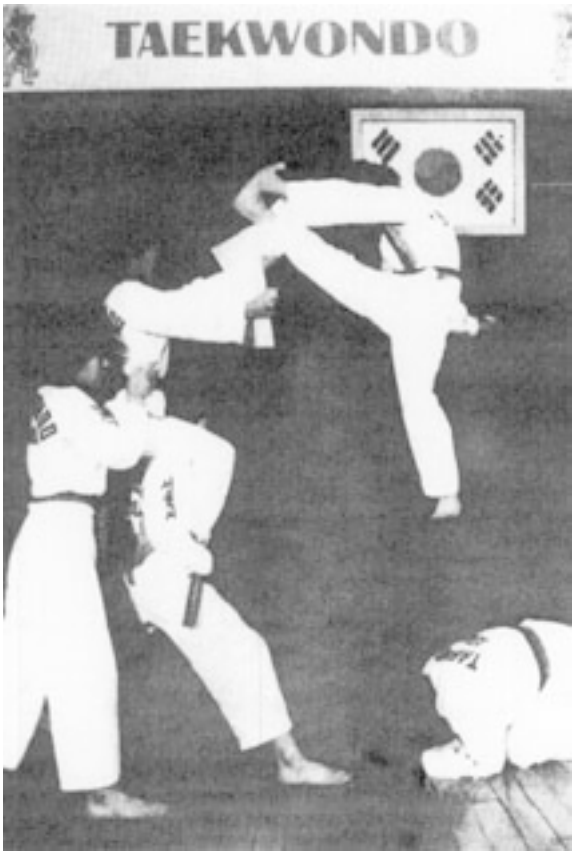


INTRODUCTION

The nature of Taekwon-Do calls upon the ability of the human body to generate speed and power. A distinguishing feature of Taekwon-Do *is it's* vast array of' spectacular jumping techniques, performed with both hand and foot, used for the purpose of demonstrations of skill, competitions, freesparring, and special breaking techniques.

This thesis will look it: the implementation of "Plyometrics", a Soviet developed form of training to enhance explosive power, speed, and strength development. Particular emphasis will be placed on jumping techniques.

Areas to be covered will include; an explanation of the scientific basis of plyometrics, research findings, Plyometrics in Taekwon-Do training, types of activities, guidelines for developing a training program, and relevance to improving Taekwon-Do abilities.

PLYOMETRICS: A THEORETICAL BACKGROUND

Plyometrics can take on many forms but often involves jumping exercises typical plyometrics drills involve single, double, or triple “bounding” jumps, jumps on to or off boxes or benches repeated upward vertical jumps for height or downward jumps off a bench followed by an immediate upward bounding jump, known as “depth jumping”. (Blair, 1990)

Plyometrics is considered a valuable training method in achieving conversion of maximal strength into power, and has been specifically demonstrated to improve jumping ability (Bosco, et al.1979). The term Plyometrics refers to a training method based on the belief that pre-stretching a muscle prior to a concentric contraction will result in a more powerful concentric contraction.

This pre-stretching prior to contraction is referred to as the “stretch shortening” cycle. This cycle is considered a natural muscle function (Komi, 1984) and is detectable j-n many sporting activities, such as throwing and jumping. The “stretch-shortening” cycle is also evident in a variety of Taekwon-Do skills, for example, slight knee bending in preparation for jumping kicks such as jumping side-kick, jumping front kick, jumping spinning kicks ... etc. Other examples can be found in striking, blocking and jumping techniques in Taekwon-Do.

Studies comparing stretch-shortening cycle movements with non-stretch shortening have illustrated improved performances due to pre-stretching.

The theory behind the influence of pre-stretching is that one or both of two mechanisms are responsible for the improved contraction force. These are;

1) The storage of elastic energy in the pre-stretching, or eccentric, phase of the movement, and

2) A stretch reflex (myotatic)

Although there is some confusion over the training effects of plyometrics it appears the increase in muscle strength and power is attributable to an increase in muscle elasticity and adaptation in neuromuscular functions. Improved elastic potential in muscle may also be due to the enhancement of the stretch reflex which is stimulated during stretch shortening muscle activity, (Lundin, 1987) where the muscle spindles are stretched resulting in stimulation of other nerve impulses and increased activation of motor units thus added contractile strength.

RESEARCH FINDINGS

Literature on the stretch-shortening cycle has been applied mainly to jumping techniques. The literature compares three types of jumps:

1) Squat Jumps (SJ) -the non pre-stretch condition, which involves a vertical jump from a static squat position.

2) Jumping with Counter Movement (CMJ) - a pre-stretch condition with a static load. This movement begins from a standing position and incorporates dropping into the squat position prior, to the vertical jump.

3) Drop Jump (DJ) -involves dropping from a specific height and rapidly changing direction on contact with ground into a vertical jump.

These three types of jumps have been used to determine the influence of pre-stretching on the concentric phase of contraction, generally via performance levels. Research by Young (1983) indicates there is an increased jumping performance by CMJ and DJ compared with SJ, which supports the notion, that pre-stretching prior to contraction benefits performance.

However there are a number of factors which could influence the results of similar research and need to be considered. Komi (1984) believes that if the stretch-shortening cycle is too slow, the stretch-reflex response may occur during the eccentric phase resulting in a loss of synchronization, reducing potential benefits.

It is also possible that if the pre-stretch phase is too long, the elastic energy stored may be 1ost as heat before it can be utilized (Komi, 1979). The shorter-range stretch is superior because it prevents the detachment 84 of muscle cross bridges and increases the utilization of stored energy (Komi). Also the magnitude of the stretch is important. If the load is too large, then the golgi-tendon organ wall inhibits the contraction resulting in reduced performance.

There are varied opinions concerning the recommended maximum load for drop jump training. Also due to individual differences in physiological make-up, there can be no magic figure suitable for everyone. Literature suggestions generally range from 40 cm to 100 cm. Common sense would dictate that any program commence at the minimum suggested height and gradually progress to greater depths to allow for muscle adaptation over a period of time.

Early studies on this subject suggest that dropping from 200-300cm without rebounding, will achieve optimal results due to the large forces involved ... up to 20 x body weight. However, this eccentric training may increase load tolerance but may not be specific to desired performance goals and may not necessarily improve power in varied applications (Dursenev and Raevsky, in Miller, 1981)

We can conclude from this that plyometric training may be specific and therefore a program should be designed according to the objectives of the individual i.e. horizontal jumps for distance and vertical jumps for height.

PLYOMETRICS IN TAEKWON-DO TRAINING

In applying the theory of plyometrics to the Martial Arts, a number of issues require analysis. There is evidence to support the use of plyometrics for any Taekwon-Do technique involving jumping.

Chu (1983) states that plyometrics trains the neuromuscular system to contract rapidly and with maximum forces. This method would appear appropriate for converting the maximum strength developed via traditional resistance training methods, into specific power, and is a recommended training method for the Martial Artist.

A question to be raised is, "Will plyometric training aid in developing power of basic kicking, blocking, and striking skins, as described by General Choi as fundamental movements of Taekwon-Do. As mentioned earlier many of these movements involve a pre-stretching action prior to the powerful muscular contraction.

A study was conducted by fourth-degree Shotokan black belt Tom Muzila in California, 1985. He selected two groups, one as a control group and the other to undergo a six-week plyometric-training program specifically for jumping.

When comparing initial test results to those after the six-week period his findings were quite significant. He explains, "on the jumping test drills the control group had basically remained the same but the plyometric group had gained anywhere from eight to ten inches." He went on to say that in relation to the lunge punch tested that the plyometrics group "was almost a foot more than the control group and it was with good form and with significantly less telegraphing motion."

Although little research has looked specifically at plyometrics in Taekwon-Do, we can compare similar movements studied. For example, Bober et al (1979) analysed the knee extension movement (similar to front kicking action) isolating the active leg. This study varied the level of pre-stretch conditions and compared these with the performance of the knee extension without a pre-stretch.

It was concluded that the stretch-shortening cycle resulted in significantly faster angular velocities compared with the non pre-stretch condition. It was also concluded that the range of the pre-stretch movement was not as vital to increased performance as was the velocity of pre-stretching.

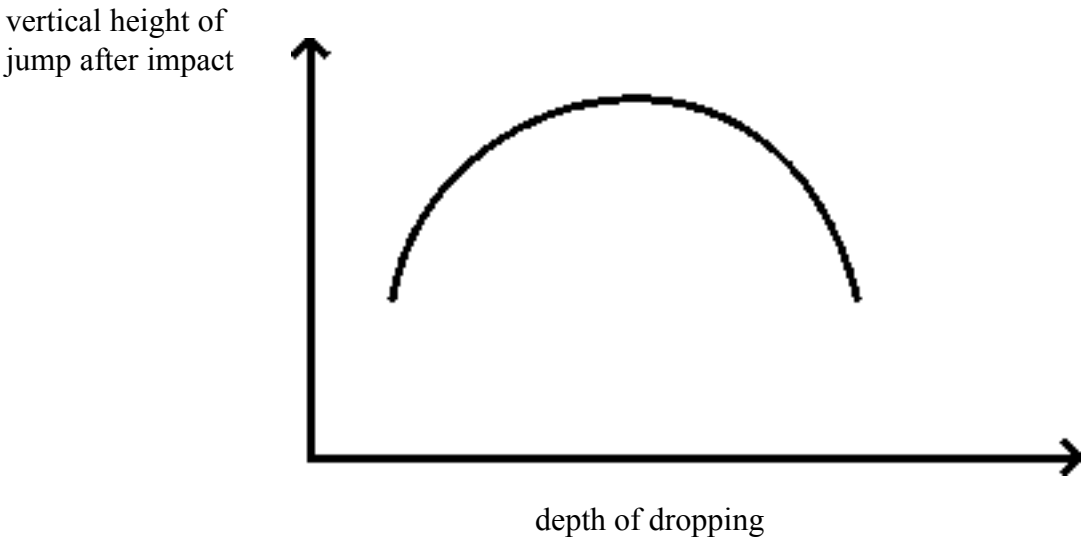
To convert into layman's terms, the preparation phase A, pulling back of the leg prior to thrusting in the front kick, provides more power than merely holding the knee up and extending the leg from a 90' to horizontal B.

DEPTH JUMPS

With jumping techniques, optimising the stretch-shortening cycle requires the performer to minimize contact time with the ground. Young (1983) found that greater average force and power was associated with jumps of moderate knee-bend during preparation and greater pre-stretch velocity.

The influence of a slow stretch-shortening cycle is illustrated in depth jumps using large dropping heights where the pre-stretch load is large resulting j-n longer contact time with the ground (i.e. slower stretch shortening cycle). Several studies have supported an "inverted U " theory between the dropping height of depth jumping and the vertical height of the jump after impact.

RELATIONSHIP BETWEEN DROPPING HEIGHT AND RESULTANT VERTICAL JUMP



Blair (1990) explains that jumping down from a height is the most effective method of developing maximum tension in the shortest amount of time - the goal of the shock method... after the jump down you must immediately jump upward - thus the term depth jumps. The faster the switch from landing to take-off, the greater the explosiveness developed.

In the context of competitive sparring this is important to the Martial Artist as it suggests that benefits achieved in jumping power aren't overshadowed by a need to telegraph movements by deep knee bending in the preparation for a jumping technique. Naturally speed of movement is more vital than vertical height to reduce the opponent's available reaction time.

In a demonstration of jumping techniques for board breaking or special techniques, the Taekwon-Do practitioner can afford a slightly longer stretch shortening cycle to maximize the effects of this action.

Knowing that the velocity of the pre-stretch is important and that excessive external loading is not vital to achieve benefits from pre-stretching it is possible that the Martial Artist can derive major benefits from plyometric training. These benefits may be applied to punching kicking, and blocking techniques.

DEVELOPING A PLYOMETRICS TRAINING PROGRAM GUIDELINES

In designing a plyometrics training program, several important factors should be considered (Anderson, 1988)

I - The athlete should have the appropriate physical conditioning levels, previous strength training of relevant areas is essential.

2 - Maintain correct techniques and posture.

3 - The prescribed load must be a reflection of the person's previous resistance training experience.

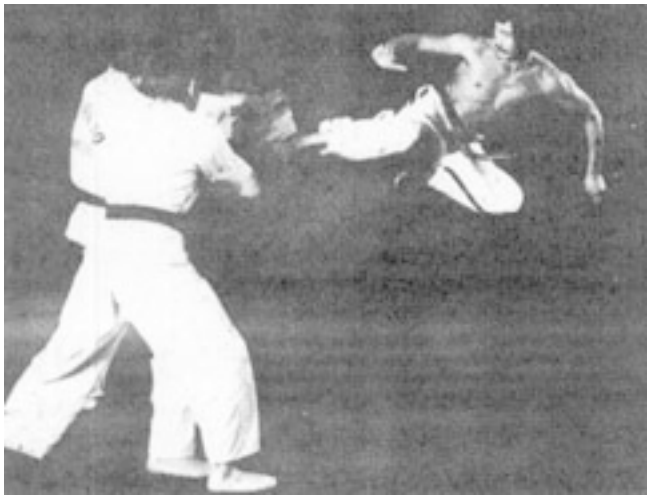
High intensity plyometric training should not follow a resistance training session, as the nervous and muscular systems should not be fatigued to ensure maximum training benefits. (Sinclair, 1981)

There is a likelihood of muscle soreness, as a result of depth jumping therefore adequate- steps should be taken to reduce this:

- Proper warm-up and stretching of muscles, joints involved
- Adequate, well-cushioned footwear
- Softer landing surface, mats, grass..etc., (particularly if barefoot)
- Select appropriate dropping height
- Avoid over-training

There are many different levels of intensity and structures of programs to coincide with the athlete's level of competence. Most literature suggests similar guidelines to that of general resistance training methods (Berger, 1962) i.e. 3 sets of 10-15 repetitions where each repetition requires a maximal effort and therefore a high level of concentration and physical effort. A rest of 1-3 minutes between sets, consisting of light jogging and/or stretching movements.

The intensity of plyometric training requires careful prescription. The load should begin at a low level and progress at a rate appropriate to the individual.



PLYOMETRIC EXERCISES

Many of the following exercises can be performed in a specific plyometric training program, as part of personal training, or incorporated into a typical Taekwon-Do class after the warm-ups and stretching, keeping in mind muscles should not be fatigued prior to plyometrics training.

I - Tuck Jumps:
- from a half-squat position, jump vertically as high as possible, bringing knees to chest.

2 - Double Leg Bounding
- with a double-leg take-off from half-squat position, jump horizontally as far as possible.

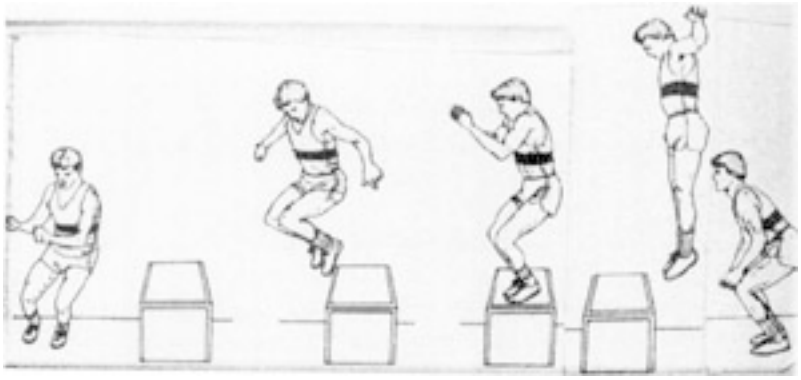
3 - Single Leg Hopping
- driving the opposite knee as high as possible, aim for maximum horizontal distance can be performed with one leg consecutively or with alternating legs.

4 - Double /Single Leg Jumping over Obstacle
- standing side-on to obstacle, either double leg jump or single leg hop from side-to-side, with minimum ground contact time. * Can use a bench, punching bag partner-held belts...etc.

5 - Depth Jumping
- from a set height, jump upwards and slightly forwards, on impact with the ground, ‘explode’ into a vertical jump for maximum height or horizontal jump for maximum distance.

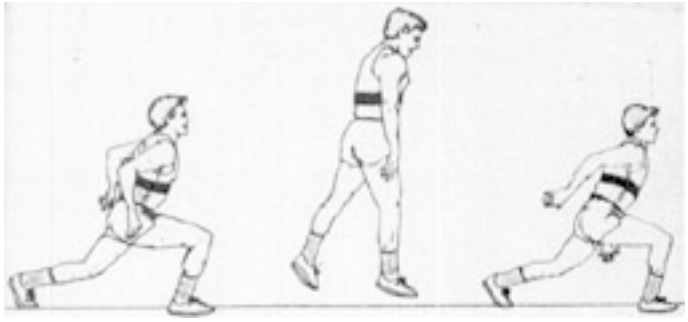
* n.b. ground contact time should minimal.

6 - Double Leg Box Bounding
- with 2 - 4 boxes placed in a row, 3 - 6 feet apart. Jump from the ground onto the first box, springing off the box and landing forward on the ground then jumping onto the next box and so on.



7 ~ Split Jump
- starting in a lunge position, jump vertically as high as possible then landing back in the ‘split’ position.

* n.b. can be performed with same side consecutively, or crossing legs in the air to alternate sides. Can also be performed using Taekwon-Do stances i.e. L-stance, walking stance, fixed stance, sitting stance..... etc.



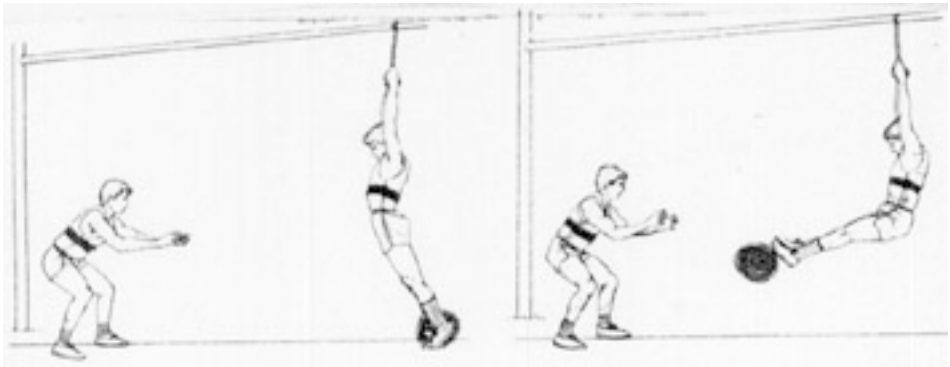
Plyometrics can also be applied to development of power in the upper body muscle groups, involved in punching blocking and other striking techniques. Below are some examples of exercises for developing power in muscles of the chest shoulders trunk and arms

I - Hand Clap Push-up with Partner
- with partner holding legs, go into push-up position and powerfully push upwards to raise body in the air, clap hands together and land in push-up position with elbows slightly bent -repeat.

2 - Bag Push
- recieve weight of bag swinging towards you, bend arms slightly then push away forcefully. Same action as reverse punch. Can use single or double hands.

3 - Medicine Ball Throws with Partner
- standing opposite a partner, throw a medicine ball back and forth, throwing with explosive force, with
minimum ball holding time.

4 - Medicine Ball Hanging Leg Toss
- holding medicine ball between ankles with feet just touching ground, person throws the ball with their legs in the air to their partner, who rolls the ball back and the process is repeated.



SAMPLE PLYOMETRIC TRAINING SESSION

INTERMEDIATE LEVEL

WARM-UP: 5 minutes of general warming up exercises with minimum bouncing.

- light jogging
- swinging leg raises to front, back and side
- arm circles, hip circles

STRETCHING: general stretching of muscles of the back, hamstrings, quadriceps, trunk and especially
calves.

TRAINING DOSE:

- all sets 8 - 10 repetitions
- 3 sets per exercise
- 2 minutes rest between sets

1. SINGLE LEG HOPS … alternate legs... 3 x 10 per leg
2. DEPTH JUMPS .... double leg take-off ..3 x 10
3. OBSTACLE JUMPS … double leg take-off..3 x 10
4. HAND CLAP PUSH-UPS … with partner..3 x 10
5. TUCK JUMPS ... 3 x 10
6. SPLIT JUMPS IN WALKING STANCE ... 3 x 10

COOL DOWN: general stretching of used areas. TOTAL TIME: approx. 40 — 45 mins.

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