Abstract

The present review study aimed to analyze and describe the methods used in shock training (plyometrics) in combat sports. Shock training is one of the most effective strategies for working strength and muscle power. These characteristics are very important for the improvement of the reaction speed, since they act directly on the proprioception. Thus several combat sports athletes seek this type of training for the execution of faster and more powerful movements such as punches, kicks and projections.

Keywords: Plyometrics, fighting sports, training methods.

Introduction

The term plyometrics derives from the Greek - Plethyein - which means plio (increase) and metria (measure), that is, the search in obtaining the greatest distances possible of the jump. This method had its origins in the USSR in the 1960s and was widely diffused from the studies published by (POPOV, 1967 and VERKHOCHANSKI, 1968) according to (BARBANTI, 2001).

Most sports activities, such as jumping and throwing, use an alternation of muscular contractions, called the elongation-shortening cycle, that is, a physiological mechanism whose function is to increase the mechanical efficiency of the movements, in which there is an eccentric muscular contraction , Followed immediately by a concentric action (VOIGHT, DRAOVITCH and TIPPETT, 2002).

It is a training method based on the use of the elongation-shortening cycle (CAE), whose elastic component of a given muscle group, when preceded by an eccentric action in the resulting concentric action, would generate a greater force. One of the means by which the elongation-shortening cycle is activated is plyometry. This method is known to develop muscle power in athletes. Power is the main component of fitness, which may be the most representative parameter of success in sports requiring fast and extreme strength (BOMPA, 2004). Thus, plyometry is used to improve the output force and increase the ability to produce explosive force due to the stimuli to the muscles causing them to perform more work in a shorter time due to the adaptations and optimization of all neuromuscular processes.

Plyometric exercises are defined as those that activate the eccentric-concentric cycle for the purpose of lengthening-shortening or counter-movement to improve the ability of the neuromuscular system to react and store elastic energy during pre-stretching so that it is used during the concentric phase of the movement (DESLANDES et al., 2003).

The great majority of plyometric exercises focus on the lower limbs to increase the speed of the run, agility and heel height, plyometrics can also be used to improve the capacity of upper limb muscles.

For (Rossi and Brandalize, 2007), plyometrics is a form used to increase athletes’ muscular power and is very important for injury prevention and rehabilitation. Through the plyometric exercises, it is possible to activate the cycle of eccentric-concentric musculature contraction, thus provoking a biomechanical enhancement of the movement, its elastic action and its reflex action. In their studies, they suggest that plyometric training improves the motor action of the movement from 25% to 45%. In this way, it accelerates the recovery of the patients submitted to the treatment through this tool. This is due to the energy source provided by the storage and recovery of the elastic energy inserted in the eccentric-concentric contraction cycle, causing the movement to be made in a potentiated and more economical way with regard to energy expenditure.

Application of Pliometry in Sports

In the present study, the use of plyometric training in athletic performance was shown to be effective in positively influencing the athlete’s performance (GIMENES et al., 2014; OLIVEIRA et al., 2009).

When talking about high performance, small changes can influence performance to win, but this type of training, although sometimes controversial in its results, has been
much sought after as an alternative to improve the performance of athletes (SANTOS, NAVARRO, 2015). However, we believe that athlete performance may be affected may be affected by various physiological and biomechanical factors.

The main physiological factor for plyometric training to be successful is the use of the elongation-shortening cycle (CAE), which can be developed by performing specific combined jumps. Therefore, this training methodology contributes to the improvement of power and sprints, through the increase of CAE (ZWARG et al., 2013).

The use of plyometric training induces important adaptations in athletes performance, this experimental performance may be an important model to be applied to the process of developing the physical abilities of high level athletes (DURIGAN et al., 2013). Thus, we consider that several sports modalities can benefit from plyometric training. (ZWARG et al., 2013) affirm that plyometric training contributes positively to the performance of soccer athletes, through improvement in CAE, time of contact with the ground and sprints. Thus, it should be observed as an important activity to be applied in a planned and rational way in soccer training. Already (DURIGAN ET AL., 2013) states that:

> It is possible that short-term plyometric training programs, despite the great development in power, show less evolution in the anaerobic capacity of young tennis players. The comparative analysis of the vertical impulse after plyometric training in juvenile basketball athletes provides the increase of muscular strength and hypertrophy with low pain index.

We then consider that the plyometric method applied in sports modalities is significant and requires the use of different techniques; It is certain that the practice of plyometric training helps to increase power, speed, explosion and muscular strength, thus helping to develop the maximum capacity of athletes in general.

### Physiological and Methodological Aspects for the Training of Force with the Employment of Pliometry

It was about 50 years after the first publications on shock training and there are still doubts about the subject. Within the methodology of Shock Training is inserted the Pliometric Method which in turn has exercises such as multi jumps, launches of Medicine Ball, among others.

The biomechanical principle involves the speed of contraction of the agonist muscles and relaxation of the antagonist, trying to reduce to the maximum the time of action between them that will act immediately in the opposite way.

To better understand the plyometric mechanism, it is necessary to understand proprioception. The proprioceptors are located deep in the muscle (receivers), aponeuroses, tendons, ligaments, joints and the labyrinth, whose function is locomotor reflex or posture. They generate nerve impulses, which can be conscious or unconscious. The conscious impulses arrive at the cerebral cortex and allow even the closed eyes to have the perception of the body itself, its segments, the muscular activity and the movement of the joints - spatial notion. They are responsible for the sense of position and movement (kinesthesia). Unconscious proprioceptive nerve impulses arouse no sensation; They are used to regulate the CNS to muscle activity through the centers of reflection or myotatic involved with motor activity, such as the cerebellum. Proprioceptors are essential to inform our brain of the limb position, and in turn, this body positioning information is essential for movement control. The faster this processing takes place, the shorter the response time. This understanding becomes important for the fights, since different from the jumps in the athletics, the modalities of combat involve numerous decision making and variation in the movements.

In Figure 1 we can observe the phases of the deep jump:

1. **1st Stage - Amortization:** by letting the body "fall" from a height "h" the athlete generates an eccentric contraction that stimulates the muscle spindle.

2. **2nd Phase - Stabilization:** this phase is very short - the myotatic reflex is triggered, caused by the stimulus suffered by the muscle spindle, preparing the impulsion.

3. **3rd Stage - Supplementation:** to the leg extension movement initiated by the intrafusal fibers, adds to the impulse commanded by the athlete’s will, generating a force of impulsion resulting from the sum of the two contractions.

During the second phase, the stimulus on the proprioception mechanism of the muscle spindle induces the myotatic reflex and causes the contraction of the muscles that the practitioner has to contract to perform the third phase jump. For this reason there should be no solution of continuity between the three phases of the plyometric exercise.

![Figure 1 - Stages of deep jump](image)

**Source:** Dantas, Ehm Pliometrics: Scientific Principles and Practical Application, 2011

In Figure 2 we can see examples of plyometrics applied in various modalities. In the specific case of combat modalities, adaptations may be made, subject to the following general principles:

a. Number of repetitions: Beginner - 80 to 100; Intermediate - 100 to 120; Advanced - 120 to 140;

b. Training frequency: between 48 and 72 hours interval between sessions;

c. Include in a maximum of 3 weekly sessions;

d. Rest interval: 1x10 - if a series lasts 40 seconds, one must rest 400 seconds;

Source: Dantas, Ehm Plyometrics: Scientific Principles and Practical Application, 2011

In the case of combat modalities, which have varied characteristics, some exercises must be differentiated:

1. Boxing - The rope jumping and jabs are a type of plyometrics;

2. Karate, Kung-fu and Tae-kwon-do - deep jumps; Lateral jumps over small barriers; One-legged jumps and kicks in the air; Push-ups of arm with palms before returning to the ground;

3. Judo, Jiu-Jitsu, Muay Thai - use of medicineball with throws and reception in the kneeling position, with trunk twist at reception and throwing, catching the ball at the back, spinning and throwing on the other side;

There are positive and negative points in the Pliometric Strength Training (WEINECK, 1999).

Positives:

- Improved intramuscular coordination and strength gain due to high intensity of loads, with no increase in muscle mass or body weight.

- Considerable elevation of strength in high level athletes.

- Adapts to the athlete's level by gradually increasing the stimuli - small, medium or large.

Negatives:

- High psychophysical load. Intense plyometric training is suitable for high-performance athletes. You need strong muscles, joints and bones that have undergone gradual adjustments.

- Inadequate performance of plyometric training (without the necessary warm-up, for example) is closely related to injuries.

- For the athlete who has already reached a high level of intramuscular coordinating ability, the increase in strength obtained through this training is reduced. Success with reactive training is only successful when properly executed. In deep jumping training, one should be aware of the correct relationship between acceleration and braking force. The ideal drop height is given by the maximum heel height reached. Elevations high or small impair the effectiveness of training.

Combat Sports

We started talking about this study by performing a search on the words, sport and combat. In the way of sport we will enter the sociological field and then into modernity. Sport is not just a word, a common noun and is not defined with a single concept. The sporting practice in the current context has been gaining diverse forms, modalities and, mainly, its purpose has been extended. The name of sport is given to the physical activities performed by people who submit to regulations and participate in individual or collective competitions.

Sport occupies an important place in modern society, either in the structuring of spaces and social positions, or in the construction of bodies. In this sense, the sport phenomenon is also a vector that allows us to perceive and analyze the formation of the habitus. Sport can be understood as a specific field of modern life. It is a relatively autonomous social space, which has rules of operation, with social actors interested in defining the dominant rules and values. (BOURDIE, 2009)
Every sport practice expresses a form of sport manifestation, and is conceived in the interrelation of a sense (a rationale for being, transmitting values) and of a certain modality (even if the rules adopted are adapted in relation to those formalized by normative entities of the Modality in question, or created by practitioners), which present themselves in a particular social environment. (Marques and Almeida, Gutierrez, 2007).

In order to understand a sporting manifestation it is necessary to observe it as a complex phenomenon, which may be present in several practice environments. One way of performing such an analysis is presented in the Model of the conception of the forms of manifestation of sport. For the configuration of this model, it is necessary to understand, in a first moment, the environments of manifestation of the sport, and in a second, to reflect on the values transmitted by its different senses. As for sports, they present greater specificity, variety and autonomy in relation to rules and history, and can be present in any environment, in any sense (MARQUES, 2007).

Modern sport, in the present, has been discussed and studied in the most diverse institutions of our society, national congresses, municipal councils, civil entities, confederations, clubs, schools and universities, but basically in its organizational, technical-tactical and Physical preparation. Discussions and actions that have as basic objective to stimulate moral ethical behavior in the context of sport are still incipient. Topics such as ethics, morals and Sports Spirit - Fair Play.

One of the facets presented by the sport phenomenon is the aspect of technical behavior: to be a complete sportsman (and not a “player”), one must learn several preparatory techniques, train them, and perform them routinely, both in the physical domain and mentally. (BARBANTI, 1994).

Modern sports require and require a huge variety of techniques, train them, and perform them routinely, both in the physical domain and mentally. (BARBANTI, 1994). Modern sports require and require a huge variety of professionals who understand both their microcosmic dimensions - the athlete and the team, and all their difficulties and particularities - as well as professionals who understand the macroscopic dimensions of sports - the media, Administration, institutions, administrative planning, its sociological and political aspects.

Within this context of appreciation of sports practices by modern man, the different modalities of struggle had to be sportivized, so that in this way art could gain more followers and survive over time. Thus, tournaments were created with well-defined rules, to attract a growing audience. The denomination Sports Combat Modes implies a configuration of the practices of fights, of the martial arts and of the systems of combat systematized in modern cultural manifestations, oriented from the decodifications proposed by the sports institutions.

Aspects and concepts such as competition, measurement, application of scientific concepts, comparison of results, codified and institutionalized rules and norms, maximization of corporal yield and spectacularisation of corporal expression are some examples of this modern transposition of secular "combat" practices. (Del Veco, FRANCHINI, 2006, PUCINELI et al., 2005).

(CORREIA and FRANCHINI, 2010) also define the term "sport combat modalities" as a configuration of the practices of fighting, martial arts and combat systems systematized in modern cultural manifestations, guided by sports institutions. In common, fights, combat sports and martial arts have a broad universe of anthropological manifestations of a multidimensional and complex nature.

We can identify combat sports with regard to a fighting or martial art that has competitions (of opposition), the norms designed, in particular, to guarantee the physical integrity and a referee to make them respect. On the one hand, the combat sport moves away from actual combat, but on the other hand, allows to face opponents who have unpredictable reactions and allows good sportsmanship (fair play and respect). They are divided into 3 contexts:

1. Those that are part of the Olympics where they are organised by the (IOC)-boxing, judo, taewondo, fencing and wrestling.

2. The Olympic semi that are part of the Olympic circuit (IOC) through the continental games-karate.

3. And the General competitive – Eastern and Western martial arts

**Final Considerations**

Through the study of plyometrics, it was possible to show that this technique can exert a strong contribution to the speed within combat sports. The correct plyometric training, that is, correct execution of the technique, volume and intensity of the exercises and trainings being in accordance with the period of competitive preparation, according to the physical conditions and the rest allied to the specific training improves the explosive speed of the specific movements so that they can be better employed in combat sports.

Thus the plyometric workload must be individualized, taking into account parameters such as: age, weight, strength level, experience, etc. However, success in this type of training is achieved by the way in which they quantify the work performed and control the application of loads and overloads in the physical preparation of the trained individual.

Although there is much research on the benefits of plyometric exercises, they still lack information on its applicability, both for athletes and sedentary.

The possible risks of injury that plyometrics can cause to the joints can be avoided if professionals are attentive to the techniques of applying these exercises, being necessary before any activity, a complete heating, as well as a correct stretching after the exercises.

From the foregoing, it is believed that plyometrics may present as a fully feasible alternative to the complementary
training within combat sports, provided that it is employed by coaches who have perfect knowledge about the parameters that regulate this type of training.

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