The Amortization Phase: Making Plyometrics Work In Your Program

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Introduction

Coaches, trainers, and athletes have always sought methods to increase power, rate of force development and reactive ability. Plyometric training is a technique used to provide a link between strength in the weight room and speed on the field. In fact, the use of plyometrics has run rampant through American weight rooms since its introduction into the United States by Wilt in the mid 1970's (13). Even though plyometrics have been around for decades, many coaches still remain misinformed on how to properly incorporate plyometrics into their athlete's training plans. Others fail to understand or apply the scientific theories behind this unique methodology of training.

A couple problematic and confusing issues that exist when it comes to the understanding and application of plyometrics include, but are not limited to:

1. A lack of clear and concise terminology in the literature used when it comes to discussing key theories related to plyometrics
2. During training application, science is often overlooked at the expense of added intensity, for example; body mechanics are disregarded, prescribed loads typically require too long of ground contact time, too large a range of motion is utilized during the exercises.

The purpose of this article is to add brief clarity to some of these issues. In addition, it will attempt to give direction towards the keys related to the proper incorporation of plyometrics into one's training programs. However, some key concerns of upmost importance, such as specific exercise execution, program design variables, and program recommendations are beyond the scope of this article. The reader is encouraged to refer to the full texts of the references for more information in regards to these previously mentioned concerns.

Science

Since its inception as a training modality, there has been much mystique revolving around the concept of plyometric training. The use of plyometric training became popular in the United States in the 1970's. However, plyometrics (more appropriately termed jump or shock training) had been used for decades by Soviet coaches before it came to its current popularity status (5, 12). However, prior to that point; this form of training was under much scrutiny due to a lack of a systematic approach to its use. Due to the work done by a Soviet Scientist and Jump Coach, Yuri Verkhoshansky, and the success of the Russian jumpers in the late 1960's, coaches were given a glimpse of how plyometric methods, in a cyclic nature, could result in extraordinary results in an athletic arena (12).

By definition, the word plyometrics literally means to 'increase measurement' (8, 9). However, the term plyometrics was originally intended to mean 'eccentric contraction'. A more practical definition is a quick and powerful concentric movement, preceded by an active prestretch, or countermovement, that involves the use of the stretch-shortening cycle (SSC) (8). Two models exist to help explain the increased concentric power production seen during the SSC: the mechanical and the neurophysiological model. The mechanical model involves utilizing the elastic nature of the musculotendinous components, namely the series elastic component (SEC), to facilitate an increase in concentric muscle action. The neurophysiological model involves the potentiation of the concentric muscle action by use of the body's natural stretch reflex. Both, then combine, through an impulsive three phase cycle, to facilitate a maximal increase in force over a minimal amount of time. These three phases include the eccentric phase, the amortization or transition phase, and the concentric phase.

For the purpose of this article and to ensure carryover into a training plan, it is important for us to revisit another theory that Verkhoshanky hypothesized in regards to the development and execution of plyometric exercises. Verkhoshanksy observed that his jumpers who spent the shortest amount of time on the ground displayed the greatest jumping performance. This led him to hypothesize that in order for an athlete to withstand and overcome the high amounts of force being placed on the body during the loading of the SSC, they needed to have a high amount of eccentric strength. He also believed that by placing an emphasis on eccentric training, this would not only create greater dynamic strength, but also greater reactive ability (11, 12). This reactive ability, a characteristic of speed-strength, is essentially the body's capacity to rapidly switch from an eccentric action to a concentric one. Greater reactive ability allows one to more fully exploit the potential energy attained in the eccentric stretch phases that are common in sport movements.

Figure 1

Even though the SSC is well researched, some things still remain unclear about it, such as the degree to which each model contributes to the overall increase of power production found within it. That being said, one thing about the SSC has been clear from early research and remains true today; the amortization or transition of the SSC appears to be the most crucial in allowing for greater power production in the concentric phase of plyometric movements (1, 2, 3, 6). This is where some of the confusion exists between researchers and practitioners, alike. This confusion comes from the lack of clear terminology as some refer to components of the amortization phase. Amortization refers to the extinction or deadening of something (9). Thus, the amortization time and coupling time (in relation to an individual's reactive ability) is the time from the end of the eccentric phase to the initiation of the concentric muscle action (8). During this phase, several physiological events take place that will determine the duration of the phase. In any event, the time delay must be kept short in duration because if a concentric muscle action does not occur immediately following the eccentric phase, the stored energy from the SEC and the potentiating ability of the stretch reflex will be negated. In addition, two other parameters on the eccentric portion of the SSC are found to be important to the restitution of elastic energy and the potentiation effect if there is: 1) Too large of range of motion/distance at a joint, or if 2) The eccentric phase takes too long, the stored energy dissipates and is expired as heat (8).

Application

As mentioned above, because the amortization and transition time is the most important phase of the SSC, proper and efficient landings become paramount. Thus, pre-landing body position as well as maintaining posture, balance, and stability after ground contact is key. An athlete should learn to land on the balls of the feet (front two-thirds of the foot) with the ankle dorsiflexed and with slight flexion at all major joints involved upon landing. If the heels touch the ground during the contact phase, the intensity or load to overcome is too great and should be reduced (1, 2, 3, 9). The shoulders, knees, and toes should all be in alignment in this landing position. All of this in combination will allow for the quickest absorption rate, lowest ground contact time, and a more rapid recovery of potential energy which will make a more powerful concentric action more likely (1, 2, 3, 6, 9, 11). Figure 1 represents the proper landing position.

Without proper landing technique, it is unlikely that the athlete will be able to efficiently stabilize the forces at the time of ground contact and switch into a positive work position in the amortization time window. In addition, because of the extreme amounts of forces the body is required to withstand in many plyometric exercises, having incorrect landing technique may put the athlete at a much greater risk of mechanical inefficiency and/or potentially facilitate a so-called non-contact injury (7). Basically, the quicker an athlete is able to switch from yielding (eccentric) work to overcoming (concentric) work, the safer the movement becomes.

The amount of this coupling time (which is also referred to as amortization in this article) will make the difference as to how the SSC of that movement is classified. In order to be of true plyometric nature and take advantage of the SSC, amortization times should be of 250ms or less (5, 9, 10, 11). In addition, Bobbert has suggested different landing techniques in order to not only keep amortization times low, but also to have specific carryover to sport. A good guideline based on his research suggests that an athlete should execute most jumping movements (plyometrics) in a 'bounce'/undampened fashion where an athlete aims to land and immediately complete the push-off/take-off phase with little countermovement and ground contact time (1, 2, 3).

Summary

By understanding and paying close attention to the amortization phase of the SSC one can efficiently utilize plyometrics in any training program where qualities of power are a goal. The practitioner should look to understand the science of plyometric/SSC movements in order to properly apply them into the training of athletes.

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