PLYOMETRIC TRAINING LOADS FOR YOUTHS AND BEGINNERS

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Lundin gives a very complete review of the literature on this popular training method as it applies in the training of youth and beginners. He includes specific strength and maturation requirements, as well as suggested volume guidelines for jumping loads.

REPRINTED FROM TRACK COACH #101 (Fall, 1987)

Plyometric training has been demonstrated to improve jumping ability (Bosco, et al., 1979; Blattner & Noble, 1979; Polhemus & Burkhardt, 1980). Such “bounce” training is widely utilized in strength programs designed to develop power or speed-strength.

Although the training effects of plyometrics are not completely understood, the increase in muscle strength and power may be attributed to an increase in muscle elasticity and adaptation in neuromuscular functions. Improved elastic potential in muscle may also be due to an enhancement of the stretch reflex which is stimulated during stretch-shortening muscle activity.

Many questions remain, however, as to what constitutes an appropriate training load. With youths and beginners, the variables of maturation and experience compound the problem of determining training loads. Following is a synthesis of research and programs to aid the coach in implementing a plyometrics program for youths and beginners.

MATURATION AND BASIC STRENGTH REQUIREMENTS

The maturation and strength requirements for beginning plyometrics training have not been investigated to any great extent. Preparatory strength training of leg extensor muscles with babies and other resistance forms has been recommended as a foundation for plyometrics work, such as depth jumps (DJ). A maximum squat of 1½-2 times body weight (BW) has been recommended by some Eastern Bloc authorities as a prerequisite for plyometric training (Radcliffe, J. & Farentinos, R., 1985; Verkhoshanskiy, V. & Chornovsov, G., 1974).

This goes along with traditional training patterns which normally follow the sequence of maximal force development preceding speed or plyometric training in the yearly cycle. This pattern, however, has been shown to be less effective than training both components simultaneously throughout the year (Bosco, 1985; Verkhoshanskiy, V. & Tatyan, V., 1983).

Eastern Bloc literature concerning pre-pubescent and pubescent strength training utilizes various forms of “bouncing” activities starting as young as 7-8 years (Fritzche, 1977; Loffler, 1979; Mekhonoshin, 1983; Ushkevich, 1985). Experience seems to indicate a natural inclination and adaptation by children to various forms of hops, steps, skips and jumps if properly administered. A squat of 11/2-2 times a child’s body weight as a prerequisite for such training is highly questionable and was probably never intended for such a population.

Even among mature athletes, a minimum strength level necessary to begin a plyometric program has been questioned (Radcliffe, J., & Farentinos, R., 1985). This is not to say that maximum strength training is not necessary, for it occupies a very important part of power development. The role it plays in the training scheme is going to be altered depending upon the biological age of the athletes.

Maximum strength activities are not recommended for pre-pubescent or pubescent athletes (NSCA position paper, 1985; Dvorkin, L; 1983), yet plyometric activities can be utilized throughout childhood. Various plyometric drills for pre-pubescent and pubescent athletes can be viewed as improving leg power through an increasingly improved take-off mechanism (Jurisma, 1980). The key to all of this is proper training loads, dependent upon age and stage of biological development.

PLYOMETRIC TRAINING LOADS FOR YOUTHS AND NOVICES

Typical probiems or mistakes in planning a plyometrics program for any level concerns appropriate training loads. This is difficult at best because of the limited research concerning the practical aspects of implementing a plyometrics program.

What research has been done has primarily focused on mature athletes in a depth jump (DJ) format. Little, if any, research has been attempted concerning the myriad of multiple jumps of a vertical or horizontal nature which comprise the bulk of many plyometric programs.

With so little to go on in reference to proper training loads, the coach must proceed with a conservative bias in developing a plyometrics program for beginners, children and/or youths. Such a program should consider the following points (Ftitzsche, 1977; McFarlane, 1983):

1. Proceed from general to more specific jumping exercises.
2. The choice of exercises must correspond to the age and biological development of the athletes without endangering due to overload.
3. The choice of exercises should allow for a gradual increase in load during the year.

Proceed from general to more specific jumping exercises.

General drills would include double-leg (DL) multiple jumps and hops of a vertical or horizontal nature. Also included in such a category would be vertical multi-jumps over medicine balls, hurdles, boxes, etc. and horizontal multi-jumps of a hopping, skipping and/or stepping nature with single-leg (SL) take-offs.

Specific jumps closely resemble or correspond exactly in speed and movement to competitive jumps. Triple, long or high jumps from a half to full approach or repeated stepping or hop-step activity from a 5-6 stride approach appear to correspond highly with competitive take-off action.

According to Lohman (1985), specific power is developed via vertical, horizontal and depth jumps of maximal intensity up to 6 reps in a series with horizontal multi-jumps preceded by a 3-5 stride approach. Generally, to exceed the above loads leads to an activity which is no longer specific to the competitive jump take-off mechanism but is defined as "power-endurance" or "jumping-endurance" (Boase, 1983; Lohman, 1985). As previously discussed, general jumping drills emphasizing technique and volume, or jump-endurance training preceed specific power training.

Bounding, or "long" jumps over 50-200m, is another exercise advocated by Verkhoshanskiy (1975) which may be categorized as a speed or jump-endurance activity. Such "long" jumps are characterized by an exaggerated striding action accentuated by horizontal drive of the free leg. Movements should be of supple, light and flowing nature. Length of bounding strides and distance covered is determined by phase of training year and training age and ability of the athlete.

Fatigue and the accompanying technique flaws may be avoided by using common sense and the limited guidelines mentioned. Even though "long" jumps and "jump-endurance" exercises are not specific to competitive efforts, such training does allow the beginner an opportunity to learn the various jump movements and adapt to plyometric training through general or exercises.

To identify breakdowns of technique, a coach must understand proper movement characteristics of the triple jump. The hop, step and jump phases of the triple jump, used individually or in combinations, comprise the vast majority of horizontal multi-jump and "long" jump exercises. For this reason, a manual describing the triple jump or using the track coach as a reference wili help in understanding proper technique.

Generally, fatigue is identified by technical flaws such as: 1. Reduced vertical height and/or horizontal distance covered in vertical and horizontal multi-jumps; 2. Reduced range of motion of extremities; 3. Loss of vertical trunk position; or, 4. Loss of synchronization (timing) of arms and legs.

Drop or depth jumps (DJ) are not specific so much in reference to the motor action of take-offs in the competitive jumps. Rather they allow the possibility for increasing the load on the leg extensor muscles over and above what various forms of multi-jumps may offer. It seems reasonable that the use of DJ with beginners should be individualized and preceded by the various forms of multi-jumps.

A suggested progression of exercise from general to more specific nature might proceed accordingly: 1. DL, straight-leg, ankle hops in place; 2. DL, straight-leg ankle hops over objects (20-40cm); 3. DL, in place, vertical hops and jumps; 4. DL, horizontal hops and jumps; 5. Various forms of horizontal hops, skips, steps and jumps with loading (contact) of single-leg (SL) nature; 6. Competitive forms of high, long, triple jumps from partial approach; 7. Depth jumps (DJ); or, 8. Competitive forms of high, long, and triple jumps from full approach.

The progression is from general to specific in respect to intensities encountered and complexity of motor task.

The choice of exercises must correspond to the age and biological development of athletes without endangering due to overload.

The majority of jumping exercises used with children and youths from 8-13 should be of a general nature. To determine the training load, not only the type of jumping exercise must be considered (general or specific), but also the number of jumps, takeoffs, or contacts employed.

The appropriate rest interval between sets is dependent on the purpose of the session. lf jumping endurance is the objective, the rest intervals may be shorter than sessions devoted to jumping power. McFarlane (1983) recommends a rest interval of 11/2-3 minutes between repetitions and 8-10 minutes between sets for activities (sprinting) exploiting speed (95-100% of maximum) over distances from 20-60m.

In jumping power sessions, multi-jumps, hops and bounds should remain in the 5-30 meter range or not exceed 6-8 contacts. This allows the athlete to exploit the power necessary in competition specific exercises by allowing adequate recovery so the workout remains power or speed oriented. Loffler (1979) also recommends 1-3 minutes between sets for recovery during jumping power sessions. Between all sets, light running and stretching is recommended to enhance recovery.

If jumping endurance is to be developed, the recovery intervals may be shortened to place a greater load upon the system. Jump endurance is developed through the use of general jumping exercises, the intensity being sub-maximal due to the greater volume (30-400m; 7-20+ contacts). Loffler (1979) recommends 45 seconds between reps and 1-2 minutes between sets as recovery times. McFarlane (1983) views speed endurance as requiring efforts from 90-100% of maximum over distances from 60-150m. Recovery between reps should be 2-5 minutes with 8-10 minutes between sets. McFarlane's suggestions may be most applicable to "long" jumps as advocated by Verkhoshanskiy (1975), whereas the recommendations of Loffler are more applicable to horizontal and vertical multi-jumps.

Generally, the number of sessions devoted to plyometrics is 2-3 per week. Activities of speed-endurance or aerobic nature should follow in the next day's training to allow for recovery from a heavy plyometric session.

Loffler (1979) suggests that general jumping ability should initiate a jump program with the number of contacts per session ranging from 150-220 in series from 7-20. Recoveries between series should be 45 seconds with 1-2 minutes between exercises. Total workout time should be 15-20 minutes.

Specific jumping drills should follow the development of general jumping ability, entailing 2-6 contacts in 3-4 series per exercise with total work equal to 80-100 contacts and 20-25 minutes. Rest intervals should be lengthened to allow recovery from specific jumping exercises. Loffler stresses the importance of technically correct performance with body weight (BW) the only resistance encountered. Such training loads represent maximum levels, so initially with beginners it may be more prudent to start with 3-50 contacts. As adaptation occurs, greater workloads may be attempted.

Ushkevich (1985) reported on training loads of 14-15 year old youths in the second year of long and triple jump training. Loads in a single session consisted of anywhere from 25-120 contacts and/or 120-200m (broken into series not to exceed 50m) of multi-jumps. Some form of jump training was included four times/ week with gradual increases in volume and specifically to the competitive take-off mechanism.

Mekhonoshin (1983) reported that the training of the take-off (amortization phase) may start in 3rd grade (9-11 years). The training consisted of DJ immediately followed by 3-5 hops over medicine balls. The DJ height for 3rd graders ranged from 25-35cm and for 4th graders 35-45cm with DL contact. SL contact DJ consisted of dropping from 15-25cm and 20-30m for 3rd and 4th graders respectively. No more than 1-3 repetitions of this drill were repeated in any session along with other drills of a general and specific nature. Also, the DH drills were employed only after 5-6 weeks of other jumping exercises.

Investigations by Bosco (1985) of muscle elasticity have indicated that the "breaking point" or maximum tolerance of stretch loads to extensor muscles of the leg increases to ages 20-25 and then decreases. In eccentric work (amortization phase), children were unable to achieve similar values as related to maximum isometric force as aduits. Bosco reports in some cases eccentric force is less than maximal isometric force among 4-6 year old children.

Such findings suggest that the Central Nervous System (CNS) at that age is not mature and the firing threshold of the GTO is relatively low in contrast with aduits to protect the body against high stretch loads. This seems reasonable at this age when muscle and particularly bones have not yet reached maturity.

Just when the CNS and GTO reach aduit maturity and firing thresholds is difficult to assess. From a practical view, the best depth jump (BDJ), or maximum rise of the Center of Gravity after a drop from height, was achieved from a DJ of approximately 20cm for 4-6 year old and 40cm for ages 10-15. The ranges appear to fall within those recommended by Mekhonoshin (1983) who was previously reviewed.

It appears, then, that determining BDJ is a means of individualizing DJ training regardless of age. BDJ represents a stretch load which allows the neuromuscular system to maximize available forces. DJ from heights which lead to a decrease in vertical jump performance are overloading the system and among beginners, children and youth, may lead to possible overload.

Presently, this method of determining training loads via BDJ appears to clear up much of the controversy concerning appropriate DJ height. Also, such an activity allows the coach to monitor adaptation. Increasing vertical jumps from a BDJ height indicate increased tolerance to stretch loads and a necessary increase in training load. Methods of determining BDJ are nicely explained by Radcliffe and Farentinos (1985) and Costello (1984).

The number of contacts recommended for mature athletes in DJ training ranges from 40-100, generally in a series of 8-10 contacts with rest periods of 1-3 minutes which include light running and stretching. Training loads for beginners should be 30 contacts per session twice weekly according to Verkhoshanskiy (1973).

For children and youths, training loads are not completely understood. It appears, however, that conservative jumping programs which follow accepted training principles may enhance leg extensor power among children (Mekhonoshin, 1983).

The choice of exercises should allow for a gradual increase in load during the year.

This can be accomplished by: 1. Gradual transition from general to specific jumping exercises; 2. Gradual increase in the number of contacts per session, per week, etc.; 3. Increase in number of sessions employing jumping exercises per week; and, 4. Testing for BDJ on a regular basis allowing intensity (height of DJ) to increase as adaptation occurs.

It must be remembered that DJs are intense and should be used sparingly among beginners, children and youths. Multi-jumps appear to develop leg strength and improve motor efficiency in jumping movements. It seems reasonable that such activities should constitute the bulk of exercises for such a population.

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