Plyometrics Program Design

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THIS TWO-PART ARTICLE WAS designed for new strength and conditioning professionals. Part 1 examines the pretraining and program considerations to plyometric training. Part 2 will address the classification of plyometric drills and how to design a program.

An examination of basic guidelines for designing a lower body plyometric program and information on how to implement such a program can be helpful for almost any coach. The theory, rationale, and importance of plyometrics will not be addressed in this article. Instead, readers are encouraged to consult other NSCA sources such as the plyometric video (10), the NSCA Position Paper (13), and various journal articles on plyometrics (1, 3, 7, 9, 11, 12). Some of the information on plyometrics and program design is based on our own empirical observations because research seldom investigates the total concept of program design.

Designing a plyometric program can be a difficult task regardless of one's experience. The discussion in this article will be based on 5 steps:

1. Pretraining considerations
2. Program considerations
3. Definition of movements
4. Progression
5. Steps in designing a plyometric program, and a sample program.

Thus a cookbook approach will be used to design the sample plyometric program. The recipe for designing the program will follow progressive steps.

■ Step 1: Pretraining Considerations

There are nine things to consider in pretraining:

- age
- body weight
- strength ratio
- current strength training
- current speed training
- experience
- injuries
- surface
- safety considerations.

Age

Because of the high intensity of some plyometric drills (1, 3, 5, 6) and the potential risk of injury to growth plates, it is recommended that athletes under 16 not perform plyometrics of shock intensity levels (the highest intensity level), that is, depth jumps. While a few physically mature 15-year-olds may be capable of performing shock intensity level plyometrics, the majority in that age group should not. Guidelines for determining whether depth jumps may be performed are as follows (8):

1. The athlete is measured as accurately as possible for a standing jump-and-reach.
2. The athlete does a depth jump from a box 18 in. high, trying to attain the same standing jump-and-reach score.
3. If the athlete succeeds, he or she may move to a higher box. The box height should be increased in 6-in. increments. This is repeated until the athlete fails to reach the standing jump-and-reach height. This then becomes the athlete's maximum height for depth jumps.
4. If the athlete cannot reach the standing jump-and-reach height from an 18-in. box, either the height of the box should be lowered or depth jumping should be aban-

doned for a while in favor of strength development. If the athlete cannot rebound from a basic height of 18 in., he or she probably does not have the musculoskeletal readiness for depth jumping.

While some athletes may be old enough to participate in plyometrics, they may lack the physical maturity. The aspect of physical maturity will be addressed in the section on strength ratios.

Body Weight

Large athletes (220–250 lbs) and very large athletes (>250 lbs) will not be able to perform the same drills, volumes, and intensities as smaller athletes (i.e., 150 lbs). It is recommended that athletes over 220 lbs not perform depth jumps higher than 18 in. (12).

Because of body weight differences, wide receivers may perform 40-yd single-leg hops while offensive linemen would use a shorter distance of 25 yds. These numbers illustrate the concept of variation in program design based on body weight.

Strength Ratio

Recommended strength ratios (strength divided by body weight) have ranged from 1.5 to 2.5 times body weight (3, 13). It is recommended that the ratio of strength (1-RM squat) to body weight be equal to or greater than 1.5 prior to performing lower body plyometrics. For example, a 200-lb athlete would need a 1-RM squat of 300 lbs before he could perform high intensity or shock level plyometrics. If the ratio is below 1.5, the athlete should continue with a strength training program and perform low to medium level plyometrics until achieving the required ratio. These ratios may be altered, subject to the intensity of the plyometric drills used.

While a 1.5 ratio may be needed for depth jumps, it is not needed for a split squat jump. At present the exact intensity levels of various plyometric drills and the strength ratios required to perform them have not been quantified. Therefore, use caution when beginning the plyometric program and employ systematic progression. Regardless of strength level, the athlete should perform 2 to 4 weeks of speed and strength training before beginning a plyometric program.

Current Strength Training Program

Athletes who have just ended a sport season and have been involved in sport-specific strength training should continue with it except when the overall program calls for changes in volume, intensity, or recovery (e.g., tapering for competition). Athletes who are not currently involved in strength training should participate in a strength training program for a minimum of 2 to 4 weeks (12) before starting plyometric training and should have the proper strength ratio (8, 12).

Current Sprint/Speed Program

To reduce the risk of injury, athletes must be in average to good physical condition prior to starting a plyometric program. They should have been involved in a sprint/speed program for 2 to 4 weeks beforehand (12) or have just completed a sport season. This will allow for strengthening and conditioning the lower extremities.

Experience

Athletes of low skill level may require additional training with higher volume and lower intensity in the form of running, exercises, and slower progression (8).

Injuries

Areas of potential injuries associated with lower body plyometrics include feet, ankles, shins, knees, hips, and low back. Although the risk of injury from plyometrics is low (4), not adhering to pretraining requirements and proper progression will increase the risk of injury (12). Be on the alert for signs of injury in these areas. In addition, previous injuries must be evaluated in relation to the potential risks of initiating a plyometric program.

Selecting different plyometric exercises and decreasing the intensity or volume of exercises will reduce the chances of further injuries. Current injuries may prevent or delay participation in a plyometric program.

Surface

Ideal surfaces are gym-like spring loaded floors or Resilite™ mats for easing the shock of landing. Floors such as basketball court surfaces of wood are only marginal for shock absorption. Synthetic tracks and artificial turf surfaces are generally marginal as well. Artificial turf has the ability to restrict the shoe from sliding upon contact. This will increase the stress on the joints of the lower body, especially during horizontal movements. Volume may have to be reduced when plyometrics are performed on artificial turf.

Never do high intensity exercises on asphalt, concrete, hard rubberized surfaces over concrete, or carpet over concrete. Natural grass can be an ideal surface. A grass surface will allow for a slight amount of give when the shoe contacts the surface.

Safety Considerations

Plyometrics require an emphasis on correct technique. A coach should be present at all times to monitor and correct the exercise technique. Where plyometrics are concerned, do not assume that more is better. If you do, it is easy to be injured or overtrained in a plyometric program. Always follow proper progression plans with regard to intensity and volume. For example, an athlete should not perform single-leg exercises until he or she has adjusted to plyometric training and learned the proper techniques of a two-footed landing (8).

■ Step 2: Program Considerations

As with pretraining, there are also nine things to consider in regular training:

- warm-up
- sport/event
- time of year
- length of program
- frequency
- progression of intensity
- progression of volume
- recovery
- fatigue.

Warm-up

All plyometric workouts should be preceded by proper warm-up (jogging, stretching, and dynamic specific warm-up) and followed by a proper cooldown (stretching) period. Without proper warm-up, the possibility of joint or muscle injury increases, and thus performance will be decreased.

Sport/Event

Associated with sport-specific considerations are the athlete's primary directional movements (8, 12). Athletics requires speed and power horizontally, vertically, diagonally, and laterally (11). Some sports or events may emphasize predominately vertical force such as spiking in volleyball, horizontal force such as sprinting, or a combination such as lay-up in basketball. While many athletes may need to perform both vertical and horizontal drills, sport-specific needs may require more of one type than another.

Exercise selection, intensity, and volume required for the sport and time of year should be considered. Sport-specific demands may require in-place or short response jumps for the shot putter, but long responses for the 110-m high hurdler.

Time of Year

Exercises, volume, intensity, and progression will vary according to the training period. Considerations should be made for off-season, preseason, and in-season programs. Generally speaking, the off-season program incorporates the most volume and intensity. Preseason is normally when volume is decreased and intensity is maintained or increased.

Few sports require any substantial amount of plyometrics during the in-season. Track and field, however, is one sport in which plyometrics is a vital part of the in-season program. Basketball and football, on the other hand, are two sports in which plyometrics are rarely performed during the in-season because of the large number and intensity of practices. However, some sport coaches may have their athletes perform specific jumping and hopping drills over bags or cones during practice. Some elite athletes (e.g., tennis, cycling, diving, gymnastics, figure skating) may perform plyometrics between major competitions.

Length of Program

The length of the plyometric program in most high school and college sports will range from 6 to 10 weeks. These time periods correspond to training periods of the year, for example, college football off-season in February and March, and high school volleyball off-season in June and July.

When planning the length of the program, consider any preplyometric strength training or conditioning that must be performed. The high school wrestler who has just ended his season and had not been doing strength training may require 2 weeks of strength training and conditioning before engaging in shock-intensity plyometrics for track. The high school athlete who goes from basketball to track, and who has been engaging in in-season strength training, may progress as quickly as 2 weeks to shock-intensity plyometrics.

Frequency

Frequency is generally considered to be the number of workouts per week. It may range from 1 to 3 a week but depends on the sport and time of year. For track athletes, it is not advisable to perform drills for the same body area (i.e., lower body) 2 days in a row at the same volume and intensity. In-season workouts may range from 1 a week for football players to 3 a week for track athletes. Off-season workouts may range from 2 for football to 3 or 4 for track.

The intensity of the daily workouts will affect the number of workouts each week. Three days of low intensity drills may be lower in overall weekly intensity and physical fatigue than 2 days of high intensity drills.

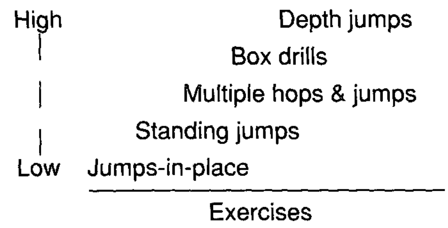
Recovery between plyometric workouts should range from 48 hrs (if 3 times a week) to 72 hrs (if 2 times a week) (8) and is influenced by the time of year, volume, intensity, and body size. Either Monday and Thursday or Tuesday and Friday workouts will allow for maximum recovery when doing plyometrics twice a week. Of course workouts may be performed on Tuesday and Thursday, or Wednesday and Friday, but it is better to allow the extra day in between for greater recovery.

Scheduling conflicts with facilities or practice days may require adjustments in the weekly workout schedule. Three-day-a-week workouts may be performed on Monday, Wednesday, and Friday, or on Tuesday, Thursday, and Saturday.

Progression of Intensity

Intensity is related to the physical stress placed on the muscles and joints, not the amount of individual effort. Although a greater effort will allow the athlete to reach greater height during a jump, only maximal efforts will be considered in this article. Intensity during plyometrics is dependent on the rate of the stretch-shortening cycle (movement from eccentric to concentric contractions). The rate of the stretch-shortening cycle is dependent on any of the following: maximum height of center of gravity, horizontal speed, body weight, effort of individual, and ability to overcome loading of the muscles.

Various plyometric exercises allow for variations in elevation of the body's center of gravity and in horizontal speed, and therefore intensity is increased. Plyometrics have been classified according to degrees of intensity. The following



demonstrates a good progression of types and intensities of plyometrics (8).

The intensity of plyometric exercises will vary greatly, therefore consideration must be given to choosing the correct exercises during a training cycle. Although there are many exercises, Part 2 of this article will present a basic list of plyometric exercises and their approximate intensity. Exercises in each category can vary in intensity.

Progression of Volume

Volume is normally expressed in number of foot contacts and/or distance. Three sets of 10 repetitions of the double-leg tuck jump would have a volume of 30. If 4 exercises are performed following this concept, the total volume would be 120 foot contacts. The number of foot contacts will depend on the intensity of the exercises, skill level, body weight, and time of year.

The volume and intensity of the overall program (strength, agilities, running, plyometrics) will also affect the volume and intensity of the plyometric program. The use of high-intensity exercises will decrease the total volume. As the program progresses from low-intensity skips and jumps-in-place to depth jumps (if the program progresses this far), the volume should be decreased. If distance is considered, then 3 sets of 40-yd alternate leg bounds would have a volume of 120 yds. Table 1 includes guidelines on training volume.

Table 1
Variation in Volume Based on Experience (expressed in foot contacts)

Season	Beginning	Intermediate	Advanced	Intensity
Off-season	60–100	100–150	120–200	Low–Mod
Preseason	100–150	150–300	150–450*	Mod-High
In-season	Sport-specific	Sport-specific	Sport-specific	Moderate
Championship	Recovery only	Recovery only	Recovery only	

*Low to moderate intensity level plyometrics.

Note. From *Jumping Into Plyometrics* (p. 14), 1992, Champaign, IL: Human Kinetics. © D. Chu, reprinted with permission.

Table 2
Variation in Volume Based on Body Weight (expressed in foot contacts)

Exercise	150–200 lbs	201–250 lbs	>250 lbs
Alternate leg bound	40	30	20
Double-leg tuck jump	40	30	20
Split squat jump	30	20	10
Lateral cone hop	30	20	10
Total	140	100	60

Note. From *Essentials of Strength Training and Conditioning* (p. 323), 1994, T.R. Baechle (ed.), Champaign, IL: Human Kinetics. © NSCA.

Large athletes (≥220 lbs) should not perform the same volume as small athletes because of the risk of injury. Table 2 is a model based on the concept of volume variations due to differences in body weight. It is not based on research of various volumes and intensities but rather on the potential for greater impact forces of large athletes. It is beyond the scope of this article to present the almost unlimited possibilities of this concept (i.e., variations as in Table 2).

Recovery

Recovery is expressed as the amount of rest between repetitions (e.g., depth jumps, standing long jumps), sets, or workouts. Because plyometric drills are maximal efforts ranging from depth jumps of 5 to 10 reps to 100-m alternate leg bounds, adequate recovery between repetitions and sets is required.

Recovery for depth jumps may consist of 15 to 30 sec between repetitions and 3 to 4 min between sets. Recovery between sets of 10 reps may be 2 to 3 min, and 3 to 4 min for distances of 60 to 100 meters. Exercises should not be thought of as conditioning drills but as speed/strength training. Recovery between workouts must be adequate, otherwise overtraining or injury may occur.

Fatigue

Fatigue will lead to a deterioration of technique and a general reduction in the quality of work. Plyometric training is based on the athlete's ability to perform maximal, quality efforts. Short recovery periods (10 to 15 sec) between sets will not allow for proper recovery. Fatigue may lead to poor exercise technique, which in turn may lead to injuries. Fatigue may be the result of a long plyometric workout or the accumulative combination of plyometric, running, and strength training programs during a training cycle. ▲

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