close

Plyometric Training for Youth

By Donald Chu
Date Released : 01 May 2000

Plyometric training is known to be an intense form of exercise that requires maximal efforts to create the physiological change associated with elite athletic performance. This system became popular in the late 60s to the early 70s and was credited with being responsible for much of the East European success in athletics during that time. Since then, the use of plyometric training has evolved into a mainstay of the training and development programs of virtually all-sporting events. With this transition came many questions, including the age, gender and strength levels of the athletes who would benefit from this form of training. This article is intended to deal with the use of plyometric training and junior athletes, both pre-and post-pubescent.

The fundamental reason to train with plyometrics is to reduce the ground contact time that an athlete spends when running or jumping. This time is reduced as the athlete matures, gets stronger, and practices the skills of their game. To further enhance resistance training the athlete spends considerable time practicing the specific movement skills they wish to improve; namely, running and jumping. These two movement patterns are often thought of as genetic endowments and affected little by outside influences such as training programs. To the contrary, research has shown that virtually all athletes can positively influence their performance outcomes by using plyometric training on a regular basis.

Resistance training is a mainstay of strength development but it should be noted that plyometric training does have an affect on the physiological changes in muscle as well. Poetteiger, et al, found that not only did plyometric training result in increased leg power, but, it was also found to result in increased muscle fiber size (diameter) in both slow and fast twitch muscle fibers. The results of this study would indicate that plyometric training could be a definite compliment to resistance training for the development of muscle mass as well as muscle power.

In order to implement this type of training with young athletes several factors must be considered. The first consideration is what controlled research studies tell us about this form of training and its effect on young children. Currently, there is little peer- reviewed research to explain the effects of this form of training available in the literature.

Avery Fagenbaum Ph.D. from the University of Massachusetts is currently studying two groups of children who participate in their "Youth Strength Training" programs offered through their Department of Kinesiology. The groups are combining plyometric training with strength training and using "games" to provide cardiovascular conditioning. Pilot studies indicate that jump training, in combination with resistance training, has resulted in significant increases in jump and reach scores and long jump scores over groups that strength train alone.

One of the reasons why this type of result might occur is the learning ability of the young child to react to the stimulus of ground contact. It is well documented and a matter of practice that children learn to play skill games such as tennis and baseball at ages as young as 6-8 years. The application of these types of activities with children has long been utilized to develop hand-eye coordination specific to these games. East European researchers have published research to support that 6-8 years is an excellent time to initiate these types of activities because the nervous system is "plastic" and youngsters can capitalize on motor learning to develop their game skills. What is equally important but often overlooked is that movement skills involving the lower extremities are extremely important in developing "athleticism". Therefore, plyometric or "jump training" can play a critical role in the development of athletic ability in the young athlete.

When designing the plyometric training program for youth we must consider the same program variables that are considered in any exercise prescription. Volume, intensity, frequency, and recovery, as well as, progression, must be manipulated to suit the needs of the younger performer.

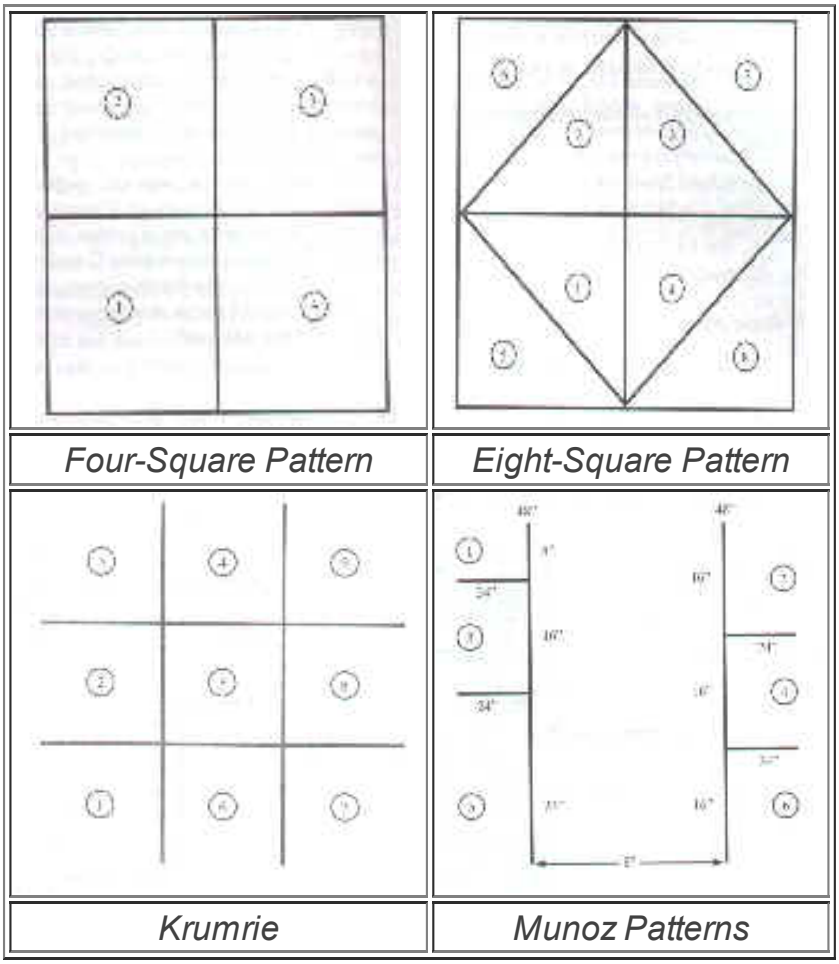
It is important to understand that plyometric training is but one piece of the puzzle, and each element of preparation (speed, strength, and jumping ability) cannot manifest themselves independently of each other but must work together to improve the functional outcome of training for the young athlete. Therefore, you are not developing strength for the sake of strength, or flexibility for the sake of flexibility, but rather, everything must work together to benefit the requirements of a given sport or event.

Footwork Drills

A unique form of footwork drills that are "plyometric in nature" and lend themselves to being extremely suitable for beginning athletes have been presented by John Frappier M.S., Exercise Physiologist from Fargo, North Dakota in the USA. The format includes utilization of one of several footwork patterns. These are known as the four-square, eight-square, Munoz, and Krumrie patterns. The latter two are named for former NFL football players who helped to develop them.

The drills are used to teach a young athlete how to move the feet out from under the body's center of gravity (C of G) and recover, allowing the athlete to be in a balanced position when the feet quickly recover to maintain dynamic balance. This is extremely useful in teaching the younger athlete to maintain balance and stability of the C of G while allowing the feet to change direction and adjust to a changing base of support. This is very specific to on-court or field adjustments that must be made quickly and without a great deal of conscious thought.

The general rule for all patterns is to count "one" each time the athlete returns to the starting point. For example, when executing a four-square drill and going from box 1 to box 2, the coach counts each time the athlete's foot or feet return to box 1. For patterns such as the 1-2-3 pattern (multiple boxes) again count "one" when the athlete returns to the starting box. These repetitions are totaled for a specific time period (such as five to 10 seconds) and recorded for future comparisons. Although Frappier offers specific routines that have been developed over time, the reader is limited only by their own imagination as to how to develop various routines. The examples that are shown here merely serve as models for this form of exercise.



Four-Square Pattern | *Eight-Square Pattern*

Krumrie | *Munoz Patterns*

Volume of Plyometric Training for Youth

There is little to substantiate the exact requirements for calculating appropriate volumes for novice athletes. The following represent "guidelines" that should be observed when prescribing exercise for this group of athletes.

1. Consider the athlete. If they are young and inexperienced, remember that there will be a learning curve associated with any exercise drill. Several sessions of training should be utilized to teach appropriate execution of the drill. The learning curve is very rapid for this age group, and proper execution is much more important than the number of repetitions achieved.

2. Observe the execution of the drill. Fatigue is the biggest detractor of execution; it interferes not only with performance of the drill it impedes learning as well. When execution falls below an acceptable level, stop the drill. It is far more important to see a drill performed correctly than to perform repetition for the sake of repetition.

3. Focus and concentration of youth is limited. The younger the athlete, the more likely they are to mentally wander during the course of a training session. It is best to perform fewer drills correctly than more drills incorrectly. Pre-planning is essential, the coach should consider which biomechanical traits (vertical jump, linear jump, change-of-direction) they would like to develop prior to beginning a training session. This allows for selection of exercises prior to practice and sets a plan of training into motion.

4. Number of “Foot Contacts”. Various practitioners have offered guidelines for the specific number of jumps in a workout (1) (4). East Europeans counted each landing from a jump as a “foot contact”. Some of the proposed workout volumes range from 60-80 counts in a workout for youth. If a multiple event jump (standing triple jump) is used then the number of foot contacts for this single event is equal to three. The number of efforts that should be used is linked to experience, gender, and basic strength levels once again.

Intensity of Plyometric Training for Youth

Intensity of plyometric exercises is determined by “effort of execution”. Jumping drills that require maximal distance or height to be achieved is going to be higher in intensity that efforts such as put forth during the footwork drills previously described. Avery Faigenbaum (2) has demonstrated in his studies at the University of Massachusetts that utilizing a 4” box as the maximal height utilized in the performance of jumping drills consisting of moving on and off the box was sufficient to achieve statistically significant results in vertical jump improvement. Apparently, athletes as young as 6-8 can still physically benefit from a drill using relatively lower heights.

Once again, European coaches insist on very “low loads” during the plyometric training phases for youth. Many of the exercises that benefit the younger athletes are those that qualify as “plyometric in nature”, such as jump roping, skipping and agility drills that require hopping and light bounding movements.

Maximal efforts should be utilized once the youngster has mastered the execution of the drill. Once the learning phase has been accomplished the athlete is much more likely to direct their efforts at force development along appropriate lines. The result will be a movement that has the subjective quality of “ease of execution”, “flowing movement” and/or “powerful effort.”

Frequency of Plyometric Training for Youth

Traditional thinking on plyometric training discusses the need to perform maximal effort days twice within a training week. This tends to allow for a recovery period of 48 to 72 hours of recovery between training days. When working with juniors, it is inadvisable that truly maximal days of training occur until they have accomplished all the learning, execution and adaptation necessary to perform maximal effort exercise.

With this in mind, it is acceptable to have a higher frequency pattern for plyometric training days. Three days a week are perfectly acceptable for juniors, given that there are not competition days at the end of each weekly cycle of training. If there are competition days included within the week or on the weekend, then the frequency of plyometric training should be reduced to twice a week.

If an active, formal warm-up is being conducted as part of each workout it is also acceptable to include four to five plyometric exercises within the context of the warm-up routine, rather than having a formal workout for a particular day. This gives the coach the opportunity to expose all of the athletes in a group to the same drills. It is also an opportunity to prescribe the number of repetitions, or time allotted to the performance of each drill. This sort of planning helps in the administration of plyometric training programs.

Recovery in Plyometric Training of Youth

The effects of fatigue on plyometric training have been previously mentioned. Fatigue is most likely to occur when the junior athlete is asked to perform exercises that do not allow for full recovery between execution of repetitions. Without full recovery, the muscular and nervous system does not have the opportunity to rid the systems of the effects of fatigue metabolites and will result in a decrement in performance. This decrement will serve to frustrate the athlete and the coach because of an inability to achieve desired efforts as measured by speed, distances, or heights. Learning new skills will be impeded for the same reasons.

The level of metabolism that should be utilized when performing these types of workouts is the ATP-PC and Anaerobic glycolytic systems. These metabolic systems require brief, intense work periods, followed by long (5-30X/work) active recovery periods. Jogging, walking, moving about are all acceptable forms of active recovery between repetitions of effort. It is well documented that active recovery is a more effective method of clearing the systems in preparation for the next work bout.

Progression in Plyometric Training of Youth

Progression in learning of plyometric exercises includes, but is not limited to, drills that are increasingly more complex. As an example, straight depth jumps as compared to depth jumps with 180 degrees of body rotation. It is imperative that the coach be able to biomechanically determine the required traits of their particular sport. An example would be the net ball coach who decides that vertical jump is a priority and that the best way to improve that skill is to train using exercises that are specific to the particular tasks of shooting and rebounding.

Progression can take the form of increasing the range of motion that a particular task requires. For example, the average angle at the knee used during the take-off in many events is approximately 140 degrees. This is what is termed a “short-amplitude” jump; a progression might be to advance to using “long-amplitude” jumps where there is a 90-degree angle at the knee achieved. Each has a particular purpose, and places a different demand on the athletes’ body. Long amplitude jumping activities are most valuable for those athletes involved in Olympic weight lifting, Free-style and Greco-Roman wrestling, and Rugby.

Another form of progression includes increases in intensity of exercise for a specific exercise. Using hurdles of different heights serves

to challenge the limits of each athlete. These changes in the height of hurdles or the distances covered represent advancement in the effort and complexity of task. The coach must be able to recognize the individual needs of the athlete and to design appropriate challenges that teach the athlete to respond quickly to the ground and reduce the amortization phase. This should be done without making the task so difficult that the athlete cannot react quickly to ground contact.

It has been noted in research conducted in the United States, that the instructions given to a young athlete greatly affect the outcome of their training. Therefore it is important that the coach know which biomechanical parameters they wish to improve as they initially design the training program, and begin to progress the levels of intensity, and difficulty.

Summary

The use of plyometric training in younger athletes has proven itself to be successful in improving their vertical and linear jump capabilities. Younger athletes are capable of performing the aforementioned drills when the outcome being sought by the coach is not just performance, but also, execution, concentration and aptitude for learning new motor skills. The level of intensity, the total volume, should be sacrificed for increased frequency and exposure to skill development.

It must be the goal of the coach to capitalize on the motor learning potential of performing plyometric exercises and drills to build a base of knowledge within the young athlete's body. This is so that base will serve as a reservoir for the time that skill is instinctual and instantaneous rather than a mental process. When a good foundation is installed, the house that is built upon it will last a long time.

References:

1. Chu, D. A., Jumping into Plyometrics; 2nd edition, 1999 Human Kinetics
2. Faigenbaum, A., Personal Communication, University of Massachusetts, December, 1999
3. Pottiiger, J, et al "Muscle Power and Fiber Characteristics Following 8 Weeks of Plyometric Training", Journal of Strength and Conditioning Research, 1999 13(3) 275-279.
4. Starzynski, T, and Sozanski, Explosive Power, 1995, Stadion Publishing
5. Young, W., et al, "Effects of Instructions on Characteristics of Countermovement and Drop Jump Performance", Journal of Strength and Conditioning Research, 1995, 9(4), 232-236