

Weightlifting in the Development of the High School Athlete

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ABSTRACT

ALTHOUGH MANY COACHES HAVE COME TO ACCEPT THE ROLE OF THE SNATCH AND CLEAN & JERK (WEIGHTLIFTING) IN THE DEVELOPMENT OF POWER AND STRENGTH, LESS APPRECIATION HAS BEEN GENERATED FOR THEIR CONTRIBUTION TO THE DEVELOPMENT OF OTHER ATHLETIC CHARACTERISTICS. THIS ARTICLE PROVIDES SUPPORTING EVIDENCE FROM THE LITERATURE AND FROM THE AUTHOR'S EXPERIENCE. THE AUTHOR'S EXPERIENCE IN IMPLEMENTING THE LIFTS TO ENHANCE OVERALL ATHLETIC PERFORMANCE OVER A LONG TERM HAS LED TO A STANDARDIZED APPROACH TO THE COACHING STRATEGY INVOLVED. THIS GENERALIZED APPROACH IS INITIATED WITH DIAGNOSTIC PRACTICES, REMEDIATION, AND TECHNICAL TRAINING THAT WILL PROVIDE THE ATHLETE WITH THE PATHWAY TO DEVELOP MORE FULLY THE CHARACTERISTICS OF HIS OR HER ATHLETIC POTENTIAL. FOR A VIDEO ABSTRACT OF THIS ARTICLE, SEE **VIDEO, SUPPLEMENTAL DIGITAL CONTENT 1**, [HTTP://LINKS.LWW.COM/SCJ/A126](http://links.lww.com/scj/A126).

It is becoming more common to include snatches, cleans, jerks, and their derivatives in the training programs of high school athletes. Many of the coaches, because of a lack of personal experience with these lifts, are not always sure of the benefits to be derived and hence do not introduce them properly nor implement them in the best possible manner. Moreover, the concept of long-term athletic development is not always implemented and the relevance of these lifts in that scheme is therefore not considered in program design.

Although many coaches believe weightlifting solely enhances strength and explosiveness, several other benefits may be derived if a proper training progression is followed. These benefits include the development and improvement of athleticism, an increase in durability, a balanced physical development, and a more efficient use of training time and energies (6). Athletes with an extensive background in weightlifting also may exhibit greater confidence and aggressiveness in their approach to competitive sports and a more complete understanding of athletic lifestyle.

In terms of female volleyball and basketball players, we have not experienced the noncontact torn anterior cruciate injuries that some programs have experienced. This is believed to be the result of the amount of

deceleration training that takes place during the “catching” phase of power snatches, power cleans, split snatches, split cleans, power jerks, and split jerks and the inclusion of full back and front squats in the regular training. Research on anterior cruciate ligament injury prevention among female athletes supports this observation (2).

Coaches who implement a properly designed training program will likely find that athletes are more enthusiastic about training and that the actual time spent in training is often shorter than other strength training modalities. The increases in proprioceptive abilities and general body awareness will likely provide the athlete with greater athletic prowess, and the lowered injury rate ensures that the best players are available for a greater number of competitive minutes.

The greatest benefits will result from a well-planned, long-term program that emphasizes proper technical performance of the lifts, while gradually increasing the training capacity, and hence restorative capacity of the athlete.

KEY WORDS:

weightlifting; derivative lifts; long-term athletic development; high school athletes; snatch; clean & jerk; power snatch; power clean; power jerk; periodization; technical training

The author has coached weightlifting in middle school and high school for many years. Athletes from other sports, such as football, basketball, volleyball, baseball, track and field, martial arts, and others have also been trained using snatches, clean & jerks, and their derivatives. Front squats and back squats supplemented the training program.

Although the program was built around a formal USAW-sanctioned weightlifting team, time and coaching were provided for both teams and individual athletes to train and develop athletic skills. Many of these athletes competed at the Junior World Weightlifting Championships. Some athletes in other sports earned college scholarships in volleyball, football, basketball, and track and field.

INCOMING ATHLETES

Athletes entering high school can more than likely take advantage of this strength and conditioning program if they have already mastered age appropriate physical qualities and attitudes toward sport. Incoming athletes at the high school level likely do best if they have already been involved in a sport activity that places emphasis on motor learning, technique training, proprioception, kinesthesia, and living an athlete's lifestyle. Frequently, athletes from gymnastics, diving, track and field, and figure skating have begun their training as athletes at ages as young as 6 years and hence come prepackaged to begin learning the lifts. In short, their nervous systems have likely been developed to the point where they can now turn their concentration to other aspects of their physical development and they understand the relationship between disciplined effort and results.

More frequently, incoming athletes lack substantial basic motor patterns perhaps because of a lack of sufficient training and instruction in fundamental motor skills. The solution may be to remediate these skills to allow these athletes to begin proper training. This is no different from having to teach

lagging math students basic arithmetic before progressing on to algebra. Much of the initial work of a strength coach must be invested in not only teaching the technical skills of weightlifting but also in incorporating some of the basic physical skills, such as running, jumping, throwing, hopping, skipping, and more.

Initial training for lagging athletes will be spent on dealing with range of motion issues, postural problems, and motor skill deficiencies while simultaneously attempting to bring the muscular development into a synergistic whole. The initial introductory process as detailed in the following section can reveal the priorities for the program design strategy. As the learning of technique progresses, other deficiencies in motor learning patterns may become apparent.

PRETRAINING

Pretraining is necessary for incoming athletes before they can begin the serious undertaking of weightlifting training. This should follow the implementation of certain specific movements designed to test the joint mobility, a survey of preexisting injuries or health conditions, and a review of the athletic history.

Those who have strong backgrounds in gymnastics, diving, dance, and/or track and field seem to have sufficient joint mobility, balanced development, sound motor learning skills, and necessary movement patterns to move quickly into a program of learning the technique of the lifts and begin regular training. Others with no joint mobility issues or postural problems can proceed directly into remedial strengthening while working on mastering technique.

Athletes who have joint mobility problems, especially because of an excessive amount of bodybuilding-type training, need to undergo an extensive period of training to remediate the shoulder platform, correct postural problems, and increase range of motion for dorsiflexion of the ankle.

The exercises administered to diagnose mobility problems are overhead

squat, squat snatch press, and front squat. Athletes experiencing trouble performing these movements with an empty weightlifting bar are considered in need of remediation training.

For those in need of mobility remediation, the previous 3 exercises are practiced for multiple sets of 5 to 6 repetitions on consecutive training days, oftentimes serving as a warm-up. There is less emphasis on these movements once the mobility has improved. Another supplemental exercise is to perform duck walks while supporting the bar overhead. These should be done both forward and backward for 4 to 5 sets of 3 or 4 repetitions for a distance of 3 m.

Individuals in need of proper movement pattern remediation may need to practice consecutive jumping from a squat position, jumping up steps, and hopping up steps on a single leg. Sprinting with proper technique and overhead throwing of medicine balls forward, backward, and from either side are also beneficial in learning to coordinate the upper body with the activity of the legs.

SNATCH DERIVATIVES LEARNING PROGRESSION

Learning the technique of the snatch and clean & jerk should occupy much of the efforts of the initial 2 to 3 months of training along with basic strengthening exercises and the development of training capacity. Technical training should be performed at the beginning of the training session, supplemental explosive work should follow that, and basic strengthening should be addressed last.

Technique is best developed through the mastery of derivative exercises that represent parts of the classic or competitive snatch. Muscle snatches, power snatches, overhead squats, snatch pulls, and snatch deadlifts are just some of the derivatives used by the author and national training systems (see refs 1,3-6, and <http://www.nscs.com/Search/?searchtxt5Benefits%20of%20clean%20&%20jerk> for a PowerPoint slide presentation by B. Takano entitled Improving athletic performance with the clean

& jerk; accessed July 25, 2012) in the teaching of technique.

The technical goals for the end of the first 2- to 3-month period should be to master the technique of the hang power snatch, the hang power clean, the hang split snatch, the hang split clean, and the power jerk. Athletes who master the technique of these movements easily can then proceed on to learning the pull from the floor, and the classic movements, although they may not find them necessary to maintain continued progress in certain sports.

The hang power snatch is taught first as it is less taxing on the grip (because of the relative lightness of the weight) and places an emphasis on the dorsiflexion of the ankles, the knee, and hip extensions while emphasizing overhead support. Pulling blocks may be helpful in learning the movement but may be inconvenient to use when working with large groups or will require the organizing of training groups composed of athletes of similar height.

Once the overhead squat (Figure 1) has been mastered, the following movements should then be learned and incorporated into the training:

- Snatch-grip behind the neck press
- Snatch-grip upright row (with emphasis on elbow height)
- Hang muscle snatch (Figure 2)
- Snatch-grip behind the neck power jerk (with proper foot movement).

These exercises should be performed for 4 sets of 4 to 5 repetitions until the athlete becomes familiar with the kinesthesia and movement dynamics involved. The early goal is to teach



Figure 1. Overhead squat.



Figure 2. Hang muscle snatch.

the finishing position of the movement so that the athlete is familiar with that before trying to learn the mechanics. The function of the coach is to emphasize the development of proprioception. The weights used should be relatively light with the emphasis placed on improving body awareness and correct performance of the movement patterns. The goal should be to position the body parts appropriately so that future development will take place in the most effective patterns.

The athlete is now prepared to learn hang power snatches (Figure 3). These should be performed as the first meaningful exercise in the session for 4 to 5 sets of no more than 3 repetitions per set. Special attention should be paid to footwork because this will aid in the development of dealing with deceleration forces, a critical factor in the prevention of knee injuries. It is also helpful to establish the policy of “no do-overs” in the case of missed lifts. This will force athletes to focus on the task if they know that they cannot repeat a lift that was missed because of technical error.

After the hang power snatch is mastered, the training can then change to include overhead squats in the same set. Thus, a set might be composed of 3 hang power snatches with the third repetition held overhead and continuing on into 3 overhead squats. This will stimulate greater development of the overhead supportive musculature while simultaneously developing the relationship between the power snatch and the descent into the low bottom position. When that sequence is mastered, the



Figure 3. Hang power snatch.

overhead squats can then be alternated with the hang power snatches.

Teaching the power snatch and classic snatch from the floor will require the most technical coaching for most athletes. Because of this large investment of coaching hours, snatching and cleaning from the floor were selectively implemented in the program. This was especially true of athletes in height intensive sports that did not require prodigious amounts of strength. Hence volleyball players and basketball players performed only hang movements during their high school years and only taught the pull from the floor when they were about to enter university athletic programs as scholarship athletes where they would have to perform movements from the floor.

As the hang power snatch is mastered, the athletes should begin to practice alternating leg overhead lunges (Figure 4) with a snatch grip. The bar is taken at arm's length overhead with a snatch width grip and then the athlete alternates legs while striding forward into a deep lunge position for 3 to 4 repetitions with each leg in a set. Four sets in the middle of the session will begin to teach the proper positioning and stabilizing to perform the movement effectively.

It is also recommended that footwork drills be performed before attempting the split snatch. The athlete stands with hands on hips, feet are aligned on the coronal plane, and the athlete drops by skimming the back foot and “prancing” with the lead foot so that they land in sequence. The back foot gaining traction first and then pushing the body forward before the front foot



Figure 4. Overhead lunge.

lands. The recovery is performed by moving the front foot back to the start position first and then the back foot moving forward. This keeps the movement of the torso primarily vertical.

With the hang power snatch, overhead squat, and alternating lunge mastered, the hang split snatch can be incorporated into the training. The repetitions should be 4 per set, 2 with the right leg forward and 2 with the left leg forward in an alternating pattern; 4 to 5 sets work well. This movement as proposed is helpful to offset bilateral asymmetries that develop from certain athletic events.

After several weeks of technique training, the athletes should become proficient at performing the hang power snatch and the hang split snatch. These will become 2 of the key exercises in long-term training and athletic development. At the same time, the athletes should be developing proficient technique in the hang power clean, hang split clean, power jerk, and split jerk while becoming stronger and developing greater training capacity.

CLEAN DERIVATIVES LEARNING PROGRESSION

Again, the finishing position should be mastered before attempting to learn the mechanics of achieving it. Thus, the front squat (Figure 5) will serve both to learn the clean racking position and to develop the legs in a functional manner. In the early learning phases, the front squat may be placed in the latter part of the sequence of a session unless an individual athlete has an especially difficult time developing leg strength or attaining sufficient ankle mobility. Four to 6 sets of 3 to 4

repetitions are appropriate, although a higher number of repetitions may be incorporated for those needing to increase bodyweight. The weight should not cause the spine to move out of a neutral curve.

A secondary movement to teach the correct role of the arms is the upright row with clean grip (Figure 6). The emphasis should always be on the elevating of the elbows and not the bar. The goal is to raise the elbows and the bar will follow in the correct pathway. Emphasis on elevating the bar will cause the elbows to move in incorrect patterns.

Since the athlete has at this point mastered the concept of rapid knee and hip extension followed by rapid hip and knee flexions to catch the weight in the power snatch, this movement pattern should already be in place to be implemented into performing the hang power clean (Figure 7). Again, the front squat should have taught the proper position for supporting the bar on the shoulders.

At this point, the athletes should have little problem mastering the hang power clean, especially if the program has been in place for some time, and there are adequate role models to observe performing the movement correctly. For explosive movements, the repetitions should not exceed 3 per set. The number of sets can vary from 4 to 6 depending on the specific situation with respect to the individual athlete, sport, and previous fatigue.

As the athlete gains mastery of the hang power clean, less time can be assigned to front squats and rows as technical learning exercises. More attention can be directed toward front

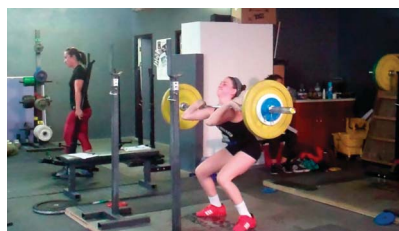


Figure 5. Front squat.



Figure 6. Upright row.

lunges with the weight supported in front of the neck on the deltoids, keeping the elbows in the same position as in performing a front squat. The athlete lunges forward into a deep split while alternating legs. Four sets of 4 right leg and 4 left leg repetitions should aid in balancing the body in the coronal plane.

Once the landing position for the front squat becomes familiar if not comfortable, the hang split clean can be practiced in sets of 4 repetitions (2 right, 2 left) in a range of 4 to 6 sets. The hang split clean provides another exercise that can be used as part of a regular training regimen. This exercise provides for explosive development, strength increases, core stabilization, and heightened proprioception and thus minimizes the number of exercises needed to train the athlete's full body.

The inclusion of these derivative exercises aids the athlete to learn the various parts of the technique of the clean before assembling them into a proficient execution of the lift (see ref. 5 and <http://www.nscs.com/Search/?searchtxt5Benefits%20of%20clean%20&%20jerk> for a PowerPoint slide presentation by B. Takano entitled Improving athletic performance with the clean & jerk; accessed July 25, 2012).



Figure 7. Hang power clean.



Figure 8. Push press.

JERK AND JERK DERIVATIVES LEARNING PROGRESSION

The jerk is best learned initially with the bar positioned behind the neck. This results in a more vertical bar pathway and a proper vertical alignment of the bar, shoulders, hips, and ankles upon completion. This may provide some difficulty for those with a thoracic kyphosis. If the condition is not severe, this type of training will do much to correct it. It also places the weight more nearly at the balance point of the mid-sagittal plane.

As the hang power snatch and hang power clean are approaching mastery, the training for the jerk should be initiated or progressing concurrently. The initial exercise to be mastered is the press behind neck. Four sets of 4 to 6 repetitions should be performed toward the end of the session, always with attention being paid to proper alignment and not excessive posturing of the head and neck.

The next exercise in this sequence is the push press behind the neck (Figure 8). This movement teaches the proper use of the legs in driving the weight up in the jerk. Insufficient leg drive will inhibit the proper extension of the elbows, and thus, there is a minimal amount of leg drive required

for the movement to be successful. This can replace the press. Four sets of 4 to 5 repetitions performed near the end of the training should work well.

The behind the neck power jerk involves the same knee-hip extension followed immediately by a knee-hip flexion that was a major component of both the hang power snatch and the hang power clean. It thus teaches yielding under the weight and like both the previously mentioned movements develops the capacity to decelerate under load. Four to 5 sets of 2 to 3 repetitions performed during the middle portion of a training session are recommended.

The overhead lunges performed in the preparation for learning the hang split snatch should provide the athlete with the proper proprioceptive feedback for the split jerk. In competitive weightlifting, athletes select one leg to be the front leg and use it exclusively. As a developmental exercise, the athlete may perform split jerks with alternating legs, but this practice is not recommended for competitive lifters.

The behind the neck split jerk is the final movement learned from the rear. The recovery from the split position can be practiced here as learned in the footwork drill. Four to 5 sets of 2 to 3 repetitions performed after

snatching and cleaning movements in the session would be most effective.

The athlete is now ready to master the jerk from the front of the neck and should be able to progress through the following series of exercises with relative ease. The volume and session placement can match the prescriptions for the behind the neck versions.

The learning sequence is therefore:

1. Press
2. Push press
3. Power jerk
4. Split jerk.

At this point, the athlete should have mastered the performance of a significant number of exercises that when combined properly with a small number of strengthening exercises will lead to enhanced strength and athletic development over the course of a high school career.

SUPPLEMENTAL STRENGTH EXERCISES

The exercises used primarily to increase strength are the back and front squats, snatch and clean deadlift, and good morning. The deadlifts should be performed with halts of 2 to 3 seconds at the power position with the goal in mind of familiarizing the nervous system with the positions to ultimately learn the snatch and clean



Figure 9. Clean and jerk.

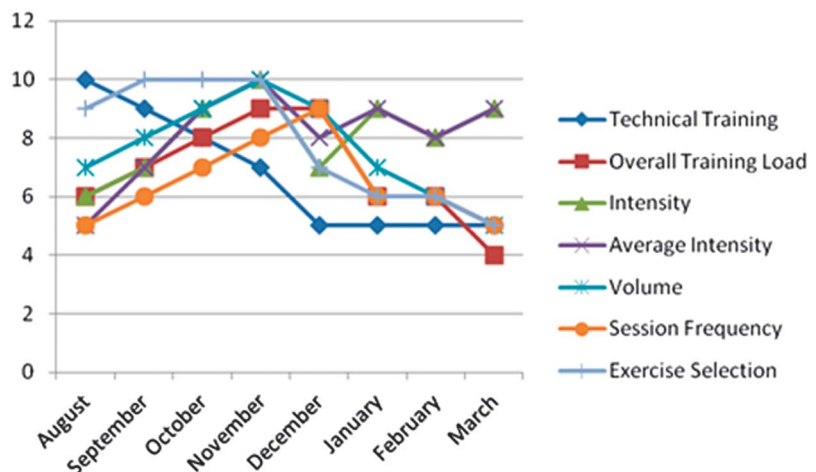


Figure 10. The relative values accorded to each parameter for a freshman athlete entering school in the fall and concluding the competitive season in the spring.

Table
Relative values for each component during a freshman year of training

Month	Technical Training	Overall Training Load	Intensity	Average Intensity	Volume	Session Frequency	Exercise Selection
August	10	6	6	5	7	5	9
September	9	7	7	7	8	6	10
October	8	8	9	9	9	7	10
November	7	9	10	10	10	8	10
December	5	9	7	8	9	9	7
January	5	6	9	9	7	6	6
February	5	6	8	8	6	6	6
March	5	4	9	9	5	5	5

from the floor. Four sets of 3 to 4 repetitions late in the session is an appropriate prescription. Attention must be given to coaching the correct positions during the performance of deadlifts.

Good mornings are performed to strengthen the hamstrings and as such require a 90° angle between the thighs with knees locked. The back remains static and the only bend is from a hip flexion. Four sets of 4 to 6 repetitions performed at the end of the session will work well.

TYPICAL TRAINING SESSION

A typical training session should consist of a snatching movement, a cleaning and jerk movement (Figure 9), an overhead strengthening movement, and squatting or lunging in that order. Most athletes can complete a session in approximately 45 minutes. Athletes whose sport event requires much higher than average amounts of strength may have to perform more sets with heavier weights that may in turn necessitate longer recuperation times between sets. For example, football linemen, throwers, and wrestlers are typical athletes in need of longer sessions with heavier weights.

MANIPULATION OF TRAINING VARIABLES

The training is most effective if it is coordinated with the athlete's competitive season. This type of training can

result in a significant performance peak during the season's final competition and maintain a steady progression in development over the high school careers of participating athletes.

The program design should be periodized with the variable factors being load, intensity, average intensity, volume, session frequency, exercise selection, intrasession exercise sequence, and combinations with other appropriate training modalities (Figure 10).

The Table represents relative values for the parameters indicated over a several month long period for a freshman entering high school sports in August and finishing the season in March, the competitive season having begun in December.

These relative values as guideline numbers are represented in the following chart. The coach needs to keep in mind that many of the guideline numbers (intensity, volume) are highly variable as they may change just because of physiological changes that occur during adolescence.

The best results will be obtained if there is a long-term coordinated plan for integrated sport preparation and strength and conditioning. This will ensure the most consistent, continued progress.

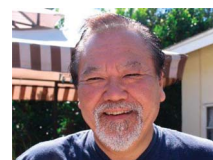
CONCLUSION

Properly designed strength and conditioning based on the derivatives of the

snatch and clean & jerk will provide an opportunity for high school athletes to develop consistently both in terms of strength gains and athletic development over the entire course of a 4-year career. Furthermore, this approach develops the musculature and neural components synergistically and hence minimizes the chances of both major and minor injuries to the skeletomuscular system. Because the resistances are variable, they can be made to be appropriate for each exercise for each individual, where bodyweight exercises can be of insufficient resistance for advanced athletes and excessive for physically immature adolescents.

The overall result of the program is dependent on proper instruction of technique during the initial phases of training. This is where the proper coaching is of the greatest value, ensuring that athletes are appropriately initiated into the developmental process.

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