CREATING POWER—ALTERNATIVE BILATERAL AND UNILATERAL TRIPLE EXTENSION EXERCISES

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INTRODUCTION

The idea of focusing on the improvement of an athlete's ability to explosively triple extend (ankle, knee, hip) vertically and horizontally, as well as bilaterally and unilaterally, is a well-recognized component of performance enhancement for athletes in many sports (7). Commonly, strength and conditioning professionals will employ weightlifting exercises and their variations to train this physical component. While the implementation of weightlifting exercises and their variations is certainly beneficial for enhancing an athlete's triple extension, they have limitations (4). Weightlifting exercises are technique extensive, require significant base-line strength, sufficient instruction, and training time for progressions. Unless proper technique is taught with a broomstick or dowel rod to very young athletes, weightlifting exercises may be difficult to effectively coach with novice athletes or large groups.

Orthopedic issues can also impact the effectiveness of some weightlifting exercises, their derivatives, and other resistance training exercises. For example, depending on the disability, some Paralympic athletes may not be able perform key parts of weightlifting movements. Many Paralympic and able-bodied athletes have musculoskeletal imbalances, which can limit the use of some weightlifting exercises. This can result in severely restricted enhancement of power or limited sport performance (5). During in-season periods some athletes have many issues that arise on a weekly basis from being in a contact sport, so the day-to-day or week-to-week nature of sport injuries can impact programming on an individual basis, which is why exercise variations are important. Alterations or adaptations in technique, caused by orthopedic issues such as poor wrist and shoulder mobility, inhibit safe catches for clean variations and shoulder stability issues may affect snatch and jerk catch positions. Technical flaws in weightlifting derivatives can sometimes lead to decreased bar velocity, which impacts the effectiveness of the exercise.

Weightlifting exercises are technique intensive. Depending on the athlete's training age, strength level, and frequency of training, it can take anywhere from 4 – 12 weeks to matriculate through the various progressions before an athlete is proficient with a given exercise (2). This may not fit into the training cycle prescribed to the athlete. Further, the time-cost of teaching weightlifting technique is substantial given an athlete's limited time in the weight room. Every minute utilized teaching advanced technique can naturally detract from time that could be utilized to train performance. Similarly, these exercises require the strength and conditioning professional to provide sufficient instructional time, supervision, and feedback to the athlete. Unfortunately, this is difficult considering some high schools and lower-level collegiate programs may have budgetary limitations that may not allow adherence to the guidelines for proper professional supervision. According to guideline 3.1 in the Strength and Conditioning Professional Standards and Guidelines, the recommended professional-to-participant guidelines are 1:20 for high school and 1:15 for college (3). Outside of well-resourced collegiate conferences and professional settings, adherence to these recommendations is sometimes a challenge, and anecdotal evidence from strength and conditioning coaches suggests in large group settings that sometimes the professional-to-participant ratio can be 1:60 or higher. This means that many novice lifters will not receive sufficient supervision and feedback regarding critical aspects of these technique-intensive lifts. Furthermore, many novice lifters lack the pre-requisite strength necessary to complete an Olympic exercise variation with the necessary velocity to achieve optimal performance transfer. As aptly put by sport scientist, "a fundamental relationship exists between strength and power that dictates that an athlete cannot possess a high level of power without first being relatively strong" (1).

Recent evidence suggests that weightlifting exercises and their variations necessitate that triple extension be performed at specific velocities to optimize transfer to the field or court. For instance, it is recommended that the hang clean exercise be performed at 1.4 m/s to optimize performance in the vertical jump (6). The addition of this recent evidence suggests that simply performing weightlifting exercises and their variations will not necessarily enhance performance. Rather, the athlete must possess a relative strength level wherein they not only produce force, but produce force rapidly. This is a significant limitation for implementing weightlifting exercises with novice lifters.

Many of the aforementioned limitations regarding weightlifting exercises can be mitigated by utilizing the exercises listed below. Each of these exercises places a focus on the mechanics of triple extension and the ability to produce force rapidly. Due to the simplified nature of the exercise technique, most of these exercises can be effectively taught and implemented into a training session on the same day. These less technique-intensive exercises are effective and enable strength and conditioning professionals to more adequately supervise and instruct large groups. Additionally, most of the exercises require the athlete to use either bodyweight, a medicine ball, or a lightweight vest. This allows an athlete to modify the exercise to their specific strength level and perform the exercise with the requisite strength and velocity necessary to elicit optimal transfer of performance. The potential limitation to this training method is that advanced athletes with higher relative strength levels will not have sufficient external load to optimize performance. In order to modify these exercises for athletes who are already exceptionally powerful, a wide variety of external load accommodations could be made. For example, each of these exercises could be performed as described while the athlete is wearing a weighted vest. Additionally, resistance to explosiveness could be increased by tethering the athlete with a waist band.

OVERHEAD MEDICINE BALL TOSS

Set-Up: Reach up to the ceiling (on toes) while holding the medicine ball (slightly scoop position, palms underneath the ball). Feet positioned slightly wider than shoulder-width (just wide enough for the ball to pass between the athlete's legs).

Execution: Start the exercise by rapidly flexing the knees and the hips while the medicine ball lowers in the scoop position. Upon achieving this "power position," rapidly extend the hips, knees, and ankles to initiate a high overhead throw.

Equipment Needed: 6 lb - 15 lb medicine ball (athlete dependent)

Key Coaching Cues:

- Initiate the throw by pushing the feet through the ground
- Hips drive the arms; think catapult; avoid whipping the low back and initiating the throw with the arms
- Leave the ground as you triple extend
- Throw a high and far pop-fly

MEDICINE BALL THRUSTER

Set-Up: Stand with a hip-width to shoulder-width stance (vertical jump). Place the medicine ball near the clavicles with the elbows pointed toward the floor.

Execution: Rapidly flex the knees and hips into a half-squat position without allowing the torso to lean forward. Upon achieving this position, rapidly extend the hips, knees, and ankles to drive the medicine ball off the clavicles and straight up into the air.

Equipment Needed: 6 lb - 15 lb medicine ball (athlete dependent)

Key Coaching Cues:

- Initiate the dip phase with a fast-half-squat
- Push the feet through the ground; hips drive the ball off of the clavicles; avoid using the arms to press the ball upward until the hips have extended
- Leave the ground as you triple extend
- Throw the ball straight up in the air

FIGURE 1. MEDICINE BALL THRUSTER - START

FIGURE 2. MEDICINE BALL THRUSTER - FINISH

LANDMINE SQUAT TO PRESS

Set-Up: Stance slightly wider than shoulder width apart. Fasten bar in landmine attachment and position the bar at the upper sternum with the hands stacked on top of one another at the top of the bar.

Execution: Rapidly flex the knees and hips into a squat position. Upon achieving this position, rapidly extends the hips, knees, ankles to drive the bar slightly forward and up off the sternum. As plantar flexion of the ankles occurs, release the lower hand off the bar to finish the extension and take one step forward if needed.

Equipment Needed: Olympic bar; ground-based landmine attachment, weight plates (athlete dependent)

Key Coaching Cues:

- Squat down to parallel or near-parallel depth
- Drive the feet through the floor, pressing upward and slightly forward
- Use the hips to drive the bar off of the sternum
- As the upper arms extend, release the left-hand and plantar flex the ankles; alternate starting hand position and pressing arm

FIGURE 3. LANDMIND SQUAT TO PRESS - START

FIGURE 4. LANDMIND SQUAT TO PRESS - FINISH

TRAP BAR JUMP SQUAT

Set-Up: Stand with a hip-width to shoulder-width stance (vertical jump). Grasp the trap bar with a neutral grip. Brace the core (belly button to spine).

Execution: Rapidly flex the knees and hips into a quarter squat position that mimics the load position for a vertical jump. Once this position is achieved, rapidly extend the hips, knees, and ankles to drive the body off the ground. The triple extension should also cause a locked arm shrug of the arms as the athlete leaves the ground.

Equipment Needed: Trap bar; bumper plates (athlete dependent)

Key Coaching Cues:

- Load into a quarter-squat position
- Push the feet through the ground; hips drive a locked arm shoulder shrug (don't pull with the arms)
- Leave the ground as you triple extend
- Land soft flexing the hips and the knees

FIGURE 5. TRAP BAR JUMP SQUAT - SIDE VIEW

FORWARD AND LATERAL POWER STEP-UP

Set-Up: Place lead-leg on top of bench or blocks with the knee and hips flexed at 90°. Arms placed up and in front of the body at chest-height.

Execution: Raise the lead leg so that the foot leaves the bench or blocks and then rapidly step down and through the bench or blocks while unilaterally extending the hip, knee, and ankle of the lead leg. The athlete should extend so powerfully that the lead leg leaves the bench or blocks after peak plantarflexion. After full triple extension has occurred, the athlete should switch legs mid-air and land with leg that started as the back leg on the bench or blocks. This switching motion will occur on the same side of the bench for the forward power step-up, but on the other side of the bench or blocks for the lateral power step-up.

Equipment Needed: Bench or blocks at the height of the athlete's tibial tuberosity (just below the knee cap); weight vest (athlete dependent).

Key Coaching Cues:

- Athlete should think knee up, toe up when initiating the movement with the lead leg on the bench or blocks
- Cock the arms back
- Rip the arms upward; drive the foot through the bench or blocks
- Triple extend and reach the hands to the ceiling; "grab the money"
- Switch feet in the air
- Land soft with alternate lead leg on the bench and back leg on the floor

REAR-FOOT ELEVATED 1-LEG SQUAT JUMP

Set-Up: Place feet in a lunge stance and elevate the back leg on a roller pad (ideally) or a bench. Place balance disc on the floor directly below the knee of the rear-foot elevated leg. Arms should be placed up and in front of the body at chest-height.

Execution: Rapidly flex the knee and hip of the lead leg until the rear-knee is 1 – 2 in. from the ground. Once this position is achieved, rapidly extend the hip, knee, and ankle of the lead leg until peak plantarflexion causes the athlete to leave the ground. Special attention should be paid to the landing component of this exercise. The athlete will be landing on the lead-leg with the rear-foot still positioned on the roller pad or bench. The athlete should have good landing mechanics and the ability to absorb high levels of force unilaterally before performing this exercise.

Equipment Needed: Roller pad or bench; balance disc; weight vest (athlete dependent)

Key Coaching Cues:

- Load into a position with the thigh of the lead-leg approximately parallel to the ground with the trailing knee 1 – 2 in. from the ground; cock the arms back
- Rip the arms toward the ceiling; push the lead leg through the ground
- Triple extend and leave the ground
- Land softly flexing the knee and hip of the lead leg

The inclusion of these exercises is recommended in the strength/power phase of a traditional periodization model. If a daily undulating periodization model is being employed, it is recommended that these exercises be incorporated in the workout of the week that is power focused. Regardless of the periodization model chosen, these exercises should receive priority and be completed at the beginning of the training session to ensure that the fatigue of subsequent exercises does not compromise the athlete's maximum rate of force development. It is recommended that these exercises be prescribed for 3 – 5 sets with a repetition range of 3 – 5 repetitions per set. The suggested rest time is 2 – 5 min between sets (2).

PLYOMETRIC CONCENTRIC BOX JUMP

Set-Up: Stand in an upright stance facing the box with the feet hip-width to shoulder-width apart. The arms should be extended overhead.

Execution: In a simultaneous motion, rapidly swing the arms back and down while flexing the knees and hips into a quarter squat position. Once this position is achieved, without pausing, rapidly swing the arms upward while extending the hips, knees, and ankles to drive the body off the ground. The landing on the box should include rapid flexion of the hips, knees, and ankles in a half squat position. The technique of a plyometric box jump does not have a high level of difficulty; however, there should be a focus on proper landing mechanics when it is implemented, and these skills should be mastered before the exercise is progressed. In the ideal landing position, the ankles, knees, and hips are flexed with the shoulders over the knees and the knees over the toes (2). The plyometric box jump can be progressed by increasing the height of the box or adding a weighted vest. The exercise can also be progressed to more intensive lower-body exercises, such as depth jumps, lateral box jumps, or a bounding/hurdle series that conclude with a box jump.

Equipment Needed: Adjustable plyometric box set ranging from 6 – 42 in. (preferably with a foam or rubberized landing surface to reduce the risk of injury with a failed jump attempt).

Key Coaching Cues:

- Rip the arms down
- Then rip the arms toward the ceiling; pushing the feet through the ground
- Triple extend and leave the ground
- Land softly flexing the knees and hips

CONCLUSION

Weightlifting exercises and their derivatives are commonly employed by strength and conditioning professionals to enhance explosive power. While the implementation of weightlifting exercises can be beneficial as they stimulate greater motor unit synchronization and therefore improve the ability to generate power, there are several disadvantages to exclusively practicing weightlifting for power development that should be considered when designing an effective training program. The aforementioned exercises are safe and require less skill to perform at maximal output. As such, strength and conditioning professionals should consider alternative exercises that are not technique-intensive exercises for novice lifters, large groups, and athletes with orthopedic limitations.

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ABOUT THE AUTHORS

Lawrence Judge is a Professor, Associate Chair of the School of Kinesiology, and Coordinator of the Graduate Coaching Program at Ball State University. Judge has been a leader in track and field coaching education and coach development for over 30 years. Since 2013, Judge has served as the National Chair of United States Track and Field (USATF) coaching education. In 2018, Judge was named a Fellow of the National Strength and Conditioning Association (FNSCA). In 2016, Judge was named as a Research Fellow by the Society of Health and Physical Educators (FSHAPE). He was the 2016 recipient of the United States Track and Field – Joe Vigil Sport Science award. This past summer, for the fifth time in his career, Judge was named to the coaching staff for the United States of America Paralympic National Team.

Josh Wildeman is currently a full-time instructor in the Kinesiology and Sport Department at the University of Southern Indiana. He also serves as the Designated Head Strength and Conditioning Coach for the University of Southern Indiana Athletic Department. In this role, he oversees the program design and implementation of strength conditioning for all athletic programs and directly conducts the training for a number of the teams, including the 2018 Division II National Champion softball team and the 2019 Final Four men's basketball team. Previously, he was an Advanced Physical Education Teacher and the Head Strength and Conditioning Coach at Castle High School for eight years. During his tenure at Castle High School, the strength and conditioning program was awarded the National Strength and Conditioning Association (NSCA) Strength of America Award from 2012 – 2014. In 2014, he was a finalist for the NSCA High School Strength and Conditioning Coach of the Year Award. Wildeman is a Certified Strength and Conditioning Specialist® (CSCS®) and Registered Strength and Conditioning Coach (RSCC) through the NSCA. He is also certified by United States of America Weightlifting (USAW) as a Level 1 Sports Performance Coach and by the American College of Sports Medicine (ACSM) as a Certified Personal Trainer (ACSM-CPT). Wildeman has been published in the Strength and Conditioning Journal *and the* International Athletic Administration Magazine*. He received a Bachelor of Science degree in Education from Indiana University in 2007 and a Master of Arts degree in Physical Education (Coaching Specialization) from Ball State University in 2010.*

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