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Abstract: The article focuses on dead lift (DL). The purpose of the work is to introduce various sport-specific applications for DL variations utilized in strength training program design to strength and conditioning coaches specifically the Romanian DL and its potential use in the power clean teaching progression. It is concluded that when the technical competence of the athlete is achieved, this exercise progression will be beneficial to the athlete's overall development and in transfer-of-training effect optimization.

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LEAD SUMMARY

The deadlift (DL) and its variations are widely accepted by strength and conditioning coaches as one of the 'big three' exercises prescribed to develop "total body strength", specifically the hip and knee extensors, spinal erectors, quadratus lumborum, core abdominal musculature, back, and forearm muscles. Therefore, the purpose of this 'exercise highlight' is to introduce strength and conditioning coaches to the many sport-specific applications for common DL variations used in strength training program design, with specific emphasis on the Romanian deadlift (RDL), for its potential use in the teaching progression of the power clean.

DEADLIFT TERMINOLOGY

While there are several reports addressing correct teaching technique of the DL, (7-9, 11, 12) few provide clarification surrounding specific terminology and explanation of the different DL styles employed by coaches (10, 17). Typically, the term DL is associated with both conventional and non-conventional styles (i.e., sumo), commonly used by athletes, with these two styles the basis of all other DL variants. A comprehensive review by Piper and Waller (17) presents 11 variations of the DL (Table 1), highlighting the adaptability and versatility of this fundamental exercise. This is an important consideration, as it is important for strength and conditioning coaches to be aware of the correct terminology for the many DL variations. The authors have found that explanation of DL variations is often more problematic than is necessary due to unnecessary confusion with surrounding DL terminology.

RESEARCH OVERVIEW

It is interesting to note, that despite the extensive use of the DL by athletes, relatively little research has been conducted exploring its application; to the authors' knowledge only five papers (1, 4-6, 16) and two abstracts (14, 18) have been published. According to research examining electromyography (EMG), a measure of muscle activation, the conventional DL results in twice as much activation of the erector

spinae muscles compared to the sumo DL (14), while the RDL is reported to have greater activation of the biceps femoris, as opposed to leg curls (18). A comprehensive biomechanical analysis of the conventional and sumo DL by McGuigan and Wilson (16) revealed that the sumo DL offers several mechanical advantages, the most significant being a more upright (i.e. extended) trunk posture at liftoff. The authors report that the decrease in L4/L5 torque during the sumo DL represents a significant safety advantage for athletes involved in strength training. Suggested mechanisms include reduced spinal flexion and increased muscular activation (6). According to previous research, a three-dimensional analysis of the sumo and conventional DL by Escamilla et al. (4) found that vertical bar distance, mechanical work, and predicted energy expenditure were approximately 25-40% greater in the conventional DL. However, further research is warranted with regards to understanding the different DL variants, specifically in determining which DL style an athlete should employ. For example, determinant criterions for prescribing DL variants should be related to the athlete's specific sport, current training status, and mesocycle goals.

ROMANIAN DEADLIFT

The RDL is suggested to be essential in developing movement proficiency with the Olympic lifts (3, 8), as the RDL establishes the correct body positioning (stance and posture) through initiation of the posterior chain segment of the hips, buttocks, and hamstrings (i.e., low back-hip hinge) (3), which is required to allow lifters to maintain optimal alignment (2). While there are different teaching progressions for the hang power clean (13, 15), we have extensively used the 6-step progression model presented by Duba and colleagues (2). The authors suggest that due to the importance of correct body positioning, teaching the RDL should be considered the first step in the progression, along with the front squat, as both movements develop the posterior chain segment (Figure 1). Once athletes have mastered the RDL, and developed solid lifting competence in both the RDL and front squat, they are ready to move onto the next progression in the model, that being the power shrug. While there is significant emphasis on teaching the RDL, for reasons previously mentioned, it has also been suggested (8) that the RDL may be the most challenging lift for athletes to perform correctly especially in athletes that present with posterior chain

segment dysfunction. This is a source of common error as the athlete tries to pull with the lower back, thereby initiating the movement without the hips, buttocks, and hamstrings (3). As such, the use of specific teaching cues is recommended to assure competent performance of the RDL (2) .

Teaching Components

The following brief overview provides explanation for the teaching components of the RDL:

(1) *Setup:* The stance is similar to that of a conventional DL with a double overhand grip. The scapula should be retracted with the spine maintaining its natural s-shaped curvature (i.e., natural lordosis of the cervical and lumbar spine) both at the beginning and throughout the entire lift (Figure 2).

(2) *Execution:* The RDL is similar to the stiff-legged deadlift (SLDL), with the exception of approximately 15° of knee flexion that is employed. Movement is achieved via hip flexion during the eccentric phase while maintaining extension in the cervical and lumbar spines, concurrent with holding the knees at approximately 15 degrees of flexion. The bar descends slowly and closely to the thighs instead of being directly underneath the shoulders (Figure 3). This reduces the torque on the lumbar spine (L4/L5) by placing the load closer to axis of rotation and over the base of support. The bar descends until it is inferior to the knee joint, or to the point where the lifter feels the need to flex the back, the urge to further flex the knees, or they have reached their maximal range of motion without compromising lifting posture (Figure 4). The key is to focus on initiating the movement at the hips, buttocks, and hamstrings while maintaining knee flexion of approximately 15°. When ascending, hip and knee extension should occur simultaneously while maintaining some shoulder retraction and the spine's natural curvature.

(3) *Common mistakes:* As previously mentioned, mistakes during the RDL are related to posterior chain segment dysfunction, and often result in faulty movement patterns. Typical lifting errors include a round flexed lower back, excessive kyphosis of the thoracic spine (Figure 5), pulling the bar against the thighs, and excessive extension of the lumbar spine at the end of the lift (Figure 6) (8). Common mistakes include not maintaining the recommended amount of knee flexion throughout the lift (i.e., approximately 15 degrees) and a lack of movement synchronization (i.e., extending the knees prior to hip extension during the ascent. Piper and Waller (17) highlight that more stress is placed higher in the hamstrings if the knees are maintained at approximately 15° flexion, whereas more stress may be felt at the insertion if the knees are straightened during the lift.

Variations

As with all exercises, there are several variations that can be applied to the RDL. Some examples include;

(1) *Grip - utilizing a snatch grip.* The grip setup described in this paper is for developing the fundamental movement progression for the hang power clean. However, if the athlete performs the RDL with a snatch grip (i.e., wider than shoulder width), then this is a preparatory movement for performing the power snatch.

(2) *Equipment - the use of dumbbells.* The use of dumbbell variations is of extreme importance in addressing athletes who present with bilateral comparison strength deficits. The functionality of dumbbells allows for both bilateral and/or unilateral exercise prescription.

(3) *Stance – performing RDL on one leg.* This is an advanced, functional application exercise variation that targets and engages the posterior chain segment of the hips, buttocks, and hamstrings. Athletes require a strong core and a well developed RDL technique as well as unilateral balance.

CONCLUSION

The DL is a fundamental exercise for the development of total body strength, and manipulation of the many DL variations provides a means for sport-specific application. However, the use of the DL should be based upon the goals, needs, and abilities of the athlete (17). Specifically, the application of the RDL allows athletes to establish and develop the correct body positioning that is essential in the progression for teaching the Olympic lifts, which can be accomplished though the use of the 6-step teaching progression (2). However, when programming the use of the DL (or DL variants), the strength and conditioning coach must devote time and expertise to develop the technical competence of the athlete in this progression. Once technical competence has been achieved, this exercise progression is considered extremely beneficial in optimising the transfer-of-training effect and overall development of the athlete.

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Table 1. Overview of deadlift variations and sport-specific applications

Deadlift variation	Primary muscles used	Comments	Sport-specific applications
Conventional DL	Gluteus, quadriceps, hip adductors, spinal erectors	Total body exercise	Football, volleyball, sailing
Sumo DL	Gluteus, quadriceps, hip adductors	Decreased lumbar stress; total-body exercise	Wrestling, rugby league, rugby union, AFL
Stiff-legged DL	Gluteus, quadriceps, hip adductors, spinal erectors	Common technical errors; low back rehabilitation contraindicated	Diving, gymnastics, sailing
Romanian DL	Hamstrings, spinal erectors	Essential learning movement for Olympic lifts (power clean) and variants	Weightlifting; field events (throws), hockey
Power Rack DL	Spinal erectors	Heavy loads utilised for increased strength	Powerlifting, rugby league, rugby union, AFL
Machine DL	Varies with exercise movement	Controlled movement pattern	Powerlifting, rugby league, rugby union, AFL
Snatch DL	Upper back, spinal erectors	Increased scapular stabilization	Weightlifting, gymnastics, ski jumper
Dumbbell DL	Varies with exercise movement pattern	Varies with exercise movement	Sailing, windsurfing, baseball, equestrian
One-arm DL	Abdominals, spinal erectors	Increased trunk stabilization	Field events (throws), rugby, squash, tennis, equestrian, archery, sailing
Strongman DL	Gluteus, quadriceps, hip adductors	Heavy loads utilising various objects; total-body exercise	Wrestling, rugby league, rugby union, AFL
Finger-grip DL	Forearm muscles, varies with exercise movement	Increased grip strength	Rock climbing, archery, basketball, gymnastics

Adapted from Piper and Waller (17). Abbreviations: AFL = Australian Rules Football; DL = Deadlift

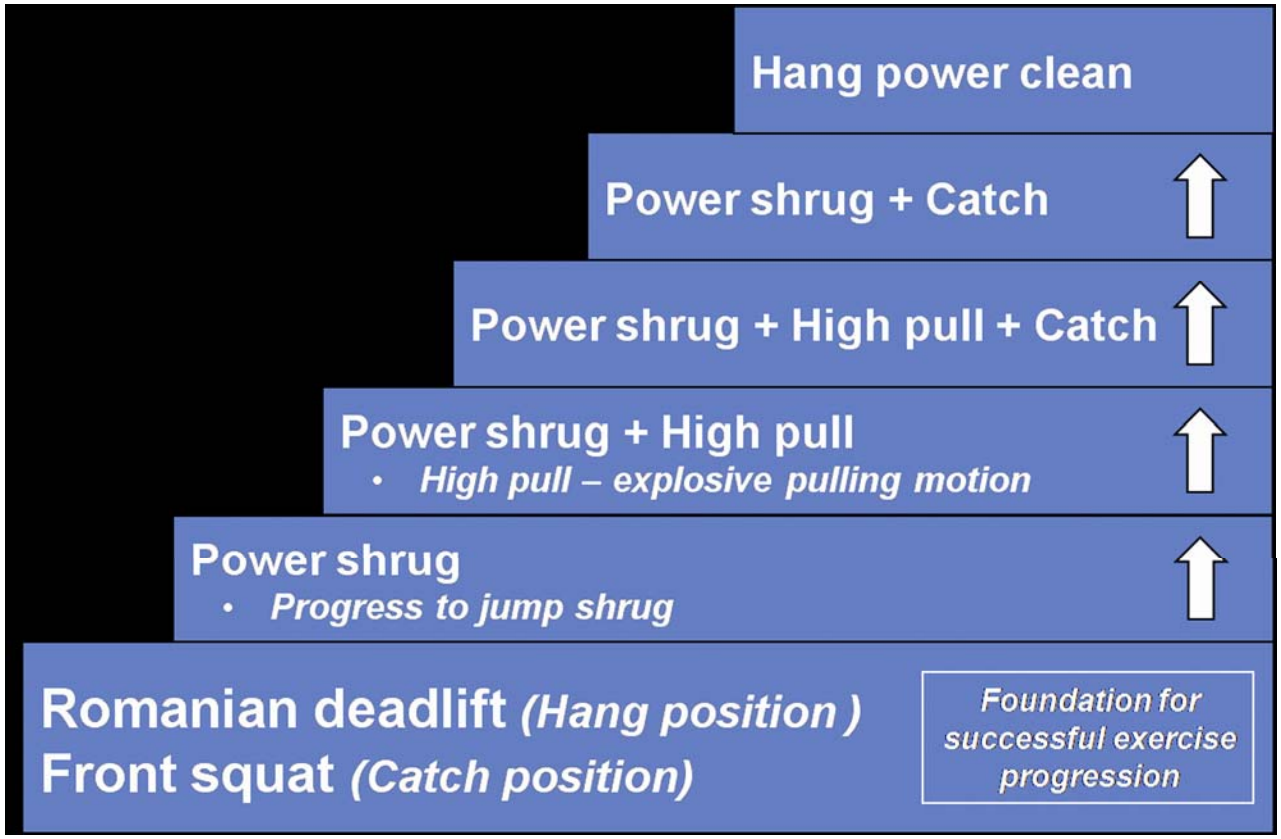

Figure 1. **Six-step teaching progression for the power clean. The RDL provides the foundation for successful exercise progression.** Adapted from Duba, Kraemer, and Martin (2).

Figure 2. **Set position for the RDL.**

Figure 3. **Mid-position for the RDL. The bar remains close to the thighs.**

Figure 4. **End-position for the RDL. The bar finishes below the knees.**

Figure 5. **Avoid the rounded back (excessive kyphosis).**

Figure 6. **Excessive extension at the end of the lift should be avoided.**