Explosive Power OR Heavy weight training

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Explosive strength is a characteristic of performance that is common in many sporting codes. However, training very frequently includes reduced velocity "strength" training which develops capacities which are only appropriate for a very few activities (e.g. power lifting).

The Contribution of Muscular Strength

Weight or strength training is often required because it is believed to improve explosive strength. Research has shown that it does increase explosive power in individuals who begin training with average strength. However, it has little benefit for explosive strength performances for individuals with previously trained or above average levels of strength.

Training with heavy loads (70-120% of 1 RM) improves maximal isometric strength but not the maximal rate of force development. In some cases it might even reduce the ability of the muscles to develop force rapidly. On the other hand, light load training with an accent on speed of movement increases an athlete's ability to rapidly develop force.

A typical total-body explosive movement (e.g. vertical jump) requires force to be developed in a time period between 200 and 350 ms. Most of the heavy-strength training-induced increases in force-producing potential cannot be realized over such a short time.

Implication. Heavy strength training is of little benefit to already strong individuals who wish to perform explosive movements.

Power to Weight Ratio

Strength training usually increases muscle mass implying that it might reduce power:weight ratio. However, an increase in muscle cross-sectional area is always accompanied by an improvement in relative strength and therefore could positively influence the power:weight ratio. Strength training cannot be justified for exclusion on the basis of increased mass.

Implication. It is the type of training that is important. A change in muscle structure, such as that which can be developed through heavy weight training, should be accomplished prior to the commencement of specific explosive power training.

Stretch-shortening Cycle

Most jumping and power activities involve a counter movement (e.g. wind-up, backswing, crouch) during which the muscles involved are first stretched rapidly and then shortened to accelerate the body or limb. This type of muscle action is known as a "plyometric contraction."

The counter movement involves muscles acting eccentrically to slow the body/limb and initiate the reverse desirable movement. As the muscles are activated, force is increased in the tendon-muscle complex, increasing its stiffness or resistance to stretching. The result is storage of elastic energy in the muscles and tendons (the connective tissues) that is recovered in the subsequent desirable "release" movement. A suddenly imposed stretch also increases neural stimulation to the muscles.

Actions without a sudden/ballistic preparatory movement are not as productive as those which employ it in the preparatory phase of an explosive movement.

Implication. Training for explosive power must include activities which maximize the stretch-reflex phenomenon in the preparatory phase of any movement.

Coordination of Movement Pattern

Power performance is affected by the interaction between agonist, antagonist, and synergistic muscles involved in joint movements. To produce a fast movement, resistance must be low. Thus, training should concentrate on relaxing antagonist muscle groups while contracting the agonist muscles. This can only be accomplished by specific-action training.

In activities where a single-leg

take-off (e.g. basketball, football) or single-arm throw (e.g. baseball, javelin throw) are used, training should be performed on unitary limbs. In activities where the limbs act as a pair (e.g. rowing, volleyball) training on those limbs should be in pairs.

Implication. Specific skill coordination, the reduction of internal antagonist muscle forces, and the maximization of agonistic muscle contraction and speed can only be accomplished by training on the actual activity itself.

Rate of Force Production

The primary reason Olympic lifting has been increasingly utilized as means of enhancing sport performance is the associated increase in explosive power or rate of force production (RFD). In many athletic endeavours power generation is one of the most important determinants of success. Movement like sprinting and jumping are highly dependent on an athlete's ability to produce force but more specifically to produce force at a high rate of speed. For example, both sprinting and jumping are characterized by brief muscle actions of maximal or near maximal force production in the minimal amount of time possible to generate a high velocity movement. The athlete's ability to successfully perform such movements is determined primarily by his or her ability to generate maximal explosive power at and through the hips. As such, any training technique or modality which can enhance the athlete's ability to generate peak power, especially through the hips, possesses a high capacity for performance enhancement in sporting skills. Simply put, Olympic lifts do just that.

In particular, rotational and extension movements must be initiated from the hips. Using the loaded movements often employed in power training can improve both the athlete's force production and overall ability to complete the movement through the full range of motion. This can have a significant positive impact on athletic performance.

Resistive Load

To produce an overload to stimulate performance change, the maximum augmented load should be 30% of that achieved in a 1RM. Performing activities with an added 30% has been shown to be more beneficial than traditional weight training, drop-jump training, or isometric training alone.

Implication. The maximum added resistance or load to an activity should be 30% of 1 RM.

Plyometric/Drop-jump Training

Plyometric or drop-jump training increases the height of jumps that are preceded by counter movements (e.g. long jump take-off, vertical jump) but have no important effects on jumps initiated from a static crouch position (e.g. track start, football lineman stance).

Drop-jump training enhances the ability to use the stretch-shortening cycle but does not increase fundamental muscle power.

For subjects who have never done plyometric training the effect is at first negative (performance worsens). This is mainly due to the protective effect of the Golgi tendon-organ reflex that occurs during sudden unaccustomed movements. After several weeks of plyometric training the inhibitory effects are reduced and performance begins to improve.

Plyometric training places considerable strain on the musculo-skeletal system. It should be preceded by a standard weight training program until substantial improvements in performance are demonstrated (e.g. for vertical jumps be able to squat lift 150% of body weight).

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Weight Training

Heavy weight training usually causes a movement to decelerate throughout its action. It produces adaptation that is specific to slow velocities. The rate of force development does not change. That is contrary to the desirable accelerative characteristic of explosive power movements. Explosive movement and light-weight training have been shown to be more effective for developing explosive power than heavy-weight training.

The one characteristic of training forms that does stimulate explosive power improvement is that the movements are performed as explosively as possible, whether or not weights or resistances are used.

Implication. There is a suggestion that perhaps a combination of plyometric and light-weight training may provide the greatest stimulus for explosive power development.

Periodization or When to Use Particular Forms of Training

The initial basic preparation period should involve weight training to increase muscle mass and strength. Activities should be whole-body as well as for specific muscle groups.

In the pre-competition phase, heavier and more specific weight training can be initiated to emphasize maximal strength. The concentric contraction phase of each exercise should be as explosive as possible.

Just prior to the competition phase, specific neural training is desirable. Heavy weights should be reduced and alternated with methods that emphasize rapid force development, high contraction velocities, use of the stretch-shorten cycle, and specific skill movements.

During the competition phase, plyometric training should be removed or largely reduced. Strength and power maintenance can be achieved by training only twice per week. If explosive training is still part of competition phase it should be stopped at least 5 days before a major competition.

EFFECTS OF TRAINING FORMS ON FACTORS OF EXPLOSIVE POWER

Training Feature	Heavy Load Weight Training	Light Load, Explosive Training	Plyometrics	Olympic Lifting	Isokinetic Training
Maximal Strength	**excellent**	fair	poor	good	good
Rate of Force Development	Good	**excellent**	good	**excellent**	fair
Stretch-shortening Cycle	Poor	good	**excellent**	poor	none
High Velocity Force Production	Poor	**excellent**	poor	good	good
Maximal Mechanical Power	Good	**excellent**	fair	**excellent**	good
Skill and Muscle Coordination	Poor	good	**excellent**	good	poor

Implication. Explosive power training employing a combination of plyometrics and light-load explosive weight work seems to be a more appropriate form of auxiliary training for more sports than the traditional heavy resistance training that is so popular and aimed at developing "strength."