Weightlifting for Sports Performance

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Introduction

Weightlifting and weight training are important tools for a sports conditioning coach. They can strengthen the body making it more robust and less prone to injury, as well as improving sporting performance by giving the athlete higher force production abilities.

Weightlifting refers to the Olympic style lifts: clean and jerk, snatch and their derivatives

Weight training refers to more generalised strength exercises commonly used in the gym

Weightlifting/weight training training effects

In general, weightlifting has the following effects on the CNS and skeletal muscle:

- Increased muscular endurance
- Increased muscle size
- Increased muscle strength
- Increased muscle power

Needs analysis

Before design a weightlifting or weight training programme for an athlete, you should complete a needs analysis of their sport and the athlete. Area's in particular to look at include:

- Muscles used (agonists, synergists, fixators)
- Movement patterns (hinge, squat, press, pull etc)
- Flexibility/mobility (especially ankles, hips and shoulders)
- Motors skills (balance, agility etc)
- Injury prevention (how are muscles used in the sport?)
- Absolute strength v relative strength
- Power requirement

Absolute strength v relative strength

Absolute strength simply measures an individual's ability to apply a force. Relative strength measures strength in relation to bodyweight. Depending upon sport, an athlete may be required to have either absolute or relative strength.

For example, a Strongman/woman competitor's success is measured in how much total load they can lift, carry or throw. However, a gymnast's success is measured in how much control they have over their movement – this requires a high relative strength:bodyweight ratio, but not a high absolute strength

Power

In sport, critical moments are often influenced by the speed with which someone can move their body mass or the mass of an object.

To move a bodymass quickly requires a high power:bodyweight ratio.

High power derives from high ‘maximal strength’ as well as a fast ‘Rate of Force Development’ RFD). Therefore, when weightlifting/training for sports performance, consideration should be given to the force required to move a resistance and the speed of movement the exercise offers

- Power = Force x (Distance/Time)
- Power = Force x Velocity

Maximal strength

Maximal strength is the ability to exert the highest force possible once. It is often measured by using a 1 Repetition Maximum test (1RM).

A 1 RM test requires the athlete to warm up thoroughly, then progressively lift heavier and heavier loads with good form, until the athlete cannot lift heavier without form breaking down. The number of lifts an athlete does en-route to their maximum lift should be limited, with adequate rest given between the increased lifts

Rate of Force Development (RFD)

RFD is the speed at which the contractile elements of a muscle can develop force. Being able to produce a fast RFD helps to accelerate a mass (body or object) and potentially give it a higher terminal speed

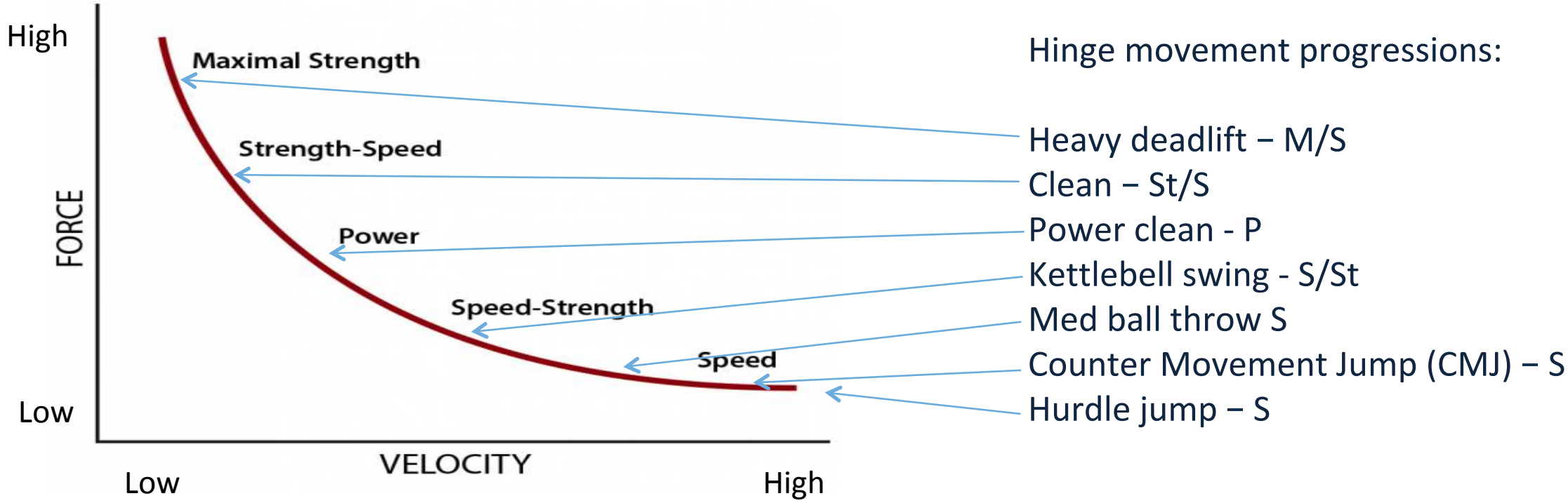
- Faster = better
  - Slow > 250 milliseconds
  - Fast < 250 ms
- Eg:
  - CMJ is slow (500ms)
  - Sprinting is fast (80-90 ms)
  - Drop jump are fast to slow (130-300 ms)
  - Hurdle jumps are fast (150ms)

Force-Velocity curve

To understand the relative contribution of maximal strength and RFD of an exercise, we can use a Force-Velocity graph. This graph plots the amount of force an exercise requires against the speed of movement that it allows.

Force-Velocity curve

The below graph illustrates where different exercises may sit on the Force-Velocity curve



Hinge movement progressions:

Heavy deadlift – M/S
Clean – St/S
Power clean - P
Kettlebell swing - S/St
Med ball throw S
Counter Movement Jump (CMJ) – S
Hurdle jump – S

Improved RFD effects

- Increases in muscle-tendon stiffness
- Increase in muscle cross sectional area
- Change in fibre type
- Increased neural drive

Causes of RFD impairment

- Increased fasicle length (stretching)
- Type 2x (fast oxidative) to type 2a (slow twitch) fibre change

Dynamic correspondence

Dynamic correspondence is the cross-over effect between training activities and the athlete's sport. As training stimulus is specific, it will cause specific adaptation. This transfer effect should always be considered to maximise the functionality of the exercise − Transfer effect considerations include:

- Direction of movement
- Amplitude of movement
- Dynamics of the effort
- Rate of force production
- Force production requirements
- Regime of muscular work

Weight training exercises are often fairly static in nature, therefore do not always offer a good dynamic correspondence. Exercises that offer the best functionality should be researched and utilised

‘Triple extension’

‘Triple extension’ (TE) refers to the lower limb movement pattern of plantar flexion, knee extension and hip extension. The majority of sports utilise TE in one form or another – whether the sport involves running, jumping or the exertion of high ground reaction force, it is from TE that we get our greatest power. For that reason, exercises that promote and increase our maximal strength or RFD (therefore power) in TE are essential

The Olympic lifts

The Olympic weightlifting movements of ‘clean and jerk’ and ‘snatch’ are generally considered the most beneficial exercises to develop TE power. They use a relatively high resistance, which must be moved quickly and therefore stimulate the nervous system greatly.

The Olympic lifts are technically hard to master and therefore variations on the exercises are also used with athletes who perhaps do not have the time available to learn the full lifts.

Common lifts include:

- Clean
- Power clean
- Hang clean
- Clean pull
- Jerk
- Snatch

Maximal strength training guidelines

To train for maximal strength the following guidelines should be observed:

Exercise	Reps	% 1RM*	Sets	Rest	Notes
Usually a functional compound exercise though could be an isolation exercise	1-5	85-100	1-5	3-5 mins	Exercise should be performed with equal emphasis on concentric and eccentric movements

* % 1RM is the percentage of the maximum amount an athlete can lift in the chosen exercise

Muscle hypertrophy training guidelines

To train for muscle hypertophy (size) the following guidelines should be observed:

Exercise	Reps	% 1RM*	Sets	Rest	Notes
Often developing muscle size is done using isolation exercises	6-11	70-85	3-8	1-2 mins	Exercise should be performed so that muscle has adequate time under tension (40 secs to 1 min) and often the set will finish in voluntary muscle failure

* % 1RM is the percentage of the maximum amount an athlete can lift in the chosen exercise

Muscle endurance training guidelines

To train for muscle hypertophy (size) the following guidelines should be observed:

Exercise	Reps	% 1RM*	Sets	Rest	Notes
Both compound and isolation exercises may be used	12-20	50-70	1-5	30 secs - 1 min	Exercises should induce muscular fatigue

* % 1RM is the percentage of the maximum amount an athlete can lift in the chosen exercise

Power training guidelines

To train for power the following guidelines should be observed:

Exercise	Reps	% 1RM*	Sets	Rest	Notes
Functional exercises that have good dynamic correspondence should be used	1-5 (stopping before form failure)	Varies from 10-95 depending upon speed of movement required	1-5	3-5 mins	Exercises should allow the 'release' of the load so that no deceleration occurs before the end of the movement

* % 1RM is the percentage of the maximum amount an athlete can lift in the chosen exercise

Injury prevention training guidelines

To train for injury prevention the following guidelines should be observed:

Exercise	Reps	% 1RM*	Sets	Rest	Notes
Functional exercises requiring high motor skill requirement or stability and possibly a strong eccentric component	12-20	Varies from 10-60%	1-5	1-2 mins	Exercises should be geared towards stabilising those movements that cause injury (usually eccentric)

* % 1RM is the percentage of the maximum amount an athlete can lift in the chosen exercise