Strength training – what are the right exercises?

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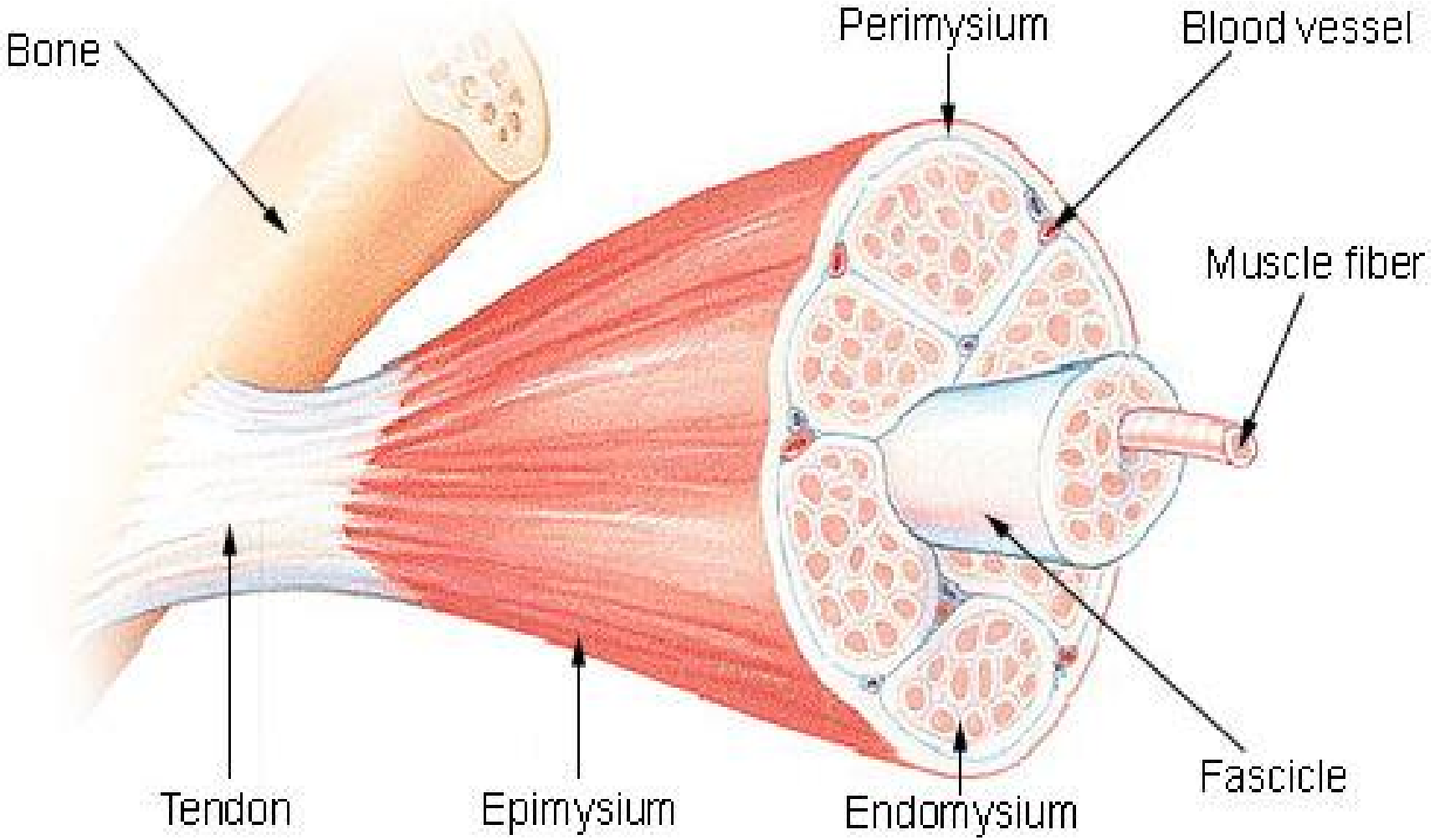
Strength training – what are the right exercises?

Nil disclosures

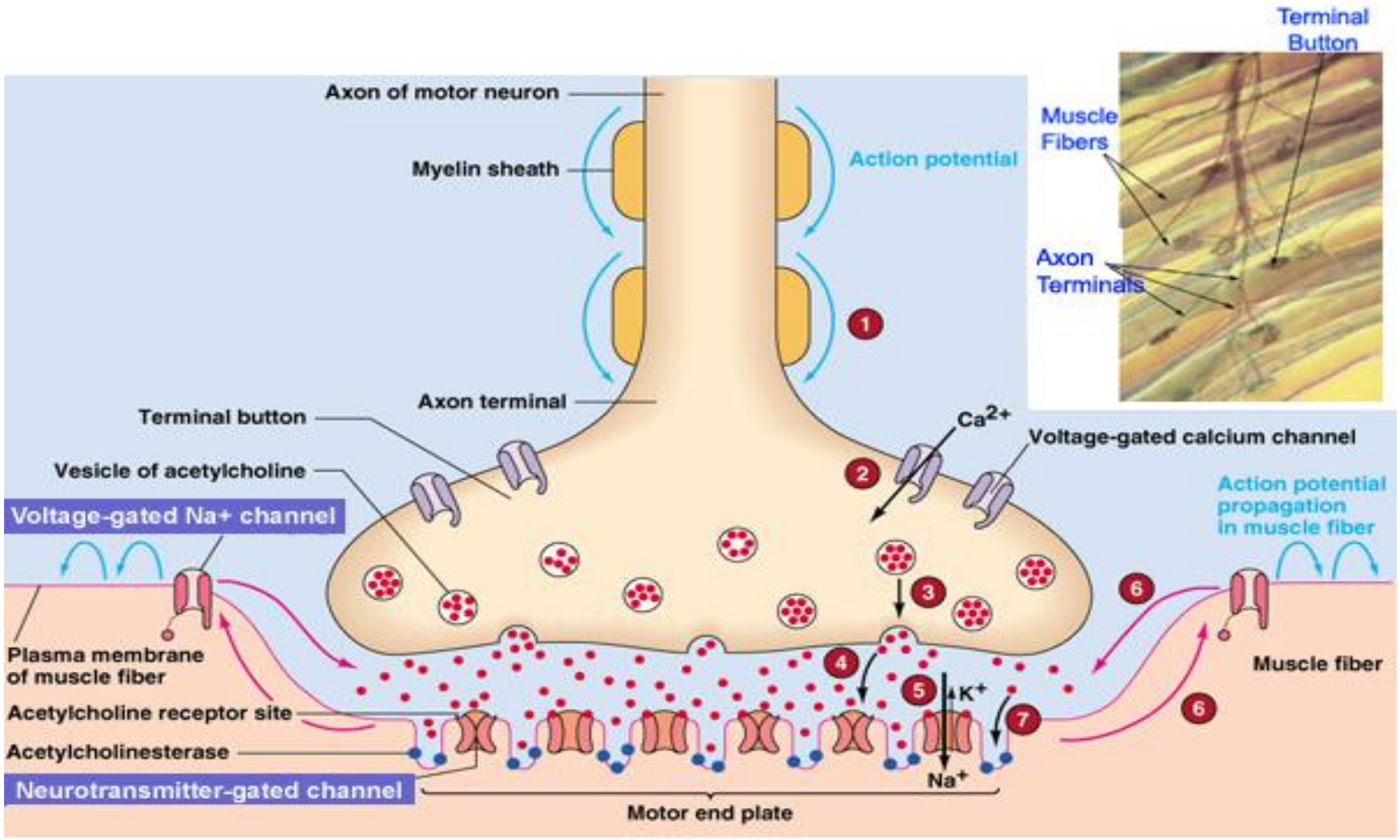
Learning Outcomes

- Basic muscle physiology
- Why strength training?
- How can I get stronger?
- Designing a programme

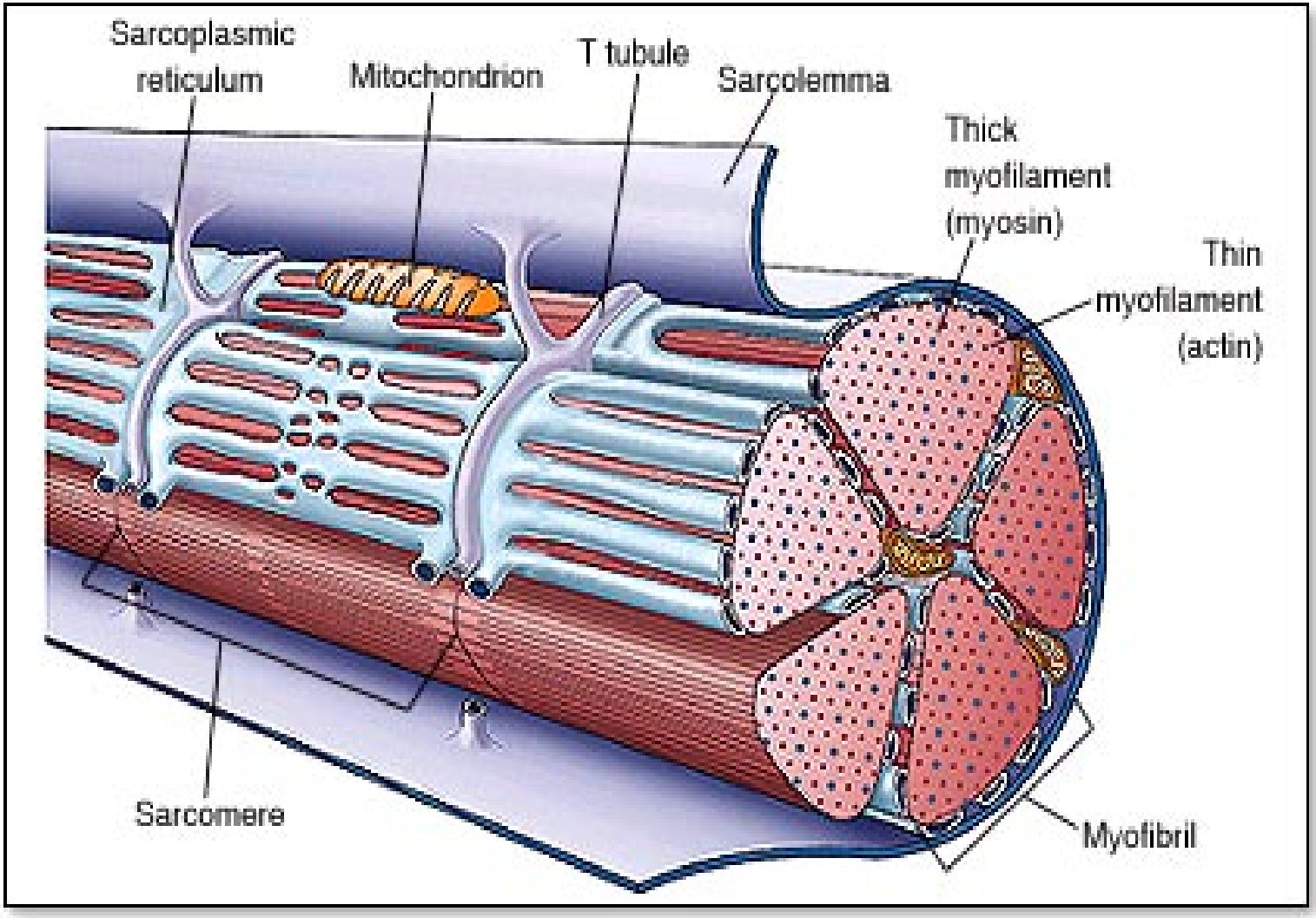
Structure of skeletal muscle



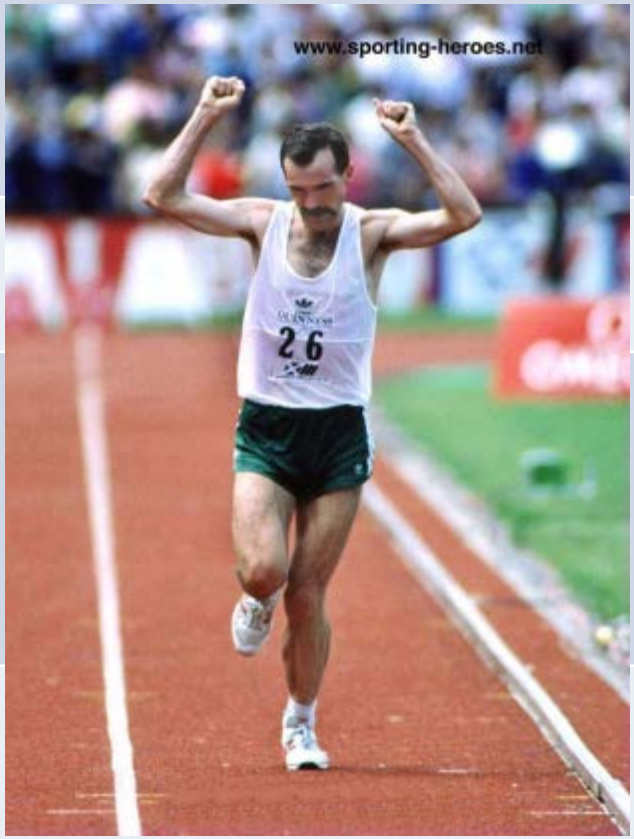
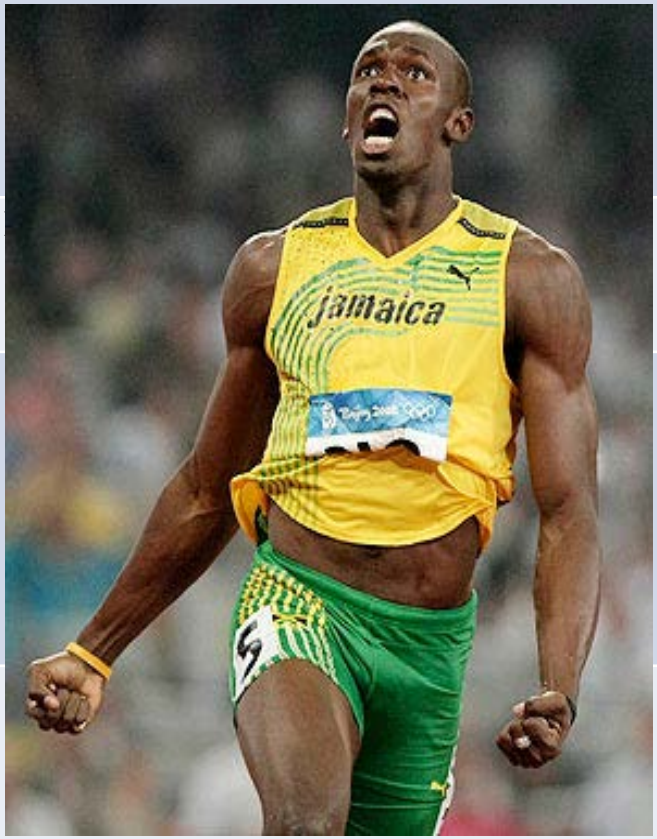
Motor unit


Terminal Button
Muscle Fibers
Axon Terminals
Axon of motor neuron
Myelin sheath
Action potential
Axon terminal
Terminal button
Vesicle of acetylcholine
Voltage-gated Na+ channel
Ca2+
Voltage-gated calcium channel
Action potential propagation in muscle fiber
Plasma membrane of muscle fiber
Acetylcholine receptor site
Acetylcholinesterase
Neurotransmitter-gated channel
K+
Na+
Muscle fiber
Motor end plate
1
2
3
4
5
6
7

Muscle fibres



Muscle fibre types

Features	Slow twitch	Fast twitch
Metabolism: • Glycogen storage • ATPase • Calcium delivery		
• Mitochondria • Capillary supply		
Motor units:		
Distribution:		

Why strength training?

- Bleed prevention:
  - Joint stability / support
  - Proprioception
  - Recurrent muscle injury

Why strength training?

- Rehabilitation
  - Effects of immobilisation
    - Fibre atrophy and transformation
  - Normalise movement patterns
  - Optimise muscle healing

Why strength training?

- Muscle healing:
  - Effects of early mobilisation v rest following muscle injury (Jarvinen 1975) – animal study

Early Mobilisation	Cast immobilisation
Increased early inflammatory response	Resolution of inflammation and necrotic tissue took longer
Earlier regeneration in form of bridging myofibres	Less intense formation of immature scar tissue (nb early scar tissue factors create a 'scaffolding' for bridging myofibres)
Earlier and more intense presence of new capillaries	Better penetration of muscle fibres ultimately bridging the gap (? Due to less scar impeding progress)
Regenerating fibres oriented parallel	Regenerating fibres randomly oriented
Evidence of scar tissue at 8 weeks	Complete resorption of scar tissue
High force required for re-injury	**Low force required for re-injury**

Why strength training?

- Age related changes

Strength changes

- Males = females
- 1.5% reduction in strength per year from 20s onwards
- Effects eccentric contractions < concentric and isometric
- Strength loss more pronounced at faster speeds
  - Loss of power has most impact on functional activities

Preventing age-related strength changes

- Long term strength training
  - High intensity resistance
  - Endurance exercises

Why strength training?

- Improved quality of life
  - Joint health
  - Balance
  - Mobility
  - Weight control
  - Self esteem
  - Social inclusion
  - Physically healthier (cf sedentry lifestyle)

Why strength training?

- Risks:
  - Yes, some . . . . .

How can I get stronger?

- Hypertrophy
  - An increase in muscle CSA
    - Increased contractile ability
    - Increased force generation
  - FT> ST fibres

How can I get stronger?

- Neuromuscular adaptations
  - How?
    - Greater recruitment of motor units
    - Better co-ordination of motor unit activation
    - suppression of inhibitory reflexes
    - reduced co-activation of antagonist muscles
  - Early phase
    - improvements in strength without hypertrophy
    - increased EMG activity
  - Late phase
    - Gains still demonstrated in late phase high load programmes without further hypertrophy
  - Cross education
    - Strength gains in contralateral limb (up to 75%)

Designing an exercise program

Position statement on youth resistance training: The 2014 International consensus

Position statement on youth resistance training: the 2014 International Consensus

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Adapted from the position

ABSTRACT
The current manuscript has been adapted from the official position statement of the UK Strength and Conditioning Association on youth resistance training. It has subsequently been reviewed and endorsed by leading professional organisations within the fields of sports medicine, exercise science and paediatrics. The authorship team for this article was selected from the fields of paediatric exercise science, paediatric medicine, physical education, strength and conditioning and sports medicine.

- *Weightlifting* is a sport that involves the performance of the snatch and clean and jerk lifts in competition.[6] Weightlifting training refers to a variety of multijoint exercises including the snatch, clean and jerk and modified variations of these lifts, that are explosive but highly controlled movements that require a high degree of technical skill.
- *Qualified professional* is a term used to represent those individuals who are trained and aware of the unique physiological, physical and

Designing an exercise program

Risks:

- Joint or muscle bleeds
- Musculoskeletal injury
  - Acute (technique)
  - Chronic (imbalance, overload)
- Aggravation of existing musculoskeletal issues

Designing an exercise program

Considerations:

- Bleed history / target joints or muscles
- Movement restrictions
- Prophylaxis
- Other relevant medical and musculoskeletal history
- Previous training and current physical conditioning
- Goals of rehab (ie. high level sport, functional ADLs)

Designing an exercise program

What type of exercise:

- Role of muscle (postural/prime mover/combination) and likely distribution of muscle fibre type (fast twitch = strength/power, slow twitch = endurance)
- Stage of healing
- Goals of rehab (eg high level sport or functional ADLs)

'Trainable' characteristics of muscle:

- Endurance – ability to resist fatigue, particularly at sub-maximal resistance
- Strength – maximum force exerted in single attempt
- Hypertrophy – increase in cross sectional area of muscle fibre
- Power – force x velocity (strength + speed)

Designing an exercise program

Progression

- Number of reps and sets
  - Endurance >20 reps, 1-2 sets
  - Strength+ hypertrophy 8-12 reps, 1-3 sets
  - Power 1-6 reps, 3-6 sets
- Resistance
  - Endurance 50% of 1RM
  - Strength 60-70% of 1RM
  - Hypertrophy 70-85% of 1RM
  - Power
    - Consider components ie force&velocity: force 30-60% of 1RM at faster speeds, velocity 30-45% of 1RM at speed
- Type of equipment

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