Strength and Conditioning for Endurance Running

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My coaching background

- Honours degree in Sports Science and S&C coach for 18 years
- Coached and advised athletes who competed in London and Rio Olympics
- S&C coach with professional rugby, professional squash, elite cycling, football & international equestrian
- Former Physical Preparation National Lead at England Athletics for 6 years
- Works closely with Physiotherapists, Osteopaths and Sports Physicians to provide end stage rehabilitation & Return to Play.
- Level 3 in sports massage therapy
- Former elite level pole vaulter for 12 years and an experienced jumps coach

Strength and Conditioning

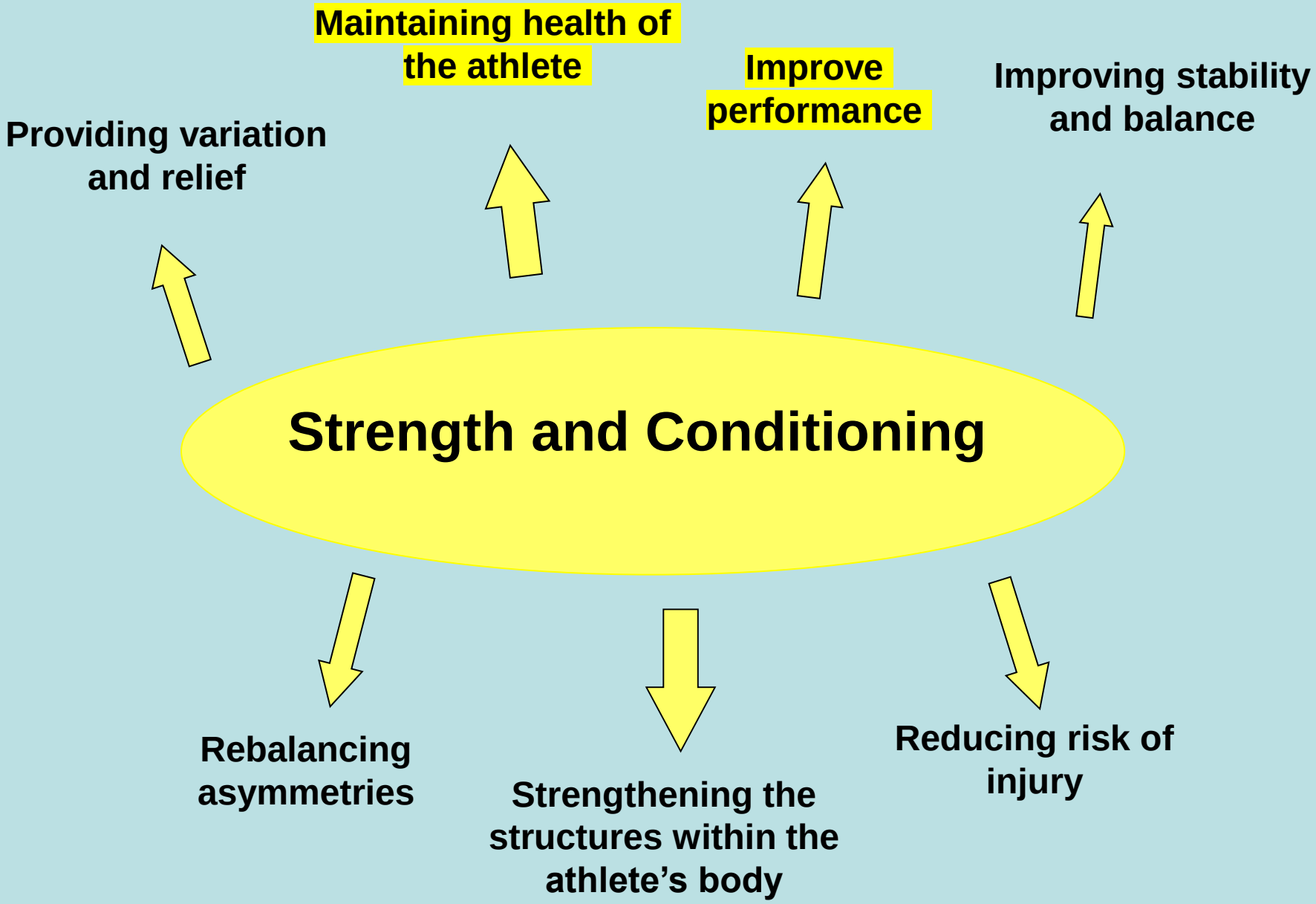
- A process of systematic training which is designed to create the capacity for training and a platform for performance

Why?

- Develop the physical qualities required to achieve the technical model
- Reach potential
- High quality movement – earn the right to progress
- Other sports – essential for developing youth athletes
- Injury avoidance – robustness to injury under fatigue
- Muscular imbalances and tightness
- Work capacity
- Self myofascial release
- Longevity

Endurance running

- Key parameters:
  - VO_2 Max, VVO_2
  - Running Economy (RE)
  - Ground Reaction Forces (GRF) 3-4 x BW
  - Ground Contact times 0.2s (closer to 0.3s for non elite)
- Volume of running - 50km/week
    - 2m average stride length
    - Equates to 25000 foot contact; 12500/foot
    - @3x BW equates to 75000kg


Maintaining health of the athlete
Improve performance
Improving stability and balance
Providing variation and relief
Strength and Conditioning
Rebalancing asymmetries
Strengthening the structures within the athlete's body
Reducing risk of injury

Work Capacity

- The ability of the body as a machine to produce work of different intensity and duration using the appropriate systems of the body (Siff)
- *It should be noted that cooperation between the cardiovascular & motor systems is important for improving work capacity, not only in endurance sports, but in all sports."*
  -Yuri Verkoshansky
- “Work capacity limit exceeded when their RFD declines by a functionally relevant amount, their movement pattern becomes sub-optimal (i.e. further training entrains incorrect technique) or their movement velocity slows enough that the targeted adaptations won’t be stimulated” (Blazevich, 2013)
- ‘Movement quality comes first, physiology comes last’ (Bosch 2013)

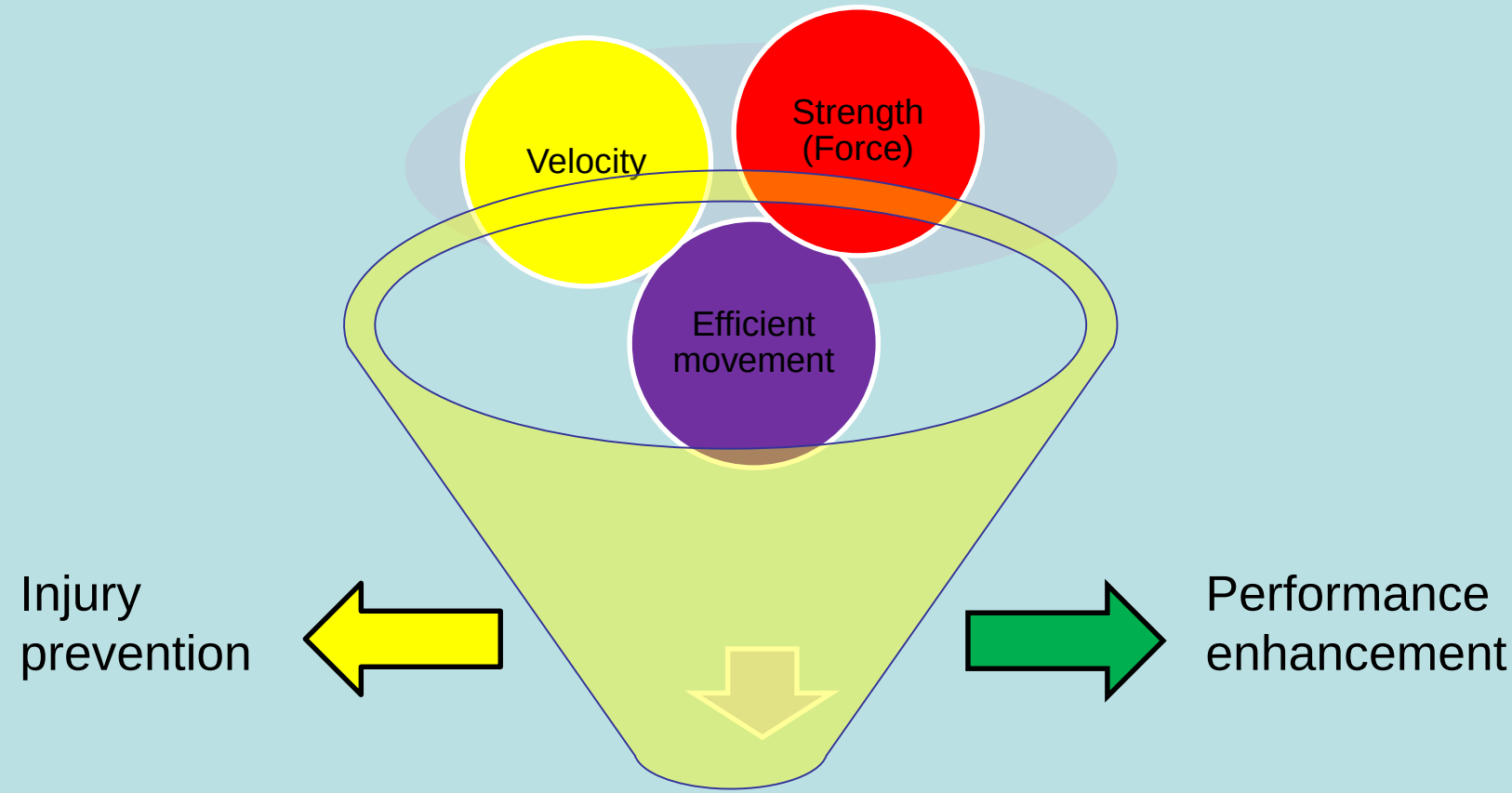
Athletics – Long term development

Event	Age of peak performance Men	Age of peak performance Women
100m	26	25
200m	25	25
1500m	**27**	**29**
5000m	**29**	**30**
Marathon	**31**	**33**
TJ	25	28
Discus	25	25
Hammer	28	*

Ages for Peak Performance in Athletics from World Statistics

*** insufficient data analysed**

How can S&C support successful performance?



Strength and Conditioning

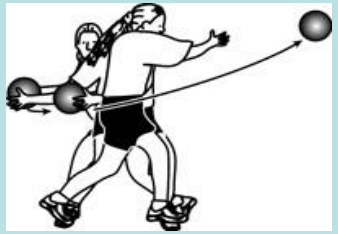
- S&C can help to improve all 3 components which in turn can create a more robust, powerful, faster athlete
- Movement skills are fundamental building blocks for good performance.
- Quality of movement – movement competence
- Without strength, stability, mobility, balance and coordination athletes cannot move efficiently or transfer force and have a higher risk of injury

The Role of Strength Training

- To optimise the bodies force, power and velocity capabilities specific for the athletes & event
- 10 cross country runners completed 9 weeks of explosive strength training (unloaded jumps & sprints) 5km Running time improved - no change in total volume of work completed between experimental and control group (Paavalainen, et al, 1999)
- Improved running economy & neuromuscular characteristics
- Stance phase limiting factor is the time frame the athlete has to express the force not the magnitude of force (Weyand et al, 2010).
- Better movement →higher force producing capabilities →more velocity → Improved running economy

Strength – Speed Continuum

Max strength **Strength speed** **Speed strength** **Max speed**



HIGH FORCE **HIGH VELOCITY**

Heavy Back Squat **Olympic Lifting** **Med ball throws** **Plyometrics**

Implications

- Endurance athletes must develop greater force producing capabilities
- Endurance athletes must develop a greater force application capability
- ‘Not about developing maximum strength, but it is about a better quality of force generation’ Zatsiorsky & Kraemer 2006

5 Areas of Injury Risk

- Hamstring
- Hip / Groin
- Foot / Ankle
- Lower Leg (shin)
- Lower Back

Based on 11 years of research with UKA World Class Talent Programme athletes

Joint Mobility/Stability

Stable

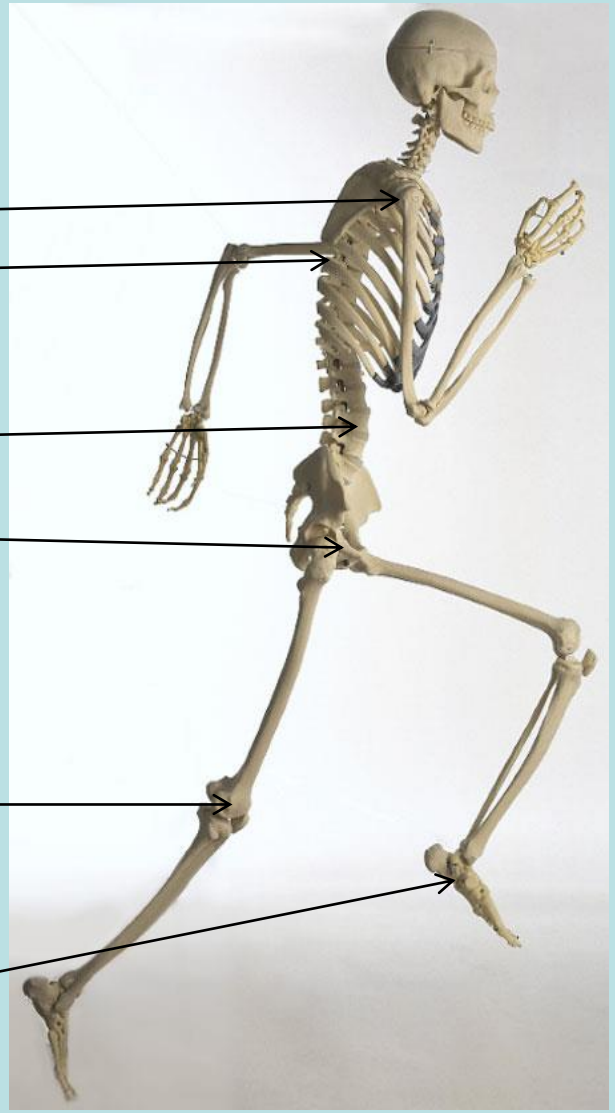
Mobile

Stable

Mobile

Stable

Mobile



Self-Myofascial Release - Foam Rolling

Self-Myofascial Release Benefits

- Fill in the gaps between deep tissue massage and other soft tissue techniques
- Reduction of scar tissue and adhesions
- Realign collagen fibres
- Target trigger points
- Improved mobility and ROM
- Improved quality of movement – if correct training is prescribed
- Pre-training to decrease tone of overactive muscles
- Feel good

Primal Movement Patterns (Underpinning movements)

- Double leg: squat through to jumps
- Single leg: SL squat through to hopping
- Push: press up through to medicine ball chest throws
- Pull: pull-up through to overhead throws
- Rotation/twist: floor through to side throws

Beginner

- Beginner - improve all biomotor abilities
- Beginners tend to respond to any training
- General adaptations occur without substantial fatigue
- Strength gains are principally neural – minimal CSA change
- Beginners cannot train with sufficient load, intensity or volume to elicit fatigue after effects
- But they can develop all of the Fundamental Movement Patterns – prepare them for performance loading
- They only get one career!

A Practical example for young athletes...

- To be good at a movement = plenty of stimulus
  e.g. squat once a week for 12 weeks = 12 stimuli
  - Not sufficient for motor development

•Squat as part of warm-up (3 x week) + squat 3 x week for 6 weeks
  = 36 stimuli (loaded and unloaded)
  - Athlete's skill level ↑
- Loaded: Medicine Ball, Powerbag, strength band, barbell, unilateral

•Training loads for children: 50% of their maximum potential is very effective

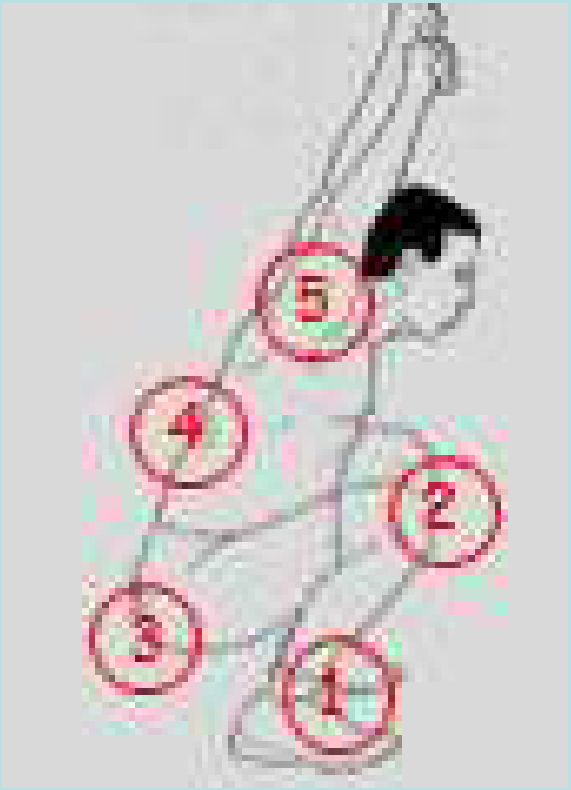
•The athlete must earn the physical right to move the programme forwards (Giles, 2004)
- Athletes must have the *physical competence* to do the *technical elements*.....in that order

Reasons for Assessment

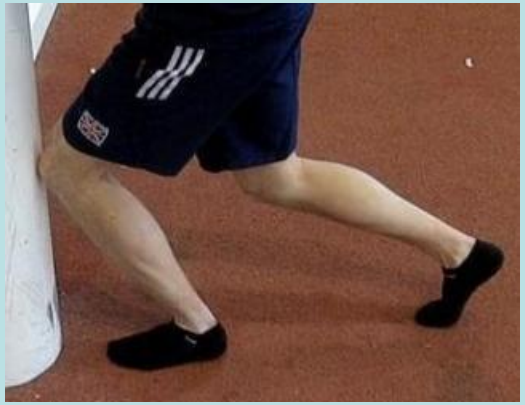
- Short term: Problem solving
  - Resolving an injury
  - Reduction injury incidence and predisposition
  - Athletes continue to present major physical limitations
- Long term : Performance enhancement
  - Explicitly link physical qualities and technical qualities
  - Accelerate technical development
  - Longevity of performance and retention

Overhead squat implications

- Limited mobility in the upper torso can be attributed to poor glenohumeral (5) and/or thoracic spine mobility (4).
- Limited mobility in the lower extremity including poor closed-kinetic chain dorsi-flexion of the ankle (1) and/or poor flexion of the hip (3) may also cause poor test performance.



Knee to Wall



- Normal range = 12-15cm

Step Over

Considers:

Stance leg hip, knee and ankle stability and range of movement

Closed chain hip extension stance leg

Open chain hip, knee and ankle flexion of step leg

Issues:

Poor stability of stance leg – weak/tight glutes 2, collapsing arch of the foot, poor range of movement

Poor mobility of step leg 3,4,5 –

UKA Exercise Classification Hierarchy (V1.1)

UNITED KINGDOM ATHLETICS

Competitive Exercise (CE)

This term refers to exercises (any activities done in training) that are identical or almost identical to the competition event. For example, for shot putters: throwing the shot (glide or spin), sprinters: various forms of sprint work, jumpers: full jumps with various approach lengths, etc…

Specific Development Exercises (SDE)

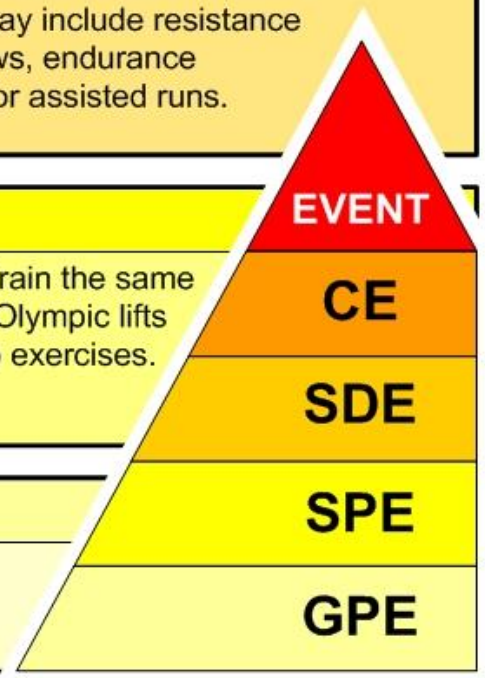
Refers to exercises that repeat the competitive event in training but in its separate parts and may include resistance or specific strength exercises (overload training). For example, for discus throwers: stand throws, endurance athletes: hill work, triple jumpers: bounding exercises with or without loads, sprinters: resisted or assisted runs.

Specific Preparatory Exercises (SPE)

This term refers to exercises which do not imitate the movement of the competitive event, but train the same major muscle groups and physiological systems. For example: For throws, sprints and jumps: Olympic lifts and various other maximal strength and special strength (explosive jumping and medicine ball) exercises. For endurance: strength endurance exercises and activities.

General Preparatory Exercises (GPE)

These are exercises that do not imitate the competitive event and do not train their specific systems. Generally speaking, these exercises are very all-purpose and used for general coordination and recovery.



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Benefits of throwing (multi-throws)

- Develop the essential physical qualities for athletic performance including running
- Ideal for foundational level athletes
- Coordinated triple extension of hip, knee ankle
- Develop force production from proximal to distal via the trunk – trunk conditioning benefits
- High release velocity at completion of movement – manipulate the force-velocity time curve
- Tri-planar movement
- Development of athletic ‘shape’
- Accessible in a club environment or on a field

Medicine ball throws

High Intensity Throws

- Explosive triple extension throws
- High intensity throwing

Throws with Pre- and Post-Movements

- Throws with steps & shuffles
- Throws with jumps
- Throws with sprints
- Throws with bounds

Multiple Throws (Force Absorbtion & Generation)

- Partner throws
- Wall throws
- Slams, chops
- Multi-directional & rotational

Stability Throws (Trunk & Joint Conditioning)

- Standing throws
- Single leg throws
- Kneeling, half-kneeling, seated throws
- Specific shoulder conditioning

Underpinning Movements

- Shoulder stability & control
- Squat patterns
- Lunge paterns
- Rotational & diagonal movements of trunk
- Proprioceptive work & drills

Reps, sets & volume load

Max Strength	• 1-5 reps per set • 15-25 reps total per exercise
Power	• 2-5 reps per set • 15-30 reps total
Strength Endurance	• 5-8 reps per set • 20-35 reps total
Motor Patterning/Hypertrophy	• 8-12 reps • 20-35 reps total
Conditioning	• 30-90 seconds per set

Integration of S&C – Weekly Example for an endurance athlete

	MON	TUES	WEDS	THURS	FRI	SATURDAY	SUNDAY
ENERGY SYSTEM		TEMPO	STEADY STATE	SPEED	REST	HILLS	STEADY STATE
PHYSICAL PREPARATION		MULTI-JUMPS (PLYOMETRICS)		MULTI-THROWS (MED BALL)	REST	STRENGTH DEVELOPMENT	
GPE WARM-UP		HURDLE MOBILITY		SKIPPING WITH ROPE	REST	HURDLE MOBILITY	
GPE WARM-DOWN	SPORTS MASSAGE	TRUNK CONDITIONING	FOAM ROLLING/ STRETCHING		REST		TRUNK CONDIT./STRETCHING

Importance of the trunk in performance

- Enhance performance by ensuring optimal movement patterns
- Improve coordination between the trunk and extremities – kinetic chain
- Spinal stability (segments)
  - Central pillar for force production
  - Decrease injury risk
- Athletic posture for optimal length-tension relationships
- Local and global stability
- Allows control in all 3 planes of motion

Training prescription and organisation

- Observation
- Opportunity
- Prescription
  - Localised or ‘system’
  - Objective
    - Stabilisation
    - Endurance
    - Strength
    - Velocity – Throws and jumps

Training focus and prescription

Physiological Adaptation	**Strength**	**Endurance**	**Stability**
	High force (strength)	Hypertrophy/↑ CSA (Str End)	Activation, trunk stability and control
Intensity of movement	>80% RM/max force if isometric	60-80% RM/ mod isometric force	<30% RM, skill/mvt or recruitment focus
RPE	Hard to maximal	Hard to maximal	Moderate
Volume	3-6 sets, 1-6 reps/ 5-10 secs isometric	3-5 sets, 5-10 reps/ > 30-60 secs if isometric	3-4 sets, 20-30 reps/ > 30-60 secs if isometric
Frequency	1-3 x per week	2-3 x per week	> 3 x per week
Fatigue	Not necessary	Necessary	Necessary
Muscular adaptation	Fast twitch hypertrophy	Whole muscle adaptation	Slow twitch hypertrophy, inc length if full ROM
Specific adaptation (if competent movement)	**↑ Force capabilities**	**↑ Strength endurance**	**Improved sports specific movements**