STRENGTH & CONDITIONING EDUCATION

Strength & Conditioning

Fundamentals Coach

Student Manual

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Study Modules:

Module 01
Coaching Essentials

Building a solid foundation

The concept of 'marginal gains' within sports performance has become popular in recent times due to the success of team Sky within elite competitive cycling. However, it is equally important that Strength and Conditioning coaches not only look to improve all elements of the entire training system, but also ensure any marginal gain increases are built on a solid foundation of performance. Put simply, coaches need to ensure that the key performance qualities are addressed within clients (e.g. movement quality, strength, power, aerobic/anaerobic fitness, etc.) before focusing on the specific minor elements that will increase performance by an important, but also marginal amount.

Evidenced based practice vs x-factor adaptation in clients

Before preparing any athletic programs, the Strength and Conditioning coach must gain a full understanding of the sport in question by completing a detailed needs analysis of the sport. This includes gaining an understanding of the biomechanical, physiological, and injury risk demands of the sport, based on current research within sport science and Strength and Conditioning literature. However, coaches must also be aware that despite what current literature suggests, a client may occasionally develop and adapt at varying rates compared to what has previously been suggested. For example, some clients will progress at a rapid rate when faced with a new training stimulus, where others may not. Therefore, sports science often attempts to explain a training phenomenon that is already being applied within practice. Hence, whereas

sports science and evidence-based practice is vitally important, so too is a Strength and Conditioning coaches' intuition, as long as this is based on sound fundamental principles and the success of previous practice, and not hearsay.

Physical literacy

Physical literacy can be defined as the ability to absorb, produce and stabilise high forces during sporting movements, with correct motor control and biomechanics, all of which underpins what has been previously highlighted within this manual. As a Strength and Conditioning coach, it is essential that such physical literacy is embedded at the onset of the training process, and that a client isn't advanced on to more advanced training forms until correct physical literacy has been developed within a client over an accumulation of fundamental training. Within a practical application sense, this means that clients should not be progressed onto more advanced forms of plyometric training for example, until the client can land correctly, perform less complex plyometrics, and possess a solid foundation of strength training, and joint stiffness.

Training adaptable clients

As Strength and Conditioning coaches, we must ensure we train clients that are adaptable, and can solve movement problems and self-organise when needed, as sport occurs within a chaotic nature. For example, when implementing movement training, coaches should regularly adapt and change movement drills, and see how the client adapts to the new task 'constraints' ensuring the clients movement 'vocabulary' continuously evolves. The development of such movement quality ensures that clients can adapt their movement strategies to meet the specific demands of a given movement task, which will ultimately result in a greater level of performance, and a greater level of robustness and injury prevention.

Module 02
Functional Assessments

The modern Strength and Conditioning coach have many roles, including the effective delivery of client preparation programming, coaching of many varied forms of training that meet the demands of the particular sport, liaising with other team members within the multi-disciplinary sports team, recording performance data, and much more. However, the main objectives of a Strength and Conditioning coach can be summarised into two key components:

- Improve Performance
- Prevent Injury

Both of which can be initially addressed by gaining an understanding of a client's movement quality, which will ultimately provide guidance on the later prescribed programs, and injury prevention protocols implemented by the Strength and Conditioning coach.

Movement assessment objectives

As previously highlighted, the information gained from carrying out a valid and reliable movement assessment provides the Strength and Conditioning coach with vital insights into a client's movement quality. Indeed, an effective movement assessment indicates potential movement dysfunctions within clients, highlights problematic movement patterns for individuals, and therefore, which training forms may requiring a greater amount of coaching, adapting, or even replacing with other training alternatives. Based on these factors, planned movement assessments within practice can be considered to have the following key objectives:

Body awareness and motor control: When carrying out a movement assessment, the Strength and Conditioning coach gains an insight into a client's overall body awareness, as often an individual maybe unaware of certain movement compensations that are occurring to allow them to perform the desired movement task. Hence, a well conditioning client would be expected to perform a required movement assessment with a greater movement quality, however it must be noted that even world class performers may struggle with a particular movement assessment (due to injuries, lack of previous conditioning, etc.).

Muscle length-tension relationship: Muscles operate at an optimal length-tension relationship, where mechanical advantage is at its greatest, and where the most actin binding sites are available allowing for greater myosin cross-bridge cycling, and therefore greater force and muscle shortening velocity. Therefore, if muscles are in a pre-shortened or lengthened state, optimal overall muscle function maybe limited, potentially resulting in a lack of sports performance.

Movement restrictions: Poor biomechanics, possibly due to a lack of motor control, and/or reduced muscle length-tension relationships, will result in movement dysfunction compensations, allowing the client to perform the desired movement task. Such movement dysfunctions may potentially indicate that similar movement compensations may occur during the acquisition of sporting actions (e.g. knee valgus occurring during an overhead squat may indicate that the same may occur during a rapid change of direction)

Indication of previous adaptions to training/sport demands: If a client clearly demonstrates uni-lateral imbalances during the performance of a bi-lateral and/or uni-lateral movement assessment, it may indicate that a client has previously or currently competes within a sport that is uni-lateral or 'one sided'

dominant. If a client struggles with any form of frontal plane movement, it may indicate that the client competes in a sport that is predominantly sagittal plane dominant, therefore, providing the Strength and Conditioning coach with vital movement quality feedback.

Responsibilities of the Strength and Conditioning coach

Before carrying out a movement assessment with any client, it is the responsibility of the Strength and Conditioning coach to have a good background knowledge of kinesiology, individual muscle function, group muscle function (both within primary movement actions, and within a stability role), and an understanding of movement mechanics. Such knowledge allows the Strength and Conditioning coach to assess and compare a client's current movement dysfunctions, against optimal movement, and act accordingly later.

A Strength and Conditioning coach must ensure that any movement assessments are carried out using a standardised testing protocol, allowing for greater test validity and reliability. For example, if a client was to perform an overhead squat test wearing sports trainers one week, and barefoot the next, then the results would most likely be very different, and therefore, invalid and unreliable. Furthermore, the Strength and Conditioning coach must be aware of how the movement assessment is instructed, avoiding any form of additional coaching cues that may affect performance, purely observing the task being completed, whilst recording feedback.

Movement assessment types

Movement assessments come in a variety of forms, with different testing methodologies, and varying ways of recording gathered data, with some being based on a more qualitative approach (observation of quality of movement) and others being more quantitative (providing a mark or score). The differences between such methods

is beyond the scope of this manual, however the difference between controlled based, and field-based movement assessments are explained:

> **Controlled based movement assessments:** this type of movement assessment involves a specific movement assessment of an isolated movement task, such as an overhead squat, thoracic rotation, etc.
>
> **Field based movement assessments:** whereas a field-based test involves the assessment of an individual's movement quality within an active setting, such as assessing a client's braking/decelerating capabilities on the field of play Both movement assessment types provide vital feedback on a client's movement quality and should therefore be implemented within Strength and Conditioning practice.

Scheduling of movement assessments

An obvious place to schedule any planned movement assessment is at the very beginning of the Strength and Conditioning process, allowing programs to be effectively designed, injury prevention strategies to be put in place, and a client's overall movement quality to be assessed. However, movement assessments should also be scheduled at multiple times throughout the annual macro-cycle plan, including during the competitive, transition, and pre-season phases, allowing a client's movement efficiency to be evaluated on a continual basis.

Module 03
Strength and How to Develop It

Basic principles recap

Before discussing the more advanced training methodology covered within this module, it's worth recapping some basic training and program design terminology:

Progressive overload: Progressive overload is the principle of program adaptation, forcing the biological bodily systems to adapt in response to the manipulation of specific training variables.

Specificity: Training specificity encompasses the SAID principle (specific adaptation to an imposed demand) and should be the cornerstone of athletic preparation. Hence, the adaptations that occur within clients due to training, is a direct result of the type of training stimulus applied.

Reversibility: If the bodily systems are not provided with the appropriate stimulus to force adaptation, then normal homoeostasis will be resumed and a reduction in the previous adaptations gained will occur.

Periodisation: Periodisation is the long-term planning of training segmented into daily, weekly, monthly and yearly blocks (micro, meso, and macro-cycles, respectively) that considers each phase of the sporting schedule, a client's previous/current training status, and how each training variable will be manipulated over the entire training period.

The need for strength training with clients

Most sports involve the ability to generate large ground reaction forces, allowing an opposing players inertia or momentum to be overcome, such as during collision sports, or when accelerating during offensive or defensive play. Furthermore, force as a biomechanical quality, is one component of power production (i.e. power = force x velocity), and as nearly all sports require optimal power production, being able to produce high amounts of force is a desired quality in clients. To increase force production in clients, Strength and Conditioning coaches must be able to effectively increase the amount of force a muscle can produce, and therefore, increase a client's strength capabilities via effective strength training. Hence, strength training is an important aspect of athletic preparation, and therefore, Strength and Conditioning practice.

Embedding fundamental movement quality

When developing strength qualities in clients, it is vital that Strength and Conditioning coaches embed the fundamental movement qualities that occur in nearly all sports, including squatting, lunging, pushing, pulling, and bracing movement patterns. As a client progresses, training can become more specific to the sport in question, however it is essential that a client can effectively perform the key movement qualities highlighted above, before progressing towards more advanced training forms.

Training – rehab relationship

It is often the case that practitioners consider 'injury prevention training' as being a separate part of the training process, when in fact, it should be considered as part of the overall training plan. Research demonstrates a clear relationship between joint stiffness (the ability to absorb and recoil force rapidly) and strength training.

Furthermore, as most ACL injuries occur within the first 50 milliseconds of ground contact, the quicker a client can recruit the stabilising muscles around the knee joint (in particular the quadriceps) the more the chance of an ACL injury is reduced (Aagaard et al, 2002). Therefore, to prevent injury within clients, coaches should aim to increase strength and explosive power (quicker muscle recruitment) in clients. The same can be said for bracing abilities, movement training, and many other forms of performance training. Hence, an increase in performance, reduces injury risk in clients.

The maximal strength – strength/power endurance relationship

During sport events that require local/global muscular endurance, the amount of force a muscle can produce reduces over time due to muscle fatigue. Therefore, if a client has greater muscle force generating capabilities in the first instance, the level of overall force reduction will be reduced, meaning a client can produce greater amounts of force within a fatigue state. Therefore, Strength and Conditioning coaches should aim to increase maximal strength in endurance clients, in addition to the required muscular endurance training.

Client led minimum intensity approach

The need to periodise training with clients is vital, allowing for the correct timing of training adaptations, and the client to peak at the right time ready to compete to their best ability. However, a Strength and Conditioning coach must possess a deep understanding of biological changes that occur as a result of different forms of training and appreciate that the client may not adapt in accordance with the overall training plan. Therefore, Strength and Conditioning coaches need to monitor their clients daily progress and may need to occasional adapt planned training loads depending on a clients perceived level of fatigue on any particular training day, despite whether or not that is in agreement with the overall training plan.

Module 04
Bodyweight Training

Mastering bodyweight movements

Clients that can perform any of the fundamental strength movements should be able to adequately perform the pre-cursor bodyweight movements effectively. Indeed, many leading Strength and Conditioning coaches highlight the importance of mastering one's bodyweight before 'earning the right' to add external load. Such foundational bodyweight movements underpin the motor control and body awareness required to be able to effectively perform the later resisted exercise equivalents. Therefore, Strength and Conditioning coaches should ensure that a client can firstly perform a body weight squat, before progressing to loaded squats, or a bodyweight lunge, before progressing to loaded lunges and split squat variations.

Such bodyweight mastery is of equal importance to both youth and senior clients. If bodyweight fundamental movements can be embedded within youth clients, then such young sportsman will be primed for the later loaded movements to come within the long-term athletic development model.

Versatility of bodyweight training

In addition to the many physical benefits of bodyweight training, another great advantage of bodyweight conditioning is the logistical freedom such training brings, as it can be applied anywhere with minimal equipment. In particular, the fact that bodyweight training can be utilised within field-based practice (e.g. on the field of play during practice) means clients can be trained effectively, away from the gym, which is a useful addition within a Strength and Conditioning coaches' arsenal.

Programming of bodyweight training

Bodyweight training in some form should be applied within a client's programming all year round, whether that be as some form of trunk stability/strengthening work, pull up variations as a vertical pull exercise bringing structural balance to programs, within warm ups, or as a standalone bodyweight training session. Furthermore, bodyweight conditioning can be applied at any time within the overall periodised model, or at any point during a client's long-term athletic development plan. For example, an experienced well-conditioned client may implement bodyweight training within a recovery phase, whereas within youth clients, such training may be the main overload focus of the session. Bodyweight training can be manipulated in many ways to progress the client, including adding reps and/or sets, adding specific eccentric and isometric tempos, increasing the frequency of completed bodyweight conditioning, or even by programming partner resisted bodyweight conditioning within programs.

Bodyweight training can be applied within many forms of specific training. For example, a Strength and Conditioning coach may program a specific reps-based circuit within a metabolic conditioning focused training session, or as part of an explosive power focused session in the form of plyometrics. In conclusion, bodyweight training is a unique, versatile, effective training method that can be applied with any client, at any time within their athletic career, and should be utilised to its best effect by Strength and Conditioning coaches in practice.

Module 05
Agility and Movement Training

Defining agility

Agility encompasses a large variety of movement qualities and cognitive process abilities and shouldn't be thought of as merely changing direction. Sport is chaotic nature, with clients required to accelerate, decelerate, and change direction from an infinite variety of possible start positions, direction of cutting angles, and in reaction to an infinite number of variable cues, all of which occur within fractions of second. Therefore, the development of optimal agility within clients should be thought of as improving an individual's total movement literacy, with the aim of embedding correct movement mechanics within one's movement repertoire, so correct movement becomes autonomous or 'automated' within clients.

Understanding agility demands

It's the responsibility of the Strength and Conditioning coach to have a thorough understanding of what correct movement is, the physical demands it requires, and how such movement quality can be improved. This includes:

Motor control: When performing an agility-based task, optimal mechanics need to be understood and embedded by the Strength and Conditioning coach. This includes no valgus at the knees, stability through the hips, braced

at the torso, a low centre of mass, and rotating the hips quickly in the new desired direction.

Strength and power: During the performance of an agility task, high forces are placed on the body, as the client is required to be able to absorb and recoil stored energy or force, at high speeds. Therefore, optimal strength and power qualities are required to allow such high forces to be firstly developed, absorbed, and reproduced again in the new desired direction, all within an extremely small-time duration.

Stiffness: Stiffness at the ankles, knees and hips relate directly to the point highlighted above, in that clients require the ability to absorb and produce high forces at high speeds. The greater the level of stiffness within the muscular-tendinous junction, the quicker this absorb-recoil of force can occur. Hence, Strength and Conditioning coaches should look to improve joint stiffness within clients, via appropriate strength and power training.

Cognitive processing: The other key element within optimal agility training which is often over looked is the ability to react in reaction to a training stimulus. It's important that Strength and Conditioning coaches understand that the addition of a reactive stimulus must be trained at some point, as this is what occurs within the field of play. However, coaches must also realise that the addition of a training stimulus greatly increases the difficulty of the agility task, and should therefore be added, once optimal movement has firstly been embedded.

Module 06
Power and How to Develop It

Power in sport

Power can be defined as the rate of work and is the product of force and velocity (P=FxV). Previous research within literature has clearly demonstrated a link between peak and average power and sprint, vertical jump, striking, and sprint track cycle performance (Baker et al, 2001., Stone et al, 2000., Loturco et al., 2016., Dorel et al, 2005., respectively). Hence, power is a key attribute within sport, and could even be argued to be one of the main deciding factors that separates the good and the great within sport. Therefore, Strength and Conditioning coaches need to have the ability to program for power adaptations effectively, understand its key principles, and how to distinguish between varying forms of power training qualities.

Power training pre-requisites

Before embarking upon a specific power training intervention, clients must first display key attributes, including sound movement competency, proper motor control, and a solid foundation of strength training. All these attributes will ensure that a client adapts to the best of their ability, both on a neurological and morphological level. Once a client has developed these key qualities, the Strength and Conditioning coach can progress the client accordingly.

Maximal strength – power relationship

As previously highlighted, one of the products of power, and a pre-cursor of power training, is maximal strength development (or the ability to generate high force). Both strength and power training require high neural drive and large motor unit recruitment. Explosive power movements require both high motor unit recruitment, and a high frequency of action potentials or 'firing rate' within the neuromuscular system. Therefore, the neural demands of both strength and power training are very similar, however if a client is capable of high motor unit recruitment (via strength training) the greater the level of neural drive, and therefore, the greater the level of power output. Hence, strength training is the bedrock of power training, and must firstly be developed within clients before embarking on a concentrated power training phase.

Load – power spectrum

There are many ways in which a Strength and Conditioning coach can increase power production within clients, including: Olympic weightlifting or speed strength, speed strength alternatives such as loaded squat jumps, plyometrics, contrast training, ballistic training, etc. (the detail of which is covered within the accommodating video content of this module and the level 4 Strength and Conditioning Award beyond this course). However, when programming power training, Strength and Conditioning coaches need to consider which type of power quality they are trying to develop in clients, and select loads based on these clear objectives. Previous research by leading authorities in power training such as Baker et al (2001) have provided a detailed logical power training framework which is an extension of the force-velocity curve, with recommended loads suggested for each power quality as detailed below:

> **Maximal strength (80-100%):** maximal strength is the ability to overcome maximal loads, or near maximal loads, and is the pre-cursor to effective power training

Explosive strength (60-80%): explosive strength is the ability to overcome high loads with maximal velocity, and should be encouraged in clients when performing such training

Max power (40-60%): maximal power output when measured biomechanically typically occurs around 40-60% 1RM, and is normally programmed within Olympic weightlifting variations, or loaded jumps

Ballistic power (20-40%): Ballistic power training has been shown to result in highly specific neural adaptions, and involves the release of an object beyond the concentric range, such as med ball throw variations

Speed power (0-20%): Speed power training involves movements that are performed out at near maximal velocity, such as plyometrics, and despite the reduced loads, are still very highly demanding

Post activation potentiation

Post activation potentiation is the phenomenon whereby the neuromuscular system is highly activated after completing a power or strength training-based exercise due to an increase in motor unit excitability or free calcium within the sarcoplasmic reticulum, resulting in an increase in performance within the power related task still to come, or sporting activity. One such form of training that manipulates this effect is contrast training, or sometimes referred to as complex sets, whereby a client's perform a loaded power exercise, followed by an exercise at a lower end of the load-power spectrum, resulting in an increased performance within the second exercise, and an overall increase in power output within the long term.

Module 07
Speed and How to Develop It

Acceleration and maximal speed in sport

Strength and Conditioning coaches are required to not only increase strength and power in clients within a strength training performance gym setting, but also to effectively coach and improve speed type qualities within clients, as nearly all sport demands the ability to be able to operate at high velocities. Two such movement qualities that are vital to most sports are the ability to be effectively accelerate, and run at maximal velocities, both of which are further detailed below:

Acceleration: Acceleration is a change in velocity over time ($a = \Delta v/\Delta t$) or put simply, how much a client's speed increases or decreases during locomotion. Most team sports only typically require a client to cover 10 to 30m as quickly as possible, and even greater reduced distances within racquet sports, and even further still reduced distances within sports that involve one and two step acceleration, such as many combat sports. During the covering the such distances, the client is still within an acceleration phase, as most elite sprinters don't reach maximal or near maximal velocities until approximately 60m of a 100m sprint, with the actual drive phase mostly occurring between 0 and 30m. Therefore, the ability to be able to effectively accelerate within clients is the key to success in sport.

Maximal velocity: Despite most sports being acceleration based dominant, clients will still be occasionally required to reach maximal or near maximal

velocity in some sports. For example, within most team sports, and client may be required to sprint the length of the field in response to a surprise attack or turnover of the play from the opposing team, or after breaking through a defensive line and running towards the goal, try-line, etc. Hence, maximal velocity is still a vital quality within a lot of sports.

Acceleration vs maximal velocity mechanics: When accelerating, a client applies large ground reaction forces both in a downward, and backwards direction, resulting in a combined (or resultant) downwards diagonal force, which results in an opposing upward diagonal reaction force (as a result of Newton III action – reaction law). This results in the client expressing a forward lean of the torso. Furthermore, during the acceleration phase, and client must apply large forces over long ground contact times to break inertia and gain momentum, meaning foot contact duration needs to be longer during the acceleration phase. Whereas during maximal velocity running, the torso becomes upright, and time duration of foot contact time increases. The amount of heel recovery increases during maximal running mechanics, whereas during the acceleration phase, the amount of heel recovery should be minimal.

As can be seen, the specific mechanics of acceleration and maximal velocity running differ greatly, and therefore, should be coached with different specific applied coaching cues, as detailed within the video lecture content within this module.

Module 08
Programming and Periodisation

Knowing the end point

When initiating the program design process, Strength and Conditioning coaches must consider what the desired 'end point' is, and how the client is going to be developed to achieve these objectives. This requires the Strength and Conditioning coach to have a full understanding of the physical demands of the sport, and therefore, what physical qualities need to be developed within the client. What also must be considered is 'where' the client is currently at in regard to said physical qualities, and which areas are the prime areas that require immediate improvement. Once such information has been gathered and understood, the coach can start the effective program development process.

Limitations of classic linear model

When learning the classic periodisation models, coaches and trainers alike are often taught the linear programming principles of increasing intensity whilst reducing volume over a period towards a 'competition phase'. However, many sports do not have a distinct competition phase, and require clients to peak at multiple times throughout the year, or to be even be 'match fit' the entire at any moment (especially within combat sports). Therefore, Strength and Conditioning coaches should look beyond a classic linear periodisation model, and consider other approaches

(undulating, concurrent, conjugated, etc.) that meet the client's needs, and consider a client's daily levels of perceived fatigue.

Accumulation of training

The Strength and Conditioning coach have many training variables at their disposal that can be manipulated to force adaptation (e.g. volume, intensity, training frequency, etc.) all of which are vital within effective programming. However, what should also be considered is the total accumulation of training placed on a client and developing better clients by increasing total training accumulation over time. It is this accumulation of training which drives performance in clients, building robust clients that can tolerate greater total training volume during the training period, leading to an increase in sports performance, and athletic development. It must be noted that this process cannot be rushed and must be gradually increased over a longer time duration, and that Strength and Conditioning coaches must understand that a client's current performance, is the product of many years' worth of total training accumulation.

Continuous adaptation

As has already been highlighted, Strength and Conditioning coaches need to ensure a continuation of adaptation is embedded within programming, through the manipulation of training variables and effective planning. When planning such long-term programs, coaches must consider the long-term cumulative training effects of each concentrated training block, and how specific concentrated blocks of training allow one physical area to be developed, without seeing a regression within the previous specific gains developed within the previous block. For example, the rotation of short specific strength and power training blocks allows the cumulative training effect of each training quality to be cumulatively developed over time, resulting in long term athletic development.

Module 09
Olympic Weightlifting

The benefits of Olympic weightlifting within Strength and Conditioning

As previously highlighted, the need to develop power within clients is essential within Strength and Conditioning practice. In particular, the need to increase a client's rate of force development is of high priority, as the time duration to apply force to an object such as when striking a ball, or to the floor as when running at maximal velocity, is very small indeed. Hence, the client that can apply the greatest amount of force, within the shortest amount of time, will be at a huge advantage when compared with other less powerful clients. One such way that high rate of force development can be developed within clients is via the programming of Olympic lifts, in the form of the classic snatch and clean and jerk lifts, or Olympic lift variations, such as the hang and power cleans/snatches variations.

Additionally, the Olympic lifts often match the kinetics and kinematics of key sport actions. Kinetics, can be thought of as the forces occurring during a movement, including both ground reaction forces, and reaction forces occurring at each joint. Whereas kinematics can be thought of as the consequences of such forces, in the form of joint displacement, angular velocity, and angular acceleration, or put simply, the resulting movement of joints. Most powerful sport actions involve high rate of force development, and triple extension at the ankle, knee, and hip, including jump and sprint mechanics. Olympic lifting involves the same kinetics and kinematics; hence, Olympic lifts have a high dynamic correspondence to most fundamental sports movements.

Weightlifting pre-requites

To be able to perform the Olympic lifts correctly, a client (and coaches alike) must firstly dedicate time and effort to learning how to perform the lifts correctly, before progressing the lifts with additional load. Mobility and motor control can be key limiting factors as to why an individual cannot perform the Olympic lifts, however, the best way to gain competency at performing the lifts, is by practising the lifts on a regular basis, under supervision of a trained Strength and Conditioning practitioner. In regard to mobility pre-requites, a client must be able to perform a deep overhead squat position, as this is the receiving position for the snatch, and be able to hold the bottom of a front squat, with a vertical torso, and the bar racked securely, as this is the receiving position of the clean.

Furthermore, as previously highlighted, explosive power is built on a solid foundation of strength training, which also relates to the Olympic lifts. A client requires adequate squat strength to recover from the snatch/clean receiving positions, and adequate back strength to maintain the correct pulling positions throughout the lifts. Therefore, Strength and Conditioning coaches must ensure a client has adequate leg and back strength, functional mobility to perform the lifts correctly, and dedicate time when learning the Olympic lifts.

Embedding the Olympic lifts within clients new to Olympic weightlifting

When embedding Olympic weightlifting practice within training, Strength and Conditioning coaches can utilise the warm up component by adding Olympic lift barbell complexes within warm ups, therefore increasing the overall volume of Olympic lift practice. Obviously, the Strength and Conditioning coach may also program for additional, separate concentrated Olympic weightlifting practice sessions, therefore planning for the improvement in client Olympic lift competency.

Module 10
Core Training

Core stability

Boyle (2005) defines core stability as 'the ability to produce and transmit force from the ground without energy leeks at the hips, spine or scapulo-thoracic joints'. Fundamentally, during the loading of external and internal forces, the body activates both local and global muscles that act to stabilise the spine, allowing forces to distributed through the muscularity, rather than to load excessively on the skeletal spinal structures, and therefore, prevent injury. Research by McGill et al (2003), demonstrated a clear link between a lack of trunk muscularity activation, and spinal injuries. Hence, as clients are subjected to high forces throughout active play, it is important that the Strength and Conditioning coach understands how to program effectively to improve a client's ability to engage the muscles that stabilise the spine, and therefore prevent injury.

Total trunk functionality

Research by McBride et al (unpublished) investigated the level of EMG (muscle activity) during a number of exercises, and demonstrated that the level of anterior, posterior and transverse muscularity activation differed between exercises. The authors reported that squats and deadlifts resulted in the greatest level of posterior muscle activation within the spinal area, whereas push up and plank variations resulted in the highest level of anterior and transverse trunk activation. Based on these findings, Strength and Conditioning coaches should consider exercise selection based on the target trunk activation area, and design programs with this in mind. For example, if a client has performed a posterior trunk activation dominant movement within their programs (e.g. squats or deadlifts) then

coaches should program some form of exercise that focuses on the anterior and/or transverse trunk stabilisers (e.g. barbell rollouts).

Such programming ensures total trunk structure, meaning a client demonstrates no torso structural weakness, less chance of spinal injury, and optimal force transmission capabilities. Stuart McGill, a leading authority within core stability and trunk biomechanics, demonstrated that a lack of trunk endurance had a direct correlation with lower back injuries, and suggested a number of trunk endurance test that would highlight which aspect of the torso muscle structure is weak in an individual (as detailed within the additional video presentation materials within this module). Therefore, Strength and Conditioning coaches should implement such trunk stability tests within literature, and program training interventions accordingly to address any postural weaknesses in clients.

Total trunk structure programming principles

As detailed within the accommodating presentations and learning materials within this module, Strength and Conditioning caches should progress a client's torso stability/strength training following a logical order, firstly concentrating on postural endurance, before progressing to movement resistance, and finally strength/power core training. Lastly, it is important that practitioners release that a 'core' exercise is one that simply engages the trunk stabilisers which if performed correctly, could be any key fundamental lift (e.g. squats, deadlifts, overhead press, etc.) and not just the addition of a plank within a program.

Module 11
Mobility and Stability

Mobility/stability and optimal performance relationships

As previously discussed within this manual, for a client to perform at their optimal performance, and be at less risk of injury, they must be able to demonstrate quality movement and motor control, physical literacy, and be able to stabilise, absorb, and produce high forces. Therefore, a client that is lacking in proper joint range of motion or stability in key positions, must be programmed with a specific intervention to address these issues by the Strength and Conditioning coach. Please note that this doesn't mean all training with such a client has to cease, but rather must be adapted or alternatives found that allows for a continuation of improved performance.

Movement dysfunctions

Sport demands that movement patterns be performed repetitively, both within practice and during competitive play, which often leads to movement dysfunctions, limitations, unilateral dominance, and altered movement patterns. Furthermore, a client who competes at the highest level may have existing movement dysfunctions that haven't been previously addressed. Therefore, it is important that Strength and Conditioning coaches have the knowledge and practical practice to able to address and manage such movement dysfunctions. Some typical movement dysfunctions seen within clients and general populations alike are:

Lack of thoracic extension and rotation: if a client cannot effectively extend at the thoracic spine, then greater extension will have to occur at the lumbar spine region,

placing greater loading on the intervertebral disks. Furthermore, if a client cannot effectively rotate at the thoracic spine, then greater movement will have to occur at the lumbar spine, or the hips, again increasing the risk of injury.

Lack of shoulder function: If a client is lacking in shoulder function, then throwing and striking performance will be limited. Furthermore, the execution of certain exercises will be limited, such as overhead presses, where the head needs to be effectively placed between the arms, or during a snatch, where the arms finish in line with the back of the head.

Lack of hip function: If a client is lacking in hip function, then a client will not be able to effectively accelerate, reach maximal velocity, change direction or perform a number of lower body focused exercises within an optimal range of motion. Hence, sports and training performance will be extremely limited.

Addressing movement dysfunctions

When addressing movement dysfunctions, the Strength and Conditioning coach must aim to increase joint range of motion to optimal (not maximal) levels, improve tissue quality via the use of self-myofascial release, and improve joint stability. Such training interventions can be embedded within warm ups, or as a standalone session focusing on improving movement quality. This allows warm ups to differentiated between individual clients. Lastly, it should be noted that such interventions should only supplement actual movement training, as often just the mere practise of a new movement will improve movement quality, and overall motor control.

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