# 'SCRIPT':
# S&C CONSULTATION RECORD AND INITIAL PLANNING TOOL

Planning all-encompassing strength and conditioning programmes for individuals and teams is complex and time consuming. Here, in the first of a new series, the **UKSCA** provides a summary of the key steps, with an in-depth look at the needs analysis.

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For the strength and conditioning (S&C) trainer, the needs analysis is an information-gathering and relationship-building process that equips the trainer with vital information prior to implementing a structured training intervention that will aim to best prepare the participant(s) for developing their physical capabilities, while supporting and enhancing their sporting performance and minimising their injury potential[1].

Table 1 (see overleaf) provides an overview of the planning process necessary to design effective strength and conditioning programmes. While this article focuses on steps one to three, further articles will provide insight into steps four to seven.

**TABLE ONE: Overview of the planning process in S&C programme design**

| | |
|---|---|
| **Initial consultation and analysis** | ■ Identify personal goals, lifestyle factors and training/injury history that will influence training decisions<br>■ Complete PARQ and informed consent |
| **Sport and participant needs analysis** | ■ Sport needs analysis: metabolic and biomechanical demands, injury analysis<br>■ Participant needs analysis: training preferences, lifestyle, age and sex |
| **Evaluation of overall physical status** | ■ Conduct appropriate fitness testing based on needs analysis information<br>■ This may also include measures of movement quality, typically assessed using a movement screen |
| **Set goals** | ■ Conduct a comparative analysis and identify gaps in the participant's development<br>■ Establish SMART training goals for the training programme |
| **Establish training context** | ■ Determine number and duration of weekly training sessions<br>■ Break down sessions into training units per week and allocate these to each specific training objective identified in the goal-setting process<br>■ Establish a typical week of training to include date, time, factoring in other commitments (e.g., work, social life, etc.) and competition schedule (travel days, recovery, etc.)<br>■ Consider location of training, equipment available and group size |
| **Design the training programme** | ■ Establish the length of the training block and session content each week to achieve identified goals |
| **Evaluation and monitoring** | ■ Repeat the battery of fitness tests and compare to initial testing data – this will measure the participant's 'adaption' to training and indicate the success of the programme, along with monitoring weekly data captured |

## Needs analysis

A three-step needs analysis process is necessary to design an effective programme[2]. The *sports needs analysis* identifies the most important combination of fitness qualities required to be successful in the sport (i.e., what does it take to win?). The *participant's needs analysis* profiles the current strengths and development areas of the participant (physiological and psychological), as well as identifying lifestyle factors that may affect training and competing. A *comparative analysis* uses information gathered in the sport and compares it to the participant analysis to identify gaps. This 'gap' analysis provides the basis for setting personal goals and offers a rationale for programme prescription.

## Sports needs analysis

### ■ Metabolic demands of the sport

The three different energy systems (phosphagen system, anaerobic glycolysis, oxidative system) will be taxed during any sport and the external demands placed on the body during the activity will dictate how much adenosine tri-phosphate (ATP) is required (i.e., product of intensity x duration), how quickly it needs to be produced (i.e., rate) and whether or not metabolic by-products (e.g., metabolic acidosis or H+ accumulation from anaerobic glycolysis) that are produced as a consequence need to be tolerated. Prolonged activities that are relatively low in intensity (e.g., long-distance road cycling) will rely predominantly on the oxidative system, whereas short duration, very high intensity events (e.g., javelin throw, maximum strength training) will largely depend on the phosphagen system. For most sports events, however, they fall between these two ends of the continuum – typically, intermittent exercise bouts of varying duration and intensity are present during team training and competition. Therefore, all three energy systems may predominate at different times, depending on the specific nature of the activity undertaken, often ranging from highly aerobic to highly anaerobic in character.

### ■ Biomechanical demands of the sport

Biomechanics is the study of human motion and there are two subdivisions of a biomechanical analysis that are essential components of the needs analysis:

**1. Kinematic analysis** looks at positions and movements encountered during the sport and provides detail on displacement, angles, velocities and accelerations of segments, joints and total-body movements. Primary muscle actions (i.e., concentric, eccentric, isometric), patterns of movement (e.g., triple extension and flexion), planes of motion (i.e., sagittal, frontal and transverse) and whether the movement is closed- or open-chain will feature as part of this analysis.

**2. Kinetic analysis** studies the forces (e.g., gravity, friction, force-time and power-time characteristics) that produce the movement. Measurements such as peak force, rate of force development, eccentric rate of force development, impulse (force x time), peak power output and average power output could all be included in a kinetic analysis, depending on sport relevance.

### ■ Common injury profiles

Injuries are one of the main reasons preventing participants engaging in long-term strength and conditioning programmes, plus they can also be responsible for significant modifications having to be made to programmes. Both these consequences of injury can lead to significant detraining, time away from the sport and loss of associated fitness.

An S&C trainer will need to explore key questions relating to injury as part of the needs analysis and understand two commonly used terms – *prevalence* (the proportion of individuals within a population who have an injury at a particular time) and *incidence* (the number of new cases of an injury during a specified amount of time).


For the S&C trainer, prevalence data is one of the key areas of interest for sports coaches who want to know which players are available for selection and training. A squad with a high injury prevalence means that a significant number of players will be missing from training or on varying degrees of modified programmes. Incidence data is helpful to pinpoint noticeable increases and decreases in injury rates – this allows coaches and trainers to look at training loads/types to help explain the patterns of injury reported.

In essence, there are four key questions the S&C trainer needs to answer:

- ✓ **What injuries are likely to occur for this participant involved in this position within their sport?**
- ✓ **Why are these injuries prevalent?**
- ✓ **Which participants are most prone to the injury?**
- ✓ **What can we do to mitigate injury risk in the future?**

## Participant's needs analysis

Significant benefit is gained from understanding those lifestyle factors that are specific to the individual and how they may impact on training. Questionnaires and an initial consultation can help with this and should attempt to understand the following:

■ **Training preferences:** Participants often have training preferences that may influence


> Participants often have training preferences that may influence the goal-setting process and exercise selection

the goal-setting process and/or exercise selection. This may mean at times there is a need to compromise and agree a method of training delivery that is optimal rather than perfect for all parties.

■ **Lifestyle:** Lifestyle factors such as sleep, nutrition, school and work commitments should be considered.

■ **Availability and key events:** The more time available means a greater window of opportunity for development. For example, when contact time is limited, a trainer may supplement one-to-one delivery with self-directed sessions, increasing volume and frequency accordingly. Holidays and periods away from home should be accounted for in the planning process. Trainers should be able to adapt around these events.

■ **Work ethic:** Individuals can have differing motivations, work ethic and capacity to train (physically). The 'principle of awareness' requires the participant to develop an understanding of both their physiological and psychological capacities and tolerances for work. There is no 'one size fits all' solution and trainers should communicate with participants to develop these areas.

■ **Training, biological and chronological age:** There are often big differences between training age (the number of years' exposure to training) and chronological age (years from birth). It is not uncommon to programme for participants who, although they have a greater chronological age, have no training history. Conversely, trainers may often work with younger populations who already have amassed significant 'training years' through exposure in their sport. It is important that both chronological and training age are known, as they both influence programme design.

## Participant benchmarking – testing and monitoring

Once the needs analysis process is complete, an evaluation of the participant's physical capacities highlighted as important for the specific sport (aka key performance indicators, KPIs) should be carried out – this provides a 'benchmark' of the participant's current training status. Some methods of data collection include:

■ **monitoring** – ongoing tracking of training loads and performances on a session-by-session basis

■ **testing** – normally administration of a battery of several tests pre and post an intervention (typically three or four times per year).

## Comparative analysis

On completion of the needs analysis (sport and participant), plus collation of fitness testing and monitoring data, the S&C trainer will need to compare the information gathered to common profiles of participants involved in the same sport. This can provide valuable information to the participant, as well as other support staff (S&C trainer, physiotherapist, technical coaches, etc.) that can be used to aid the goal-setting process and subsequently direct training emphasis and prescription.

## Goal setting

Goals can be broken down into specific training phases across the whole training/competition year and will be relevant to each phase. It is an integral element of the participant preparation process; if goals are not distinguished, the chance of a meaningful training intervention being achieved is drastically limited. Goal setting and aligning realistic KPIs can provide focus and intent to the intended training intervention. They should follow the **S**pecific, **M**easurable, **A**chievable, **R**ealistic, **T**imeous principle.

## Integrating the needs analysis

Understanding performance is complex and multifactorial – this requires the S&C trainer to invest a large proportion of their time in completing a detailed needs analysis of both the individual participant/squad and the sport, following the process outlined in this article. It is important that everyone included in the participant's development (including the participant) takes a collective responsibility to create a positive training environment that enables the participant to achieve their personal and sporting goals. This requires effective communication between the group and an appreciation of the contribution all members of the team make, particularly since the actions of team members will have an effect on how well the trainer can carry out their responsibilities, which essentially are to:

■ enhance the physical qualities that are key to sporting success

■ create a robust participant who can continually train and be available for competition.

When deciding on the goals and KPIs for the competitive season ahead, the trainer must take into consideration a number of participant analysis variables previously discussed. If goals and KPIs do not match the needs or take into consideration the individual participant and/or team requirements, this will lead to them being unrealistic and the participant(s) will become disengaged or suffer unnecessary injury due to the overestimated training demands[3]. The next article will focus on equipping the trainer with applied knowledge in setting sport-specific KPIs across a range of sporting disciplines.

# ‘SCRIPT’:
# A FOOTBALL CASE STUDY

In the last issue, part one of our new series by the **UKSCA** outlined the first steps in the information-gathering process prior to writing and implementing effective strength and conditioning (S&C) programmes. Here, part two focuses on providing the S&C trainer with a sport-specific case study of how to capture and use this information to develop a thorough understanding of the sport, carry out a comparative analysis and set SMART training goals for an individual participant.

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The following case study is based on a female footballer, with the corresponding needs analysis detailing the sporting requirements.

Football is played over 90 minutes and divided into two 45-minute periods, separated with a 15-minute half-time interval. Football is regarded as an aerobic intermittent sport, meaning the predominant energy source is aerobic glycolysis. The key performance-related movements are sprinting, high-intensity running, jogging, walking, jumping (single and double leg) and change of direction manoeuvres, indicating that football incorporates multi-directional movements at various intensity levels[1]. Players are reported to cover distances of 9,000-13,000 metres per match; this is multifactorial dependent on playing level and positional differences, plus tactics can alter distances[2]. For example, it has been reported that wider midfielders and centre midfielders (average > 11,000 metres) cover more total distance during a match compared to centre backs and forwards (average < 11,000 metres). Furthermore, wide midfielders covered the greatest distances at high intensities (speeds categorised over 14km/h$^{1}$), with centre backs producing the least[3]. Key determinants of successful performance are anaerobic-based movements/actions such as jumping, accelerations, decelerations, sprinting and high-intensity running. These actions only contribute to less than 30% of a game, yet superiority in these attributes is pivotal across all successful teams[4]. This is supported through the findings of Faude *et al*[5], who reported that most goals were preceded by a powerful action (83%), this predominantly being a straight sprint performed by either the goal scorer or assisting player. It is further reported that high-intensity running was repeated on average 125 times per match, with the average duration of 2.3 seconds[4,6]. The metabolic demands can be tracked through individual heart rate and VO$^{2}$max, although these metrics do not directly correlate to high-intensity work being performed. It was found that the average game intensity was 70-80% VO$^{2}$max; furthermore, it was reported that 49.6 ± 21.1% of matches are spent above the heart-rate-measured anaerobic threshold. This highlights the importance of developing a high aerobic capacity, allowing for an increased level of recovery, removal of the anaerobically produced lactate and an increased efficiency and capacity at performing high-intensity related actions[7].

Female football has progressively increased in popularity throughout the world of sport, with substantial increases in young female participation rates over the past decade[4,8], with increased physical athleticism contributing to the enhancement in playing dynamics[9,10]. Development and enhancement in playing dynamics are mostly exhibited by improvements in speed, power, strength, aerobic and anaerobic capacity[6]. Therefore, it is the job of the S&C trainer to prepare and develop the participants' physical capacities and robustness to tolerate the competitive demands, assisted by the needs analysis process.

Due to the repetitive frequency and physical demands of the sport, this exposes the particpants to an inherent risk of injury; therefore, biomechanical analysis and injury management will be covered in the next article.

## Individual analysis

The female footballer is aged 17 and playing Academy football (under-18 level) at an elite club. The participant's personal characteristics are: height 160cm; mass 50.9kg; body composition 13.5% (a lean body composition can positively impact on movement efficiency and offset fatigue, thereby improving sporting performance). The participant's individual circumstances should also be considered. Education, work or other commitments may impact on the training week and limit the participant's ability to train as desired or recover from training sessions. The participant is currently at university, studying four or five days a week, attends training three days per week and has a match every Sunday. The participant's training history for the sport is 10 years and, with regards to resistance training, she's had five months' exposure to deliberate and purposeful strength-based training.

> "When collecting fitness-testing data, it is important to use valid and reliable tests that can accurately detect changes in performance"

It is important to determine participant training history, as this will impact on other factors such as training frequency. As illustrated in Table 1, the participant falls within the 'intermediate' status; therefore, resistance training frequency would be two or three times per week. Beginner participants may require longer between workouts to recover compared to advanced participants. However, as the training status of the participant improves, training frequency (number of sessions/week) can increase. If all the previously mentioned elements are not factored in, the training expectations placed on the participant may be unrealistic and may lead to sub-optimal performance or even injury.

## Creating a testing battery

A complete understanding of the requirements of the sport allows the S&C trainer to develop a comprehensive sports-specific testing battery. This can then be administered to benchmark players' physical abilities against those required in the sport. Fitness testing should ideally take place at the beginning of the pre-season training cycle to provide accurate baseline data[11], with further testing being carried out at periodic times

TABLE 1: **Classifying resistance training status**

| | RESISTANCE TRAINING BACKGROUND | | | | |
|---|---|---|---|---|---|
| Resistance training status | Current programme | Training age | Frequency (per week) | Training stress | Technique experience or skill |
| Beginner (untrained) | Not training or has just begun training | < 2 months | < 1-2 | None or low | None or minimal |
| Intermediate (moderately resistance trained) | Currently training | 2-6 months | 2-3 | Medium | Basic |
| Advanced (well resistance trained) | Currently training | > 1 year | 3-4+ | High | High |

*Adapted from Haff & Triplett (2016)*[16]

throughout the year. This can help measure the effectiveness of the training programme and also help to influence future programming decisions.

## Considerations

The testing battery should include tests that assess the specific qualities identified in the needs analysis. The S&C trainer should also consider which resources (time, equipment, staff) are available to them to complete the testing battery, as this will ultimately decide which tests are performed. In addition, participant training history and experience should also be taken into account. Limited skill or technique may prevent the participant from performing the test safely and increase the chance of injury. In addition, if the participant does not have sufficient skill to perform the test, it is probably not going to provide the S&C trainer with a true and accurate measure of the physical quality they are trying to assess. In this case a simpler, less complex alternative should be found.

## Selecting fitness tests

When collecting fitness-testing data, it is important to be sure you are using valid and reliable tests that can accurately detect changes in performance. Validity, reliability and sensitivity are key concepts the S&C trainer should become familiar with[12]. The validity of a test refers to its ability to measure what it is supposed to measure, while a test's reliability refers to how repeatable it is. Finally, a test with high sensitivity is capable of detecting changes in performance. The countermovement jump has been shown to be a valid and reliable test of lower-body power[13]. Therefore, this test will allow the S&C trainer to capture consistent data with a low typical error, making it very sensitive to change in the presence of training adaptations or fatigue.

## Testing battery

Taking all analysis elements into consideration, the following tests (see Table 2) were used to assess the participant's physical capabilities based on their high levels of validity, reliability and sensitivity[13,14,15] and also their high levels of sport specificity. In addition, the intermediate training status of the participant allows us to examine lower-body strength and power capabilities through the repetition maximum (RM) testing of the back squat and power clean exercises. RM testing assesses the maximum amount of weight that a participant can lift for a desired number of repetitions – typically one, three or five RMs are tested in compound strength-training exercises. This method of strength assessment should only be considered for intermediate or advanced strength-training participants[16].

Tests should be performed in order from least to most fatiguing, so as to maximise recovery between tests and improve subsequent test performance[11]. The order, where possible, should be as follows:

- **Anthropometry** (e.g., height, weight)
- **Skill and/or speed/power tests** (jumps and/or sprints)
- **Maximal strength tests** (squats, bench press, pull-ups)
- **Muscular endurance tests** (aerobic or anaerobic tests)

On occasions where the S&C trainer is working with large groups or is working under specific time constraints, performing the tests in this order may not always be possible. The S&C trainer should replicate this order in future testing sessions[11].

## Comparative analysis

Following the completion of the testing battery, a comparative analysis between the individual participant's test results and normative fitness testing values found in the sport is performed. See the participant's comparative analysis in Table 2.

Here, areas of strength and weakness can be identified and this provides the S&C trainer with a clear direction with regards to setting training goals. If access to normative data for elite-level participants is not always available, the S&C trainer should use the team or squad information collected to establish group fitness testing norms[17].

## Goal setting

The goals of the training programme should focus on developing the physical qualities that play a dominant role in successful performance[18], as described in the needs analysis section[16].

The SMART principle should be used to help the S&C trainer set goals for the participant to ensure the training goals are specific to the needs of the participant, measurable, achievable, realistic and completed in a realistic timescale. Setting unrealistic or unachievable targets can hinder the training process, place the participant at increased risk of injury and potentially lead to overtraining.

The SMART goals for the participant have been identified as developing lower-body strength and power. These goals have been identified through the large deficits as shown in the comparative analysis (see Table 2). Development of strength in beginner and intermediate resistance training participants is very important[19,20]. Increasing levels of maximal strength sets a good foundation from which explosive power and speed can be better developed than by employing power and speed training strategies alone[19]. Therefore, the goal for this participant should be to aim to improve lower-body strength by 10% over the pre-season training period (eight weeks in length). As the participant is still only moderately resistance trained, steady progression of approximately 5% over two four-week training programmes should be achievable in the given timescale.

The next article in this series will focus on the use of movement screens to assess movement quality, in order to inform programme design to prevent injury.

TABLE 2: **Comparative analysis showing individual participant's results vs normative values**

| Capability assessed | Test | Individual participant's result | Normative values of comparable level | Difference vs normative value |
|---|---|---|---|---|
| Body composition | Body fat % | 13.5 | 18.5 | -27% |
| Lower-body power | Countermovement jump (CMJ) | 28 | 35 | -20% |
| Speed (acceleration) | Sprint 10m (s) | 2.5 | 2.31 | 8% |
| Speed (top speed) | Sprint 30m (s) | 5.6 | 4.86 | 15% |
| Lower-body strength | Back squat 3RM x BW | 0.9 | 1.3 | -31% |
| Aerobic fitness | Yo-Yo intermittent running test level 1 | 1,360 | 1,379 | -1% |

*Values highlighted green = on a par with or better than norms; amber = areas of concern; and red = improvement is required. Norms taken from Nesser et al (2009)[21] and Martinez-Lagunas (2014)[22].*

# MOVEMENT SCREENS AND THE S&C TRAINER

Part three of our **UKSCA** series looks at the purpose of movement screening for the S&C trainer and provides an example of a movement screen overview.

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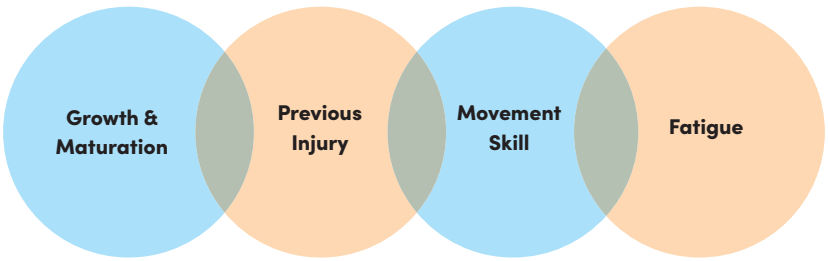
Movement screening provides the Strength and Conditioning (S&C) Trainer with a framework for observing a series of fundamental movement patterns, in order to create a movement profile of their participant prior to programming. There is a number of published movement screens available to choose from, with the Functional Movement Screen (FMS)[1a,1b] and the Athletic Ability Assessment[2] being the most commonly used and reported by S&C trainers and other health professionals. Although these systems provide a comprehensive list of fundamental movement screens, the S&C Trainer rarely carries out the complete list of exercises recommended in any particular one movement screen system. It is more typical that movement screen exercises are selected from a range of sources to specifically address and support information gained from the Strength and Conditioning Consultation Record and Initial Planning Tool process (or SCRIPT). This was discussed in parts one and two of this series. Specific movements (i.e., the kinematics), injury profiles and mechanisms identified from the sport needs analysis, plus person-specific risk factors identified from the participant needs analysis (e.g., sex, age, anthropometrics), will all influence what movement screening tools are deemed relevant for inclusion. The selected movement screens will then typically be incorporated into the more comprehensive battery of tests that measure specific physical qualities underpinning sports success.

The purpose of movement screening is to attempt to identify compensatory movement patterns that, in theory, could indicate sub-optimal movement strategies that could reduce performance and increase injury risk[3]. That being said, evidence supporting their ability to predict injury risk is not well established, with some authors showing no link to injury[4] and others making recommendations that they are a valuable tool that can predict injury risk throughout a season[5,6,7]. The reality is that factors that predispose an individual to injury are multifactorial[8] (see Figure 1) and some authors suggest that screening tools are unlikely to ever be able to predict injury risk with sufficient accuracy[9].

Similarly, the ability of movement screens to be able to predict athletic performance has also been questioned[10]. The reason for this is predominantly down to the fact that screening protocols typically do not assess movement quality under load or at high velocity and, as such, lack specificity to sporting actions. Movements that require fast velocity will shift the focus of attention from an internal (i.e., what the body is supposed to be doing) to an external focus. In the latter, the focus is on successful task completion and relies on the body automatically self-organising to achieve success – little conscious thought will be given to alignment and how to do the movement as is the case in a movement screen. Loading will also alter the participant's movement strategy. Screening movements are often unloaded, although sport requires load tolerance from collisions, jump landings, changes of direction, etc. Despite these findings, the rationale behind the concept of a 'movement screen' is logical – the body is designed to tolerate and dissipate load but, if the joints are misaligned, they are unable to do this effectively. Compensatory movements that remain uncorrected could lead to the development of chronic overuse injuries later on in life. *fp*

**Figure 1**

Mitigating factors that may predispose an individual to injury




“The movement screen can accelerate the trainer’s technical knowledge, observation skills and understanding of technical models”

In order to identify 'compensatory' movement patterns, the kinematic sequence observed by the participant in the screening test will need to be compared to an 'ideal technical model'. This represents the least injurious way of performing the movement and will give you a good starting point for assessing good-quality movement.

**As an S&C Trainer, you should be encouraged to develop your own philosophies on the relevance of movement screening to your participants. Regardless of whether this tool is able to predict injury risk or, indeed, athletic performance, there are some additional benefits to conducting a movement screen that relate to trainer-participant relationships. It can:**

- educate the participant about the importance of good movement quality and the benefits of supervision
- raise the participant's awareness of their own movement capabilities – sometimes actual and perceived movement competencies are different things
- accelerate the S&C Trainer's technical knowledge, observation skills and understanding of technical models
- provide benchmark values for current movement competencies and can be part of a testing battery or monitoring strategy to assess training programme effectiveness; obvious improvements in this will help motivate your participant to continue to adhere to their training protocols
- be a great way to assess WHO you are working with if you are working with a group of 'new' athletes and what their programme requirements are, plus develop trainer-participant relationships.

Despite these listed advantages of movement screening, it cannot be forgotten that the job of the S&C Trainer is to observe and coach movement and, as such, movement screens will be conducted by effective S&C Trainers every session. It is also worth noting that movement screens implement a scoring system to measure/benchmark movement quality[1a,b]. If this is the case, it could be argued that the time spent carrying out and scoring formal movement screen assessments may detract from valuable training time, for no greater gain.

It is also commonplace for S&C Trainers to video participants within sessions to aid the coaching process, as well as educate the participant on their own movement competency – a pure video file will maintain a richness of information that could be lost by attributing a score to the test. However, as an S&C Trainer, if you decide that movement screens are a useful addition to your practice,

> "Construct a series of movement screens that can tell a story about your athlete"

the next step is to construct a series of movement screens that can tell a story about your athlete. They should progress from simple to complex tasks, with additional challenges of load and velocity being incorporated. In this scenario, it is possible to identify at what stage the participant's movements start to deteriorate (i.e., the point the movement becomes unsafe and/or ineffective) – this provides useful insight into what should be included in the design of the programme.

With the information gathered in the previous UKSCA article based on female football (previous issue), the remaining section of this article will focus on the selection of movement screens to assess lower limb injury risk in that particular case study.

TABLE 1: **Movement screen overview**

| MOVEMENT SCREEN/TEST | PURPOSE | REFERENCE/ FURTHER READING |
|---|---|---|
| **Split Squat** (20kg barbell or broomstick) | ■ Develop confidence and ability to train with load in a unilateral position<br>■ Assess ability to maintain correct ankle, knee, hip and trunk alignment while keeping a stable base of support<br>■ Assess neuromuscular control and/or strength deficits between right and left leg<br>■ Develop lower-body strength | 15 |
| **Walking Lunge** (20kg barbell or broomstick) | ■ Assess ability to maintain correct ankle, knee, hip and trunk alignment while changing the base of support<br>■ Assess neuromuscular control and/or strength deficits between right and left leg<br>■ Develop confidence and ability to dynamically stabilise a lunge position and accelerate out of the lunge<br>■ Develop lower-body strength | 2 |
| **Single Leg Hop & Stop Test** | ■ This is not a maximal effort test – the participant needs to travel sufficient distance to make it a challenging task (typically 70-80% effort) but the key assessment is movement quality<br>■ Assess neuromuscular control and/or strength deficits between right and left leg<br>■ Develop confidence and ability to rapidly triple extend and to decelerate on one leg<br>■ Assess the participant's ability to maintain correct ankle, knee, hip and trunk alignment with the addition of increased speed of the movement<br>■ Develop lower-body power (concentrically and eccentrically) | 2 |
| **Triple Hop & Stop Test** | ■ Develop confidence and ability to rapidly triple extend, rebound and to decelerate on one leg<br>■ This test is a maximal effort test – it does not directly assess movement quality (although you can do this through the use of video) but is a measure of the participant's ability to accumulate as much distance as possible and 'stick' the landing of the last hop. The right and left legs can be compared to identify neuromuscular and strength asymmetries between limbs<br>■ Develop lower-body power and elasticity or 'reactive' strength | 16 |
| **10-second Tuck Jump Test** | ■ Develop confidence, co-ordination (upper and lower body) and ability to rapidly triple extend, rebound and to decelerate on two legs<br>■ Develop lower-body power and elasticity or 'reactive' strength<br>■ This is a maximal effort test and assesses the participant's ability to maintain movement quality under fatigue<br>tuckjumpassessment.com | 17 |

## Assessing lower limb injury risk in a female footballer

It is important to note that strength is a fundamental component that underpins an array of physical attributes, providing the basis for enhanced sporting performance, aiding in the prevention of injury. High relative strength capabilities are needed in the lower extremities for movements that require the athlete to accelerate (large concentric force production), decelerate (large eccentric force absorption) and maintain control while manoeuvring into different cutting, jumping and running positions.

It is documented that 57-88% of all female soccer injuries are associated with the lower extremities, with the most common locations being the ankle, knee and hips[11]. It has been highlighted that, within female professional football, participants are four to six times more likely to sustain an injury of the anterior cruciate ligament (ACL) compared to male counterparts[11]. ACL injuries in females are high in occurrence and severity; there are different variables that have been reported to contribute to the potential of obtaining an ACL rupture, these being deficiencies in muscular activations, muscular imbalances, and kinematic factors concerning structural and mechanical aspects[12]. Knee valgus is identified as a major contributor and excessive knee valgus motion is highlighted as contributing to non-contact ACL injuries, with the knee visually sustaining a medial collapse of the knee during dynamic-based tasks[13]. It has been reported that, when knee valgus angles are above 10.8°, individuals are at greater risk of injury[14]. Females commonly have greater knee valgus angles, side-to-side differences in knee valgus, and lower knee and hip flexion angles compared to males. Also, during vertical drop landing, females exhibit greater external abduction forces compared to males, therefore explaining the high occurrence of ACL injuries within female athletes[14].

In light of the needs analysis information above (and from the previous article), the following movement screen tests have been selected for inclusion: Split Squat; Walking Lunge; Single Leg Hop & Stop Test; Triple Hop & Stop Test; 10-second Tuck Jump Test. Table 1 outlines the purpose of each test and where the reader can go to access further information on how to perform the tests. The tests should be performed in the order presented in the table, with sufficient rest between tests to ensure the athlete is not in a fatigued state prior to starting the test.

As stated, it is important to be selective in the movement screening tools you feel are the most important to utilise based on the information you have gathered through the needs analysis process. This will enable you to subjectively analyse the movement competency of the individual you are working with and, ultimately, provide you with essential information that can further influence the programming process. In the next article, you will see a detailed assessment of these movement screens with a live case study.

For references visit fitpro.com/references

# How to use **movement screens** to plan training

Part four of our **UKSCA** series works through a sequence of movement screens for a particular case study, in order to provide a working example of how the information gleaned from these tests can be used to inform training goals and prescription.

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**In order to show how we can use the information collected from a series of movement screens, there are a few points to consider as follows:**

## TECHNICAL MODELS

Technical models describe what 'good' looks like for a specific movement skill and include details such as joint positions and angles, weight distribution, force application, and trunk and limb alignment. They provide an ideal assessment framework and guide for the strength and conditioning (S&C) trainer to observe a participant's movement quality and, in some cases, can provide the basis for the scoring system attributed to certain movement screens.

## ATTRIBUTING RISK

One of the key outcomes of assessing a participant's movement quality via a movement screen is to identify a potential injury risk associated with observed movement deficiencies. For the S&C Trainer, there is a number of strategies that can be used to guide decisions about risk stratification.

The first is the scoring system, if available. For example, the Functional Movement Screen (FMS) assessment includes seven separate movement patterns, each rated on an ordinal scale (3-0) according to competency, symmetry and the presence or absence of pain. This provides a maximum score of 21 if all screens are completed, with a cut-off score of ≤14 typically reported as a predictor of injury[1]. For some movement screen batteries, there is a scoring system available (e.g., athletic ability assessment[2] and 10 second tuck jump[3] test) but there are no scores or range of values that have been specifically attributed to a 'significant increase in injury risk'.

In addition, the reality is that the S&C Trainer rarely sees 'perfect' movement, meaning their participant does not demonstrate movement that mirrors the ideal technical model. In these cases, it is up to the S&C Trainer to formulate an evidence-based opinion on how much deviation they are prepared to accept from 'perfect' before allowing their participant to load a movement safely – this concept is known as the 'margin of tolerance'. Put simply, a small margin of tolerance means the S&C Trainer will only allow a slight deviation from 'perfect' technique before they allow the participant to load an exercise.

In general, when people are at the start of their S&C journey or, conversely, are competent lifters who perform movements under high load and/or high speed, the margin of tolerance is usually relatively small because these are two relatively high-risk scenarios, although margins will differ between trainers. It is also important to remember that margins of tolerance and interpretation of scoring systems will depend on the athlete (e.g., biological age, sex, previous injury and training experience) and sports needs analysis (e.g., injury incidence and prevalence data, stage of the season).

## CASE STUDY: Female footballer

**The case study presented below involves a female footballer, aged 17 and playing Academy football (under-18 level) at an elite level. The movement screens included are the split squat, walking lunge, single leg hop and stick, triple hop & stop and the 10 second tuck jump test. Key findings from each movement screen will be identified and risk stratified, with the aim of highlighting areas of focus for the strength and conditioning intervention. The scoring systems presented in the following tables are taken directly from the relevant published papers – for more information, please go to the full article.**

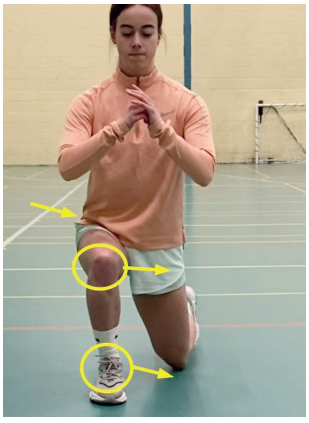
## 1 SPLIT SQUAT

**TABLE 1:** SCORING SYSTEM FOR THE SPLIT SQUAT
(five on each leg), adapted from the athletic ability assessment[2]

**Lunge positions incorporate hip mobility, trunk stability, strength and motor control in one exercise. The complex interaction of these components illustrates dysfunctional patterns or components of athletic movement.**

| ASSESSMENT ITEMS | 3 | 2 | 1 |
|---|---|---|---|
| Knee/ankle alignment | Perfect alignment and control of knee/ankle throughout every rep | Inconsistent form with some perfect reps OR minor misalignment on all reps | Poor alignment throughout |
| Hip control | Perfect alignment of hips throughout | Inconsistent form with some perfect reps OR minor loss of control on all reps | Excessive loss of control from neutral throughout the movement |
| Trunk control | Maintain neutral spine throughout. No forward or side flexion/ movement | Inconsistent form with some perfect reps OR minor loss of control on all reps | Forced lumbar extension or lack of trunk control during force production |

- **The split squat is a prerequisite movement for other more complex lunge patterns – this is not one of the standard athletic ability assessment (AAA) screens but, due to the similarity of the movement to lunge patterns, the same AAA criteria can be applied.**
- **Stride length should ensure a vertical front shin and back thigh position for each rep.**



| Assessment score (based upon athletic ability assessment scoring system[2]) | 5 out of 9 – medium risk, resulting in an amber flag |
|---|---|

**Split squat key findings**

- ✔ Difference between left and right alignment from ankle, knee and hip
- ✔ Knee valgus during descent more significant on right knee, as shown in picture
- ✔ Medial collapse of the right ankle
- ✔ Pelvis misalignment, with internal rotation, contributing to or from knee valgus
- ✔ Knee valgus more prominent in right knee during descent compared to left knee

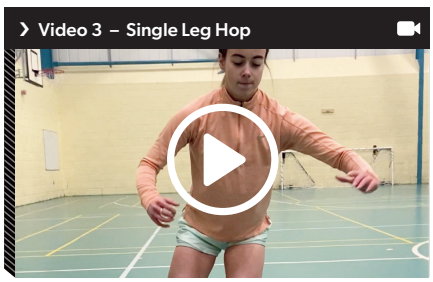
## 2 THE ATHLETIC ABILITY ASSESSMENT WALKING LUNGE (10 STEPS, FIVE ON EACH LEG)[2]

The criteria for assessing this movement are the same as in Table 1. Please note that, when performing the walking lunge movement, there should be no stopping at the middle of the stride pattern and tempo must be consistent – emphasis is on full hip extension between each stride.

| Assessment score (based upon athletic ability assessment scoring system[2]) | 4 out of 9 – medium risk, resulting in an amber flag |
|---|---|

### Walking lunge key findings

✔ Continued from the split squat, difference between left and right alignment from ankle, knee and hip
✔ Inconsistency of stability of ankle and knee when planting foot forward in lunge pattern, more noticeable in right side
✔ Right knee medial collapse
✔ Pelvis misalignment still evident on right side, with internal rotation, contributing to or from knee valgus
✔ Trunk position held well, although lateral movement when right side stepping forward (notice barbell deviates from parallel alignment to the floor)


## 3 SINGLE LEG HOP & STICK

TABLE 2: Scoring system for the single leg hop & stick
(3 x each leg)[2], adapted from the athletic ability assessment

**The capability to reduce and stabilise forces in a unilateral environment is critical for change of direction and multi sprint ability in many sports and training modalities. Being able to reduce force and stabilise efficiently not only quickens the ability to change direction and, therefore, increase sporting performance, but efficiency through this movement is likely to reduce risk of non-contact injury incidence. Single leg power production is also a key component of acceleration in sport.**

| ASSESSMENT ITEMS | 3 | 2 | 1 |
|---|---|---|---|
| Hip/knee/ankle alignment | Perfect alignment of hip/knee/ankle | Inconsistent form with some perfect reps OR minor misalignment on all reps | Poor alignment throughout |
| Balance/control | Landing with perfect balance and control | Sticks landing but is unbalanced. Adjustments made via other body movements | No balance/ control on landing |
| Power position (1/4 squat position) on landing | Lands in single leg power position/ quarter squat after every rep | Inability to land in power position on some but not all reps OR makes adjustments post landing to attain power position | Excessive hip/ knee/ankle flexion. Poor positioning to reproduce force |

- **Jump distance is challenging but not maximal**
- **Participants must stick and hold the landing position for ~ 3secs**

| Assessment score (based upon athletic ability assessment scoring system[2]) | 3 out of 9 – high risk, resulting in a red flag |
|---|---|

### Single leg hop & stick key findings

✔ **Jumping:** during jumping action, knee valgus is evident and excessive
✔ **Landing:** ankle, knee and hip alignment is inconsistent and generally poor
✔ Excessive knee valgus on landing
✔ Medial collapse of ankles on contact as load of body is taken; right side is worse
✔ Right side landing is not performed well – landing happens when leg is mostly straight and then flexion of knee occurs post landing
✔ Pelvis misalignment on landing; right side landing more prominent

## 4 THE TRIPLE HOP & STOP TEST

Participants will hop as far as possible in three hops – they must stick and hold the landing position in the last hop for ~ 3secs. Participants stand on the testing leg with toes placed on the starting line. Distance hopped will be measured from the starting line to the point where the heel hits on the third and final hop. The participant will be allowed three trials on each limb, alternating limbs for each trial – the best score for each leg will be used to calculate asymmetry using the bilateral strength asymmetry (BSA)[4] calculation shown below:
BSA (%) = (Stronger limb – Weaker limb)/Stronger limb x 100

### Triple hop and stop key findings

✔ Difference between left and right alignment from ankle, knee and hip on landing
✔ Quadricep dominant landing strategy (i.e., knee flexion with delayed hip flexion on landing)
✔ Lack of neuromuscular control causing inconsistency in landing strategy and stability
✔ Knee valgus evident on landings and hold at end of movement
✔ Over 10% difference from right to left, highlighting an asymmetry in the right lower extremity

TABLE 3: TRIPLE HOP & STOP ASYMMETRY RESULTS

| | |
|---|---|
| Distance | Distance covered is greater in the left side compared to the right |
| Assessment score[4] | Over a 10% difference in total distancing, highlighting an asymmetry and resulting in a red flag |

## 5 THE 10 SECOND TUCK JUMP TEST

TABLE 4: 10 second tuck jump assessment grading criteria[3]

| Criteria | Yes/No |
|---|---|
| **Knee and thigh motion:** | |
| 1. Lower extremity valgus at landing | Yes |
| 2. Thighs do not reach parallel (peak of jump) | Yes |
| 3. Thighs not equal side to side (during flight) | No |
| **Foot position during landing:** | |
| 4. Foot placement not shoulder-width apart | Yes |
| 5. Foot placement not parallel (front to back) | Yes |
| 6. Foot contact timing not equal | No |
| 7. Excessive landing contact noise | No |
| **Plyometric technique:** | |
| 8. Pause between jumps | No |
| 9. Technique declines prior to 10 seconds | No |
| 10. Does not land in same footprint (excessive in-flight motion) | Yes |
| **Total score (out of 10)** | **5** |


| | |
|---|---|
| Assessment score (based upon athletic ability assessment scoring system[2]) | 5 out of 10 – medium risk, resulting in an amber flag |

### 10 second tuck jump key findings

✔ Knee valgus evident, more prominent on right side
✔ Medial collapse on right ankle on contact, contributing to knee valgus
✔ On foot contact, feet not equal placing as right foot behind left
✔ Torso positioning maintained throughout jumps
✔ Thigh positioning at top of jumps is inconsistent

### SUMMARY

From the case study movement screen observations, it is apparent from the first single leg squat test that the participant has lower limb alignment issues, lacking strength and stability around the ankle, knee and hip joints. An asymmetry between right and left legs has also been demonstrated. Simple bilateral and unilateral strength-based exercises such as squat, lunge and step-up variations will help address these deficiencies alongside eccentric hamstring work (e.g., Romanian deadlift) to improve knee stability on landing. Jumping-based exercises, particularly eccentrically focused (e.g., double leg or single leg landing from a box) and reactive or rebound drills (e.g., pogos, hurdle jumps and hops) will help improve landing mechanics and lower-limb stiffness to increase stability and control on landing.

It is important that the S&C Trainer maps out a training approach that takes into consideration not only the training goals associated with identified movement deficiencies, but also the sport performance goals set by technical coaches and the rest of the support/coaching team. For the S&C Trainer working with participants involved in performance sport, it is not feasible that they programme only to address identified movement deficiencies; whilst effort should be put into improving the quality of key movements, the S&C Trainer often needs to find ways of working around movement deficiencies (i.e., identify exercises of sufficient movement quality to allow safe loading) to allow adequate loading for strength and speed development associated with performance goals.

It is essential that all exercises are adequately coached and supervised, but also that corrective exercises are performed in sufficient volume and consistently to see an improvement. For the S&C Trainer, when time is often pressured and focused on performance outcomes, it is important to remember that corrective exercise can be performed at any point within a session wherever they can be 'fitted in', just as long as they get done. Therefore, rather than just simply thinking of the warm-up and cool-down as the obvious place to include such exercises, consider placing them at other points of the session – for example, in between main exercises as 'fillers' or in technical sessions when the coach is setting up the next sport-specific drill. fp