Programming and Periodisation for Team Sports

Moisés de Hoyo Lora and Luis Suarez Arrones

Abstract Training programming and periodisation is widely acknowledged as crucial for optimising training responses. The achievement of physical aims is impossible when attempted without considering the different possibilities of periodisation, which is understood as the structuring of the training process and competition participation into various phases, periods and cycles. Thus, this chapter introduces different training periodisation concepts and summarises a large body of findings describing their potential benefits and possible limitations. Applying periodised planning to team sports poses unique challenges due to the variety of training goals, volume of concurrent training and practices, and extended season of competition. Therefore, practical suggestions are offered in this chapter to address these challenges and apply programming and periodisation to the design of strength training programmes for different phases of physical preparation for team sport athletes.

Keywords Strength training periodisation · Traditional periodisation · ATR blocks · Microstructure periodisation · Tactical periodisation

1 Introduction

Multiple definitions of the term "periodisation" can be found throughout the sports performance literature. For instance, Isurin (2016) defined periodisation as the main planning strategy for athlete preparation. Lambert et al. (2008) described the term as the purposeful process of systematically planning a short- and long-term training programme by varying training loads and incorporating adequate rest and recovery.

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According to Manchado et al. (2018), training periodisation is a strategy to promote long-term training and performance improvements with pre-planned systematic variations in training specificity, intensity, and volume organised into periods or cycles within an overall programme. In this sense, in team sports, a typical periodisation plan involves phases or cycles of varying training demands and goals programmed throughout the pre-season, competition, and transition (off-season) phases (Mara et al. 2015; Suarez-Arrones et al. 2019). The transition period in team sports is generally characterised by a substantial reduction in training, even including complete training cessation for a few days. During the off-season, players also participate in other sport activities to retain fitness and/or follow individualised training programmes offered by their clubs to facilitate faster adaptation during the subsequent pre-season phase (Silva et al. 2016). The pre-season is commonly characterised by a high frequency of training sessions and friendly games shortly after returning to training, with rapid increases in training load within a few days (Silva et al. 2016). Regarding the competition period, the playing season in team sports such as football or rugby can span in excess of 35 weeks, particularly in Europe. In this context, the major obstacles for fitness coaches working with these teams are the frequent matches and extended competition period. Given this requirement to continue regular competition over many months, achieving the necessary training periodisation represents a significant challenge that we will attempt to address in this chapter.

Designing periodised training programmes for team sport athletes poses unique challenges and difficulties. This is mainly due to the fact that athletes are required to work on multiple aspects of their individual fitness and physical readiness to perform, while concurrently participating in extensive technical and tactical team training sessions to prepare for upcoming matches, as well as extended periods of competition (Mujika et al. 2018). All these elements must be addressed in the course of the training plan. Therefore, there is a need for planned variations in the training programme to systematically shift the emphasis to promote these different training effects at different phases of the preparation period (Gamble 2006). For fitness coaches, physical periodisation is the systematic planning and variation of training demands, with the aim of optimising physical condition and minimising the risk of injury (Fleck 2011). For team sport players, appropriate strength training (ST) periodisation is needed to achieve these aims.

To achieve these goals, different ST modes with (i) distinct sources of external resistance (traditional free weights, ballistic exercises, plyometrics, weightlifting, flywheel technology, motorised devices and/or sport-specific strength-based actions), (ii) different combinations of the temporal organisation of strength/power training loads (e.g. microcycle and training session variations), (iii) distinct loads, (iv) a wide range of movement velocities, (v) specific biomechanical characteristics, and (vi) different training surfaces, have been adopted with the final end point of achieving an improvement in players' performance in relevant motor tasks (e.g. jumping, sprinting, and changing direction) and reducing the rate of injuries (Silva et al. 2015). In accordance with this, this chapter introduces novel concepts of ST periodisation and summarises a large body of findings describing their potential benefits and possible limitations for team sport players.

2 From Theory

The contemporary theory of training was established in the 1960s and early 1970s by Matveyev (1964) and Ozolin (1970) and became known as the classic or traditional periodisation training model. In this model, training starts with high-volume and low-intensity workloads and shifts to an increase in the intensity and a decrease in the volume as the athlete progresses towards the competition phase (Matveyev 1964). The periodisation model at that time was largely based on individual sports and did not consider team sport scheduling (Manchado et al. 2018). Thus, for example, modern team sports require the achievement of a high level of performance during every match, which the traditional periodisation model may not provide. Team sports also require a high level of performance in many abilities simultaneously (Manchado et al. 2018).

To overcome the limitations of traditional periodisation for team sports, different training models have been developed over the last few decades. In this process of development, the first adaptation of the traditional model for team sports was proposed in 1985 by Issurin (2008). Unlike the traditional concept, this alternative version proposes a high concentration of training means within appropriate preparation cycles. These proposed alternative concepts of athlete preparation were called 'ATR block periodisation' training systems. In this model, the athlete has a higher number of peaks in many games (Issurin 2008). ATR block periodisation is divided into three blocks, which are the accumulation, transformation and realisation blocks. The accumulation block has higher residual training because the coach prescribes aerobic endurance and/or aerobic resistance, maximal strength and basic technical and tactical training (Issurin 2010). The transformation block has medium residual training because the coach prescribes specific training through special and competitive exercises with the aim of improving the physical preparation and the technical and tactical aspects of the athlete (Issurin 2014). The realisation block has a low residual training effect and the objective is for the athlete to achieve their peak during the championship (Issurin 2008). ATR block periodisation is suitable for several sports because the objective is to achieve many peaks during the season (Velásquez 2019).

In the best interest of peak performance at major competitions, these athletes can afford to exhibit subpar performances and even miss competitions that do not fall within the scope of their main goals. By contrast, team sport athletes usually need to perform at a high level week after week if they want to be in contention for the championship at the end of the competitive season (Mujika 2007). Thus, one characteristic which is common to all team sports is that the regular leagues entail competition which takes place over long periods of time. These competitions include at least one competitive match every 7 days, and often two or three competitive matches per week, subjecting the athlete to very high levels of competitive stress for extensive periods of time. This load must be taken as a highly specific load and is considered as such within the planning of the micro-structure (Tarragó et al. 2019). In this context, alternative methods for team sports have been

emerging. Seirul-lo (1987) designed microstructure periodisation for team sport games in order for the player to develop the cognitive aspect. Based on this new paradigm, we are able to interpret the athlete as a hyper-complex structure that is made up of interactions and retroactive actions between the following structures: (i) conditioning structure; (ii) coordination structure; (iii) socio-affective structure; (iv) emotional-volitional structure; (v) creative-expressive structure; (vi) mental structure. Each structure must be considered as the expression of underlying processes. Within this context, Seirul-lo Vargas developed a working methodology known as and recognised by the name of "structured training". This method develops a form of organisation and training called the "structured microcycle", which is the smallest structure in the programming and accepts and considers competition as a load that changes and conditions the different structures in the training period between competitive matches (Tarragó et al. 2019). In the "structured microcycle", ST is considered as a part of coadjuvant training (preventive, recovery, structural, and specific-quality), which comprises all the factors that allow athletes to reach and maintain a state of health that enables them to perform the tasks proposed by optimising training on a daily basis (Gómez et al. 2019).

In a similar way, in 1989 Frade designed "tactical periodisation" with the aim of quickly preparing the football team tactically (Delgado-Bordonau and Méndez Villanueva 2018). Within the tactical periodisation training approach, tactical, technical, physiological and psychological aspects are rarely trained in isolation, which is believed to improve specific motor skill acquisition and accelerate tactical learning (Delgado-Bordonau and Méndez Villanueva 2018). In fact, daily training components are not only structured in relation to technical/tactical objectives, but also to the physical capacities to be targeted ("Physiological dimensions provide the biological framework where the football-specific training/recovery continuum lies") (Delgado-Bordonau and Méndez Villanueva 2018). In practice, when playing once a week, the three main training 'acquisition' days allow the successive development/maintenance of the three main physical capacities, i.e., strength, endurance and speed. Focusing more on a given quality on a given day likely allows the training stimulus to be maximised when the other qualities recover, which may decrease physiological interferences (Delgado-Bordonau and Méndez Villanueva 2018) and, in turn, lead to greater adaptations (Buchheit et al. 2018). This so-called horizontal alternation in the physical components to be prioritised is often achieved while targeting all intra-session training sequences towards the same quality. For example, a 'strength-conditioned session' would include a strength-oriented warm-up (e.g. light plyometric drills and single-leg horizontal hops), locomotor-based strength work (e.g. accelerations, changes of direction and sled pulling) and game-play sequences including, irrespective of the actual technical/tactical requirements, high and qualitative neuromuscular demands (e.g. high number of players/playing area ratio and maximal intensity of actions with adequate rest periods) (Buchheit et al. 2018). Although this model was designed for use in football, it is now used in other team sports.

2.1 The Optimal Dose-Response Relationship for Strength Training in Team Sports

ST has two fundamental aims, which are to optimise performance and reduce the rate of injury. Therefore, in team sports, the capacity to maximise neuromuscular power production is fundamental to success and critical for achieving high levels of performance and greater velocities in sport-specific movements (Cormie et al. 2011). The improvement of high-intensity, explosive actions such as a sprint, change of direction or vertical jump is an important goal for coaches and athletes (Bolger et al. 2015; García-Pinillos et al. 2014). Wisløff (2004) reported that there is a strong correlation between maximal strength, sprinting, and jumping performance in elite football players. Moreover, different authors have shown that when players perform a periodised ST programme, the injury rate is reduced (Hoyo et al. 2015; Askling et al. 2003; Arnason et al. 2007). In this sense, eccentric training for muscle injury prevention has been suggested as a means of decreasing the high prevalence of these injuries (Hoyo et al. 2015; Askling et al. 2003; Arnason et al. 2007) with even more promising results than those observed with concentric training (Mjolsneset al. 2004).

In a meta-analysis, Peterson et al. (Peterson et al. 2004) showed how effect sizes for training frequency (2 and 3 days per week) were similar with no additional benefit to training 3 days per week. Regarding reducing the injury rate, Steib et al. (2017) concluded that ST achieved a reduction in the risk of injury of 42% (and up to 50%) when programmed correctly. For this, it seems that 2–3 sessions per week of about 30 min each are needed, although it is possible to produce similar effects with 10–15 min. It is important to consider the duration of the programme, as it was proven that programmes of more than 6 months in duration were not more beneficial than other shorter ones. What seems clear is that, with less than 30 intervention sessions, the benefits and preventive effects have already been observed (Steib et al. 2017).

In the real-world team sport training environment, there is limited time for ST sessions to take place during the in-season period. The search for time-efficient strategies that concurrently enhance several locomotive-specific actions while preventing injuries is crucial. Furthermore, it is often difficult to develop a science-based ST programme that comprises two or three sessions per week. In this sense, several studies have investigated the effects of frequency of ST and its effects on specific performance (i.e. sprints, jumps, COD, etc.). Hence Peterson et al. (2005) observed that, depending on the training status of the subjects, the best choice in terms of frequency and intensity of training would be three sessions per week for untrained individuals. On the other hand, for recreationally trained nonathletes and athlete populations, maximal strength gains were elicited using two sessions per week (Peterson et al. 2005). In this regard, our group analysed the effects of a combined ST programme (full-back squat, YoYoTM leg curl, plyometrics and sled-towing exercises) on performance among elite young football players when this training programme was performed one or two days per week.

In conclusion, the combined ST programme improved jumping ability, independently of training frequency, though the achievement of two sessions per week also enhanced sprinting abilities (linear and COD) among young football players. In accordance with this, the majority of strength and conditioning coaches in professional leagues typically report to have used ST twice per week in-season (Ebben and Blackard 2001; Ebben et al. 2004; Kraemer 2004). However, the number of sessions in each microcycle could be modified according to the number of competitive games in the period.

2.2 *Strength Training Scheduled During Different Microcycles*

The weekly scheduling of in-season workouts is dictated by the dual need to allow the player to recover from the previous match and avoid excessive residual fatigue at the end of the week in preparation for the next game. Regarding ST scheduled during a typical microcycle consisting of one competitive match, according to the available literature, intense training is not scheduled in the 24–48-h post-match period (Wrigley et al. 2012; Impellizzeri et al. 2004) to facilitate recovery of muscle function and damage. In these microcycles, the greatest volume of on-field training is typically scheduled in the middle of the training week, between 2 and 4 days prior to the match (Malone et al. 2015), with ST programmes most commonly carried out 48–72 h after the match (McCall et al. 2014). Moreover, during congested fixture periods (2 or more matches per week) common to team sports, ST programmes are often sacrificed to prepare for, or compete in, the following match (McCall et al. 2014), for which overtime may result in muscle de-training (Gabbett 2005; Rollo et al. 2014) and render the player more susceptible to injury (Opar et al. 2015). However, Lovell et al. (2018) showed how carrying out eccentric training in the middle of the microcycle (MD+3) increased measures of muscle damage and soreness, which remained elevated on the day prior to the next match (MD+5). Accordingly, the authors indicated that eccentric training should be scheduled early in the microcycle to avoid compromising preparation for the following match. In addition to this, a recent study showed that eccentric exercise of maximal intensity does not per se affect muscle damage biomarkers in an eccentrically accustomed muscle, being evident at the 10th week of training in those training recreationally (Margaritelis et al. 2021). Therefore, muscle damage occurs as a result of the muscles being unaccustomed to responding to a specific muscle contraction pattern, and it is crucial to be adapted to these neuromuscular stimuli.

2.3 The Most Common Strength Training Exercises Used and Optimal Training Load

In team sports it is common to use different ST exercises and loads in accordance with different aims and perspectives. As an example of this, plyometric training is a type of training that involves jumping exercises using the stretch-shortening cycle (Markovic and Mikulic 2010). According to Bedoya et al. (2015), the specific actions performed during plyometric training are similar to team sport demands. Meanwhile, resistance training approaches are based on emphasising the vertical component during the lower body triple extension such as in different squat exercises, due to the fact that these are deemed closer to actions performed at high velocity, such as sprinting and jumping tasks (Kawamori and Haff 2004). Authors have generally tended to use high loads in their studies (70–90% 1 repetition maximum [1RM]) to improve high-intensity actions such as jumping or sprinting (Chelly et al. 2009; Smilios et al. 2013; Styles et al. 2016). In this regard, greater magnitude improvements have been reported in sprinting ability through heavy loads (80% 1RM) in comparison to maximal power output load in the squat jump exercise, though no inter-group differences are presented (Harris et al. 2008). Conversely, other authors have stated that high velocity seems to be crucial to yield positive performance adaptations (McBride et al. 2002). Furthermore, a recent study has shown that a training programme using light loads (40–60% 1RM) at maximal intended velocity may be a preferential stimulus for jumping and sprinting improvements (Hoyo et al. 2016a). Therefore, it seems that the combination of moderate load and maximal intended velocity might also be useful for improving high-intensity actions.

Freitas et al. (2017) published a meta-analysis in which they analysed the short-term adaptations in sprint and vertical jump performance following complex training in team sports. Complex training consists of alternating heavy resistance training exercises with plyometric/power ones, set for set, in the same workout (Freitas et al. 2017). In the aforementioned study, complex training had positive moderate effects on sprint performance and mild effects on vertical jump among team sport athletes. The authors concluded that this training method was a suitable option to include in the season plan. With regards to the intensity of the conditioning activities, intensities below 85% 1RM exhibited greater training effects than maximal loads (>85% 1RM) (Freitas et al. 2017).

On the other hand, resisted sprinting has been implemented as a method for overloading the abilities specific to sprinting acceleration performance (Petrakos et al. 2016). It provides a greater resistance than normal sprint training and may provide a greater stimulus to the working muscles, and optimise training adaptations and crossover to dynamic athletic performance (Hrysomallis 2012). This type of training is commonly used to increase sprinting performance (Spinks et al. 2007). In this regard, the optimal resisted load for sprint training has not been established yet, although it has been suggested that a resistance reducing the athlete's velocity by more than 10% from unloaded sprinting would entail substantial changes in the athlete's sprinting mechanics (Spinks et al. 2007; Lockie et al. 2003).

Until recently, few researchers have exceeded relatively light loading parameters (e.g. approximately ~10% velocity decrement) for fear of creating dissimilar conditions to unresisted sprinting resulting in negative adaptations (e.g. slower running velocity and/or altered running technique) (Spinks et al. 2007; Lockie et al. 2003; Alcaraz et al. 2009). However, there is some preliminary evidence to suggest that training using much heavier loads may be beneficial for accelerative performance (Kawamori et al. 2014). Thus, several studies have proposed that the initial phase of acceleration up to 30 m might be improved using loads ≥20% body mass, while to improve high-speed acceleration phases, loads around 5–12.5% of body mass should be used (Bachero-Mena and González-Badillo 2014; Morin et al. 2017). In this regard, Cross et al. (2018) investigated the effects of resisted sprint training on sprinting performance and underlying mechanical parameters (force-velocity-power profile) based on two different training protocols: (i) loads that represented maximum power output and a 50% decrease in maximum unresisted sprinting velocity and (ii) lighter loads that represented a 10% decrease in maximum unresisted sprinting velocity. Both resisted-sprint training protocols were likely to improve performance after a short training session. However, widely varying individual results indicated that adaptations may be dependent on pre-training force-velocity characteristics (Cross et al. 2018).

As an alternative to these traditional training methods, flywheel inertial devices have appeared increasingly in scientific research and are being incorporated into regular training programmes (Hoyo et al. 2015, 2016a; Tous-Fajardo et al. 2016). The benefits of these devices include both eliciting a greater overall amount of muscle activity than traditional overload exercises (Askling et al. 2003) and a greater eccentric overload (Romero-Rodriguez et al. 2011). Therefore, the introduction of eccentric overload training (EOT) methods, which can overload the eccentric phase, might be appropriate to improve jumping, sprinting and COD abilities in football players as different studies have reported (Hoyo et al. 2015, 2016b). In this sense, several studies have shown that the knee flexors are very likely contributors to sprint acceleration performance, where subjects who produced the greatest amount of horizontal force during sprinting are both able to highly activate their hamstring muscles just before ground contact and present high eccentric hamstring peak torque capability (Edouard et al. 2016). Moreover, it seems that eccentric strengthening exercises for the quadriceps, adductors and hamstrings reduce the thigh muscle strain injury rate in team sports, developing stronger muscles at longer lengths (Hoyo et al. 2015; Askling et al. 2003; Arnason et al. 2007; Brughelli et al. 2010; Núñez et al. 2020).

3 From Practice

In this section, sample microcycles will be provided to illustrate the periodisation strategies proposed for each phase of the training year for a generic team sport, using the example of a football team. The rationale for the approach used for each

of the respective training cycles is outlined below. Specific programme variables, such as the length of each phase and exercise selection, will vary depending on the length of the playing season and demands of the particular sport (Suarez-Arrones et al. 2019).

3.1 Detraining Period (Off-Season)

Normally, the detraining period in football consists of five-six weeks. During the first two weeks, players are asked to completely rest and avoid any kind of physical activity. Thereafter, for the remaining three weeks, players are instructed to perform an individualised training programme that includes high-intensity running interval training (HIT) and strength training, with the training sessions being carried out 4 days per week. Each training session normally consists of a warm-up, ST in the gymnasium (gym), and HIT at the end of the session or at a different time of day. The warm-up involves joint mobility and active stretching exercises. The ST is structured into three different session types, which are core and sensorimotor exercises, functional exercises (involving different joints and planes during specific movements), and more isolated structural strength exercises (three sessions) for the upper and lower body using different equipment (free-weight, instability, and suspension training). An example of a one-week individual training programme is shown in Table 1.

3.2 Retraining Period (Pre-Season)

Usually, in football, the pre-season retraining period lasts six or seven weeks. Our proposal is based on a previous study (Suarez-Arrones et al. 2019) where the players supplemented the football training with an ST programme structured into four different session types, including (i) ST in the gym; (ii) specific ST on the field; (iii) activation training; and (iv) individual training.

ST in the gym is usually organised as circuit training before the football drills are carried out on the field. Players perform one or two laps of a circuit consisting of 10–12 exercises mainly focusing on the lower limbs, combining free weights with non-gravity-dependent flywheel inertial devices and motorised devices, and including some functional exercises for upper-body and core muscles. In addition, complementary ST sessions are prescribed with exercises for upper-body, core, and lumbo-pelvic stability. Strength training sessions in the gym last 30–40 min each, while complementary sessions last 20 min. The main exercises employed in the gym sessions for the lower limbs are as follows: football-specificmovements (side step, cutting, lunge) focusing more on the horizontal force (anterior–posterior/posterior-anterior/lateral and rotational) using Versa Pulley® (VP) (0.19 kg m^2 and 0.26 kg m^2 inertias), several bilateral and unilateral half-squat or lunge exercises

Table 1 An example of a typical training schedule during the off-season (detraining period)

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Warm-up (5 min) Joint mobility and active stretching **Complementary training** Balance + Core + Functional training (Hip focus, 12 exercises (∼20 min): Frontal Bridge TR × 2 × 6 × 6″; side bridge TR × 2 × 6 × 6″ (each side); Bridge 1 leg Fitball 2 × 6 × 6″ (each leg); Russian twists on fitball 2 × 30″; single leg balance (closed eyes) on bosu 2 × 30″; single leg jump on bosu 2 × 30″; band adductor 2 × 10 (each leg); barbell glute bridge 2 × 10; standing adductor on fitball 2 × 10 (each side); push up + side plank 1 leg 2 × 10 (each side); static wall squat 4 × 15″; "the glider" 2 × 10 (each side)	Warm-up (5 min). Joint mobility and active stretching **Complementary training** Balance + Core, 6 exercises (∼10 min): Frontal Bridge TR × 2 × 6 × 6″; sidebridge TR × 2 × 6 × 6″ (each side); Bridge 1 leg Fitball 2 × 6 × 6″ (each leg); Russian twists on fitball 2 × 30″; single leg balance (closed eyes) on bosu 2 × 30″; single leg jump on bosu 2 × 30″	Other sport	Warm-up (5 min). Joint mobility and active stretching **Complementary training** Balance + Core + Hip Muscle, 12 exercises (∼20 min): Frontal Bridge TR × 2 × 6 × 6″;sidebridge TR × 2 × 6 × 6″ (each side); Bridge 1 leg Fitball 2 × 6 × 6″ (each leg); Russian twists on fitball 2 × 30″; single leg balance (closed eyes) on bosu 2 × 30″; single leg jump on bosu 2 × 30″; band adductor 2 × 10 (each leg); barbell glute bridge 2 × 10; standing adductor on fit- ball 2 × 10 (each side); push up + sideplank 1 leg 2 × 10 (each side); static wall squat 4 × 15″; "the glider" 2 × 10 (each side)	Warm-up (5 min). Joint mobility and active stretching **Complementary training** Balance + Core, 6 exercises (∼10 min): Frontal Bridge TR × 2 × 6 × 6″; sidebridge TR × 2 × 6 × 6″ (each side); Bridge 1 leg Fitball 2 × 6 × 6″ (each leg); Russian twists on fitball 2 × 30″; single leg balance (closed eyes) on bosu 2 × 30″; single leg landings on bosu 2 × 30″	Off	Off
	Strength training Upper and Lower body, Circuit training. 3 × 8 exercises (30 min): leg press 8 rep; push up TR × 8 rep; pull TR × 8 rep; single deadlift with dumbbell 6 rep (each leg); standing dumbbell arm swing			**Strength training** Upper and Lower body, Circuit training. 3 × 8 exercises (30 min): half squat 8 rep, bench press 8 rep, seated cable row 8 rep, barbell curl 8 rep, barbell lunge 8 rep (each side), lateral elevation shoulder 8 rep		

(continued)

Table 1 (continued)

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
	30″; high box jump 6 rep; standing dumbbell fly on fitball 8 rep; barbell lunge split jump 6 rep (each leg) **Endurance training** HIT (short intervals). 3 × 6′ [20″ (98 m): 20″ (passive rest)], rest: 3′			(each side), pulley triceps extension 8 rep, high box jump 6 rep		
Endurance training HIT (long intervals). 2 × [3 × 4′ running (800 m)] rest/rep: 2′, rest/set			**Endurance training** HIT (short intervals). 3 × 6′ [10″ (50 m): 10″ (passive rest)], rest/set 4′	**Endurance training** HIT (short intervals). 8 × 30″ running all out straight line, rest: 3′		

using Kbox® (0.10 kg m^2 and 0.05 kg m^2), bilateral and unilateral leg-press and leg-curl using Yo-Yo Technology® (0.11 KG m^2), several exercises focusing on the posterior chain using free weights and inertial devices (i.e. barbell deadlift, barbell hip-thrust, hip-extension or hip-thrust in versa pulley®), anterior cross chain and posterior cross chain using Kine Dimanics®, elastic bands, free weights and/or body weight. The main exercises employed in the gym sessions for upper-body, core, and lumbo-pelvic stability are push-up and pull-up exercises using free weights and Kine Dynamics®, functional bilateral rotational exercises using VP, single leg side, prone and front bridge using Fit ball, cable wood chops using VP and several functional unilateral push and pull exercises using VP + Kine Dynamics®.

Specific ST on the field lasts 20–25 min each session and consists of different combined football drills with goal-shooting (finishing), including high-intensity actions such as plyometric jumps, resisted sprinting, duels, different changes of directions, and high-speed running, among others.

Activation training consists of neuromuscular training exercises in the gym or on the field, as an initial part of the training session and before the specific football drills. Examples of exercises used are those focusing on core, hamstring, groin and abductor muscle activation combined with sensorimotor exercises on stable/unstable surfaces. In addition, some individual activation sessions are also prescribed to some players when the team starts directly on the field ($\sim$10 min). Activation training sessions with the whole group last 20 min each.

Individual training consists of ST sessions in the gym focusing on the player's weak points for injury prevention (i.e. imbalances, posterior chain, groin, abductors, calf, and rectus femoris). The individual training is usually planned after the football training on the field and lasts 10–15 min. An example of the training programme for the team is shown in Tables 2 and 3.

3.3 In-Season Period

There is limited time for ST sessions to take place during the in-season period in a professional context. Therefore, an approach with time-efficient strategies that concurrently enhance several locomotive-specific actions while minimising the risk of injuries is essential. The neuromuscular intervention should be carried out both in the gym and on the field, combining different ST methodologies with football-specific strength-based actions, and this type of training session must be delivered to the whole squad with excellent compliance. The criteria of the designated programmes and contents are selected and timed according to current scientific knowledge and the practical and clinical expertise of the staff members involved (coaches, fitness coaches, physiotherapists and medical doctors).

Our proposal, based on the study of Suarez-Arrones et al. (2021), is an approach where ST is usually structured before the football exercises on the field, although there are also some post-training interventions. Players perform one or two sets

Table 2 An example of a typical training schedule during the pre-season (one friendly game/week)

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
AM	Trip to Training Camp	**Strength training GYM**[2] Individual exercise: individual defensive technique Group Exercise: specific drill pass Group Exercise: game possession 4v4 + 3 jokers	Collective exercise: defensive technique Group Exercise: specific drill pass and finishing Collective exercise: game	Rest	**Strength training GYM**[2] Collective exercise: defensive organisation Group Exercise: offensive evolutions—Collective exercise: game	Group Exercise: generic drill pass Group Exercise: generic rondos	Collective and individual recovery
PM	**Activation**[1] Collective exercise: individual technique—Group Exercise: generic drill pass –Group Exercise: generic rondos –Group Exercise: game possession 4v4 + 3 jokers	Group exercise: individual defensive technique Group Exercise: specific drill pass and finishing Group Exercise: SSGs 6v6 + Gk **Complementary strength training**[3]	Rest	Introduction HIT: medium distance drill Group Exercise: offensive evolutions Collective exercise: conditioned game **Complementary strength training**[3]	Group Exercise: specific drill pass Collective exercise: offensive organisation	**Friendly Game:** (45 min each player)	Rest

[1]1 × 12 exercises: Russian belt deadlift (8 rep.); Russian belt squat + hip-extension (8 rep.); hip-flexion with band (10 rep./leg); lateral band walk (10 rep./leg); side bridge on fitball (6 rep./side); kneeling on fitball (20 s); single-leg prone bridge on fitball (6 rep/leg); single squat on bosu (8 rep./leg); different landings on bosu (6 rep./leg); lateral lunge on whole body vibration (8 rep./leg); 2-way bunkie side bridge (6 × 6 s./side); skater hops (10 rep.). [2]2 × 12 exercises: single lateral squat on kbox (6 rep./leg); single-leg Yo-Yo Leg-curl (6 rep./leg); anterior–posterior side step on VP (6 rep./leg); lateral crossover cutting on VP (6 rep./leg); trunk rotation on VP + Kine (10 rep./side); single-leg leg press Yo-Yo multigym (6 rep./leg); single standing pull + trunk rotation with Kine (10 rep/side); lateral step-up box (8 rep./leg); single-leg dumbbell deadlift hop (8 rep/leg); lateral barbell lunge on whole body vibration (6 rep/leg); downward cable wood chops on VP (8 rep/side); hip-extension on VP (6 rep/leg). [3]2 × 12 exercises: push-up with Kine (12 rep.), pull-up + trunk rotation with Kine (12 rep.), ball pull-over throw (10 rep.), single-arm push + trunk rotation on VP (8 rep./side), single-arm pull on VP (8 rep./side), suspended crunch with Kine (8 rep./side), dumbbell bench press on fitball (12 rep.), cable single-arm row in VP (8 rep./side), seated dumbbell clean on fitball (10 rep.), plank in bench + fitball (20 s.), side plank with fitball (20 s./side), up-down plank (12 rep.)

Table 3 An example of a typical training schedule during the pre-season (two friendly games/week)

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
AM	**Activation GYM**[1] Group Exercise: generic drill pass Collective exercise: offensive organisation + defensive transition Collective exercise: game possession 9v9 + 3 jokers	**Strength training GYM**[2] Individual exercise: individual technique Group Exercise: specific drill pass + HIT short intervals drill with COD Group Exercise: game possession 4v4 + 3 jokers	Group Exercise: specific drill pass and finishing Collective exercise: offensive organisation + defensive transition Collective exercise: game **Complementary strength training GYM**[4]	Rest	Players with more than 45 min played: Recovery (aerobic training, Foam Roller, and contrast therapy) Players with less than 45 min played: Group Exercise: SSGs5v5 + GK + HIT short intervals drill	Rest	Rest
PM	Rest	**Specific strength training Field**[3] Group Exercise: specific drill pass Collective exercise: game possession 8v8 + 3 jokers	Rest	**Friendly Game**	Collective exercise: individual technique Group exercise: generic rondos **Individual training GYM**[5]	**Individual activation** Group Exercise: specific drill pass Group Exercise: game possession 4v4 + 3 jokers **Complementary strength training GYM**	**Friendly Game**

[1]1 × 10 exercises: Russian belt deadlift (8 rep.); Russian belt squat + hip-extension (8 rep.); adductor slides with kine (8 rep./leg); standing abductor with Kine (10 s./leg); specific side plank (kicking a ball) (6 rep./side); single-leg plank (10 s./leg); side plank with kine opening and closing legs (6 rep/leg); single balance exercises on bosu (15 s./leg); different landings on bosu (10 rep./leg); frontal lunge on whole body vibration (8 rep./leg). [2]1 × 12 exercises: single lateral squat on kbox + bosu (6 rep./leg); hip-extension kick in Exentrix (6 rep./leg); postero-anterior side step on VP (6 rep./leg); lateral crossover cutting on VP (6 rep./leg); trunk rotation on VP + Kine (10 rep./side); soccer kick exercise with VP (10 rep./leg); single standing with trunk rotation with Kine (10 rep/side); step-up box with jump (8 rep./leg); single-leg hamstring bridge on box (5 s. isometric +8 rep/leg); lateral barbell lunge on whole body vibration (6 rep/leg); upward cable wood chops on VP (8 rep/side); landings in bosu with elastic band at the waist (6 rep/leg). [3]Drill 1: 4 × (2 jump hurdle drills + receive and passing the ball + 4 change of directions of 90° + receive the ball + dribbling and finishing. Drill 2: 4 × (20 m sled running with Run Rocket + 30 m of running gradually increasing the speed (>25 km/h) + deceleration + receive the ball + dribbling and finishing. Drill 3:4 × (in pairs, jump up and head the ball + 5 m running pushing between them + 1vs1 and finishing). [4]2 × 12 exercises: push-up + trunk rotation with Kine (12 rep.); pull-up with Kine (12 rep.); push-up + side-plank-leg (12 rep.); single-arm push on VP (8 rep./side); single-arm pull + trunk rotation on VP (8 rep./side); bilateral trunk rotational on VP (8 rep./side); bench press (12 rep.); single-arm dumbbell row (8 rep./side); standing dumbbell fly on fitball (12 rep.), pull up (>6 rep.), bar dip (12 rep.), atomic push-up with Kine on bosu (10 rep.). [5]An example of a player: 2 × 6 exercises: hip-extension kick in VP (8 rep/side), single-leg hip thrust with elastic band (8 rep./leg), deadlift (8 rep), walking dumbbell lunge (8 rep.), single-leg Yo-Yo Leg-curl (6 rep./leg), adductor in VP (8 rep./leg)

(based on weekly matches) of a circuit consisting of 10–12 exercises (between 6 and 10 reps per exercise) mainly focusing on the lower limbs in coordination with the subsequent training that will be carried out on the field (specific ST on the field). This is done by either prioritising strength on the first acquisition day (i.e. Wednesday) using small spaces, and endurance and/or speed on the second and third acquisition days (i.e. Thursday and Friday) in larger spaces (Fig. 1).

In addition, complementary ST sessions are scheduled during the season with exercises for upper-body, core, and lumbo-pelvic stability (usually after training); and activation training sessions consisting of neuromuscular training exercises in the gym or on the field, as an initial part of the training session and before the specific football drills. ST sessions in the gym last approximately 30–40 min, while complementary ST sessions and collective activation training sessions last 15–25 min.

Individual training sessions are also scheduled primarily targeting player weak points such as previous injuries. The individual training is mainly organised as secondary prevention for a specific group of players with a theoretically heightened risk of suffering an injury episode and are mostly carried out in the gym. The sessions' criteria and content are selected and organised according to the player's weak points. As an example, the organisation of the different training interventions with a high-risk player (a biceps femoris long head injury in the previous season) during a typical microcycle is shown in Fig. 2.

This individual work is carried out in combination with the collective ST of the whole team (Fig. 3). Additionally, the same player is subjected to (i) individual activation before an on-field training session in large spaces with a high volume of high-speed running (Fig. 4), (ii) individual ST after the on-field training (Fig. 5), and (iii) individual activation before an official game (Fig. 6).

Additionally, the same player is subjected to (i) individual activation before an on-field training session in large spaces with a high volume of high-speed running (Fig. 4), (ii) individual ST after the on-field training (Fig. 5), and (iii) individual activation before an official game (Fig. 6).

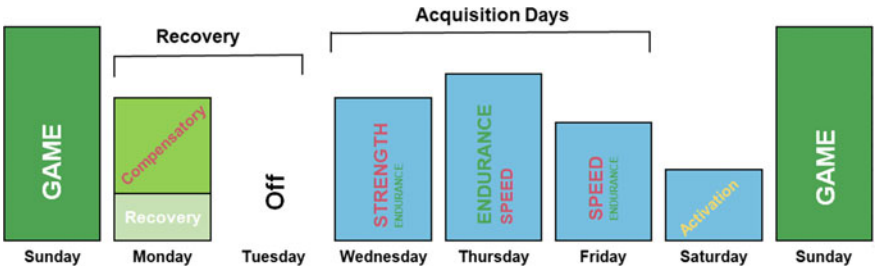

Fig. 1 An example of the organisation of the on-field training contents during a microcycle in football

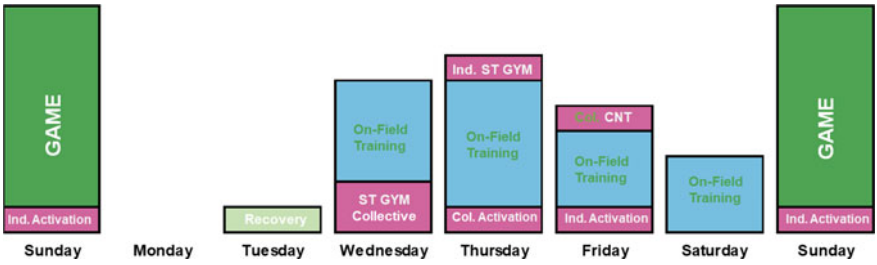

Fig. 2 An example of the organisation of the different training interventions with a high-risk player, who suffered a biceps femoris long head injury in the previous season, during a microcycle in football. *ST* strength training; *Ind* individual; *Col* collective

Fig. 3 An example of collective strength training in the GYM. The training consists of 2 × 10 exercises (between 6 and 10 reps per exercise) mainly focusing on the lower limbs

As reflected in the different images, our proposal combines different sources of external resistance such as free weights and other methodologies with greater eccentric overload such as non-gravity dependent flywheel inertial devices or motorised devices for a stronger eccentric overload. Elastic cords/bands, sliding boards, suspension training, pneumatic cable devices and the player's own body weight are also used. To determine the training intensity (i.e. external load) to be employed during the ST, a velocity-based assessment with incremental loads using free weights and different inertias with flywheel technology and conic pulley should

Fig. 4 An example of different exercises used during individual activation for the posterior chain before on-field training in larger spaces with a high volume of high-speed running

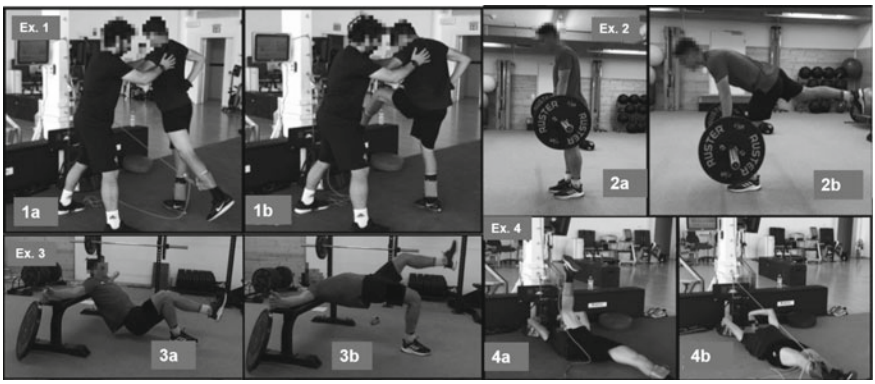

Fig. 5 An example of different exercises used during individual strength training after the on-field training with a player who suffered a biceps femoris long head injury in the previous season

be performed for the most employed exercises. The inertia/load with which the player achieves higher average power is used during the training and individually readjusted every few weeks. For the exercises that employ another source of resistance (e.g. elastic cords, mini-bands and sliding), exercise intensity is regulated subjectively (as usually done by fitness trainers). In addition to overloads related to manipulation of external resistance and speed of execution, overloads in many exercises are also achieved by manipulating motor control/coordination, muscle lengths, and mechanical perturbations. Wide varieties of exercises are employed through the season aimed at providing variability and avoiding stagnation and monotony.

Fig. 6 An example of different exercises used during individual activation before a game

4 Filling Gaps

Team sport athletes need to perform at the highest level week after week if they want to be in contention for the championship at the end of the competitive season. Therefore, there are no unimportant games and there are no performance peaks.

Neuromuscular training in team sports has two main aims, which are to reduce the injury rate and optimise performance. The reality is that there is limited time for ST sessions to be carried out during the in-season period, therefore, time-efficient strategies that concurrently enhance several locomotive- and other high-intensity-specific actions while preventing injuries are crucial.

In the professional field, neuromuscular interventions are commonly carried out both in the gym and on the field combining different ST methodologies with specific strength-based actions, prioritising the greatest volumes of ST in the first acquisition days, several days before competition. A frequently used approach is one where ST is habitually structured before the specific exercises on the field, though there are also different post-training interventions. On these days, the players generally perform ST mainly focusing on the lower limbs in coordination with the subsequent training that will be carried out on the field. In addition to this, individual training sessions are also scheduled primarily targeting player weak points, and complementary ST sessions are planned during the week with exercises for upper-body, core, and lumbo-pelvic stability. As preparation for the joints and muscles for the on-field training, activation sessions are also incorporated combining different neuromuscular exercises in the gym or on the field as an initial part of the subsequent specific training.

5 Take-Home Messages

1. Try to adapt your strength training programme to the field training demands.
2. Time for strength training sessions is reduced in team sports, so try to make your strategies optimise performance and reduce injury risk at the same time.
3. Seek to individualise your strength training strategies as much as possible according to positional profile, imbalances and muscle deficits and history of injuries.
4. If you decide to use strength training programmes with eccentric overload, introduce it progressively so that the athlete can adapt.

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