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SPORT-SPECIFIC PREPARATION FOR TOP PERFORMANCE

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Top performance is a challenge and coaches must accept this challenge by providing the best possible coaching programs for their players. A revolution has taken place In the use of sports science in coaching and todays top coaches have called on experts in sports science and medicine to enhance their player's performance, to reduce the potential of injury and to extend the playing career at peak level. An increase in the amount of research into the physiological an physical demands of different sports, the most efficient training methods and regeneration techniques provides valuable information and coaches can use this information to maximize their coaching programs.

CONDITIONING PROGRAM, RUGBY, BASKETBALL, VOLLEYBALL, PHYSIOLOGICAL AND PHYSICAL DEMANDS, TRAINING METHODS.

Successful performance in international competition requires an effective training program based on the physical and physiological demands of the sport and the capacities of the team or players to respond to those demands (Smith & Thomas, 1991). Different sports and or positions in a sport exert different demands on different parts of the body in different ways (Kibler, 1990:19). Rugby places mainly macrotrauma stresses on certain parts of the body over a relatively short time, while long distance running places microtrauma stresses on the lower extremities over a relative long time (Kibler, 1990:19).

The analysis of the physiologic and physical requirements for both sports, both team and individual, are difficult (Stone & Steingard, 1993:173). Methods to estimate energy cost includes film analysis of intensity, heart rate monitoring and timing of the work-to-rest intervals in competition (Stone & Steingard, 1993:173). The Lexington Clinic Sport Medicine Centre developed a method to characterize sport on the common denominator of all athletic activity, namely the muscle (Kibler, 1990:20). On a macroscopic level the muscle has five identifiable parameters that are basic to all activity, namely flexibility, strength, power, anaerobic endurance and aerobic endurance (Kibler, 1990:20). Other muscle activities such as jumping, throwing and kicking are combinations of these basic parameters (Kibler, 1990:20). Each of these parameters has different importance for performance or injury reduction (Kibler, 1990:20). The Lexington Clinic Sports Medicine Centre also developed a rating scale that ranks a parameter's relative importance to optimum performance or injury reduction (Kibler, 1990:20).

The aim of the study was to use the method and rating scale of the Lexington Clinic Sports Medicine Centre to identify the energy-and physical demands of rugby, basketball and volleyball and to give guidelines for sport-specific conditioning programs.

Performance in rugby is an amalgam of numerous physical parameters such as a particular physique, a certain ration of lean body mass to fat body mass (Bloomfield *et al.*, 1994:64), speed, strength, endurance and flexibility (Golby, 1991:8 & Paish, 1991:11). The game also demands specific physical performance of players occupying different positions (Golby, 1991:10 & Hazeldine & McNab, 1991:11). Although the identified physical parameters stay the same for the positions, their relative importance is different. According to Bauer (1986:28) the most important physical parameter for high level performance in rugby is power.

In a study by Van der Merwe (1989) he determined the work-rest ratio of rugby as 39:61 percent for forwards and 32:68 percent for backs. He also indicated the type of activity as intermittent energy bursts interspersed with active recovery periods. This is an indication that anaerobic energy production is an extremely important aspect of rugby, and that anaerobic power generated over a few seconds, is more important than anaerobic endurance (Telford, 1991:130). Anaerobic power is shorter alactic and or lactic acid-accumulation events and therefore rely on the aerobic energy system to recover (Telford, 1991:131). A better trained aerobic system with a higher anaerobic threshold should enable higher intensity work to performed with less lactic acid production and aerobic endurance training promotes better removal of muscle and blood lactic acid by the aerobic pathways (Telford, 1991:131).

The important parameters for performance in rugby are shown in table 1.1 as well as their relative importance.

Table 1.1 THE IMPORTANT PARAMETERS FOR PERFORMANCE IN RUGBY AND THEIR RATINGS

PARAMETER	NEED	RATINGS
Power	Maximally required for optimum performance	4
Anaerobic power	Maximally required for optimum performance	4
Strength	Maximally required for optimum performance	4
Aerobic endurance	Synergistic for optimum performance	3
Flexibility	Necessary for injury reduction	2

The most important parameters for basketball are anaerobic power, aerobic power, strength upper and lower body power, muscular endurance and flexibility (Stone and Steingard, 1993). In studies by Busko (1989) and Latin *et al.* (1994) they also identified the different demands of the basketball playing positions. Although the identified physical parameters stay the same for the positions, their relative importance is different.

The energy supply for performance skills in basketball is supplied by adenosine triphosphate (ATP) through the stage I (ATP-PC) anaerobic system as well as stage II (AN-LA) anaerobic lactate system (Stone & Steingard, 1993:175). Boatwright and Todd made use of an interval basketball drill with a work-rest ratio of 1:3 to improve basketball player's anaerobic power. The difference between the results of the pre-and post-tests were significant for peak power, mean power and sprint times.

Just a in rugby, the aerobic energy supply system is also called into play in basketball to meet endurance requirements and aid in recovery from the anaerobic efforts (Stone & Steingard, 1993:175).

The importance parameters for performance in basketball are shown in table 1.2 as well as their relative importance.

Table 1.2 THE IMPORTANT PARAMETERS FOR PERFORMANCE IN BASKETBALL AND THEIR RATINGS

PARAMETER	NEED	RATING
Power	Maximally required for optimum performance	4
Anaerobic power	Maximally required for optimum performance	4
Strength	Synergistic for optimum performance	3
Aerobic endurance/power	Synergistic for optimum performance	3
Muscle endurance	Synergistic for optimum performance	3
Flexibility	Necessary for injury reduction	2

According to Blight (1994:37) it is possible for players with low physical performance measures to be as successful in volleyball as players with outstanding physical traits. He identifies vertical jumping ability as an important component in volleyball skills. Jumping ability correlates well to athletic performance in sports that require a considerable amount of jumping (Blight, 1994:37).

Volleyball, according to Viitasalo *et al.* (1987) is an "interval" sport, having high alactic anaerobic power production with fairly long recovery periods. According to Heimer *et al.* (1988) and Smith *et al.* (1992) the most important parameters for volleyball are anaerobic power, aerobic endurance, strength and power. Fry *et al.* (1991) also identified flexibility.

The important parameters for performance in volleyball are shown in table 1.3 as well as their relative importance.

Table 1.3 THE IMPORTANT PARAMETERS FOR PERFORMANCE IN VOLLEYBALL AND THEIR RATINGS

PARAMETER	NEED	RATINGS
Power	Maximally required for optimum performance	4
Anaerobic power	Maximally required for optimum performance	4
Strength	Synergistic for optimum performance	3
Aerobic endurance	Synergistic for optimum performance	3
Flexibility	Necessary for injury reduction	2

Once the above analyses have been carried out, it is possible to devise more specific scientific training and practice sessions for the given sport in general and for specific players (Siff & Verkhoshansky, 1996:425). At this point it is also important to draw up a multifactorial fitness profile of each player to

assess each player's capacities to respond to the demands of the sport (Siff & Verkhoshansky, 1996:425). The multifactorial profile is based upon scientific tests to delineate positive information to increase performance and to decrease injury risk (Kibler; 1990:2).

In the above analyses it was determined that rugby, basketball- and volleyball players must possess anaerobic power. A high level of anaerobic power performance is based on higher anaerobic threshold and on the removal of muscle and blood lactic acid (Telford,1991:131). Both the anaerobic threshold and the removal of muscle and blood lactic acid will improve if the aerobic system is well trained (Telford,1991:131). It is therefore necessary to include aerobic endurance training in the conditioning program of rugby,basketball-and volleyball players. However the aerobic endurance of ball-sports players must not be compared with that of runners and it should not be expected to achieve extremely high standards in long continuous running (Telford, 1991:131)

Practical methods to train aerobic endurance is through long distance-, Fartlek-and interval training (Telford,1991:131). These methods are best introduced in this order (Telford, 1991:131). The longer aerobic work is essential to prepare the body for some more specific work to follow and is useful in the off-season preparation (Telford, 1991:131). However it is important to know that aerobic endurance exercise performed at low intensity for long periods during the same stage as a conditioning program for strength, will affect the development of strength and power (Siff & Verkhoshansky, 1996:52). Fartlek and interval training is useful in the pre- as well as in the in-season (Telford, 1991:131). Interval training is the most important method of endurance training for ball-game players because it can be constructed to meet firstly the requirements of the particular stage of training and secondly the specific requirements of the sport (Telford, 1991:132). The interval training in the in-season must enhance the anaerobic power energy system and will consists of intermittent energy bursts interspersed with active recovery periods. This type of interval training can be implemented in sport specific drills by manipulating the number of players in the drill, the duration of the drill, the intensity of the movement and the area in which the drill is performed (Telford, 1991:132). A small area will provide predominantly alactic short sharp work, while a larger area will provide more aerobic and lactic anaerobic energy production (Telford, 1991:132). Intermittent energy bursts interspersed with active recovery periods can also be implemented in the plyometric training program as well as well as in the sport-specific agility program. The basic anaerobic training intervals for rugby and basketball are shown in table 1.4 and table 1.5.

Table 1.4 ANAEROBIC TRAINING INTERVALS FOR RUGBY

Energy system	Work	% Max	Rest	Repetitions
ATP-PC (i)	8-15 sec	100	12 sec - 2 min	5-20
AN-AL (ii)	30-60 sec	90	4-5 min	5-10
Rugby specific	8-60 sec	Varies	Varies	5-20

Table 1.5 ANAEROBIC TRAINING INTERVALS FOR BASKETBALL

Energy system	Work	% Max	Rest	Repetitions
ATP-PC (i)	5-15 sec	100	15 sec - 2 min	5-20
AN-AL (ii)	30-60 sec	90	4-5 min	5-10
Basketball specific	5-60 sec	Varies	Varies	10-20

The power parameter in rugby is different from the power parameter in basketball and volleyball, because the rugby player has to overcome a higher external resistance in scrums, rucks and tackles and needs strength dominated power (Siff & Verkhoshansky, 1996:129). In contrast, basketball's movement patterns involves intensive and explosive muscular contraction against restricted external resistance and the muscular strength level is reduced (Jarver, 1991:135). In volleyball the resistance that is to overcome involves mainly the player's own body weight (Jarver,1991:135). Rugby players will spend more time on strength development than basketball-or volleyball players.

The simplest way to define power is to look at it as the forces times the distance divided by the time (Jarver, 1991:140). Based on this there are three main possible ways to develop power, namely increase the force (strength) while time and distance remain constant, increase the distance while force and time remain constant and decrease the time (speed of movement) while the force and the distance remain constant (Jarver, 1991:140). The distance over which the force acts in the movement can be looked upon as being part of the skill or technique development, leaving two major components for the development of specific power (Jarver, 1991:141). The development of strength, which could be applicable for rugby and the development of speed to decrease the movement time, which would be applicable for basketball and volleyball (Jarver, 1991:141). This does not mean that the development of strength should be ignored in basketball and volleyball (Jarver,191:141).

Power is also the ability to apply force throughout a full range of body-point movement and the type of activity which enhance this is the Olympic style lifting exercises and plyometric training (Siff & Verkhoshansky, 1996).

The rugby, basketball- and volleyball player will begin with a strength development program in the off-season. Before the player starts his strength program he must first follow an introductory phase for 4-6 weeks with low intensity (60-70% of 10-RM) and high volume work to prepare his body for the high intensity of the power program. Table 1.6 shows the basic guidelines for the development of power.

Table 1.6 THE POWER DEVELOPMENT PROGRAM IN RUGBY, BASKETBALL AND VOLLEYBALL

VARIABLE	OFF-SEASON	PRE-SEASON	IN-SEASON
Objective	Strength development (Longer for rugby)	Strength and Power development (Strength power for rugby and speed power for basket- and volleyball)	Peak athletic power
Load (% of 1-RM)	80-100	80-100	90
Repetitions per set	1-5	1-5	1-3
Sets per exercise	4-7	3-5	2-3
Rest between sets	2-6	2-6	2-6
Duration (sec per set)	5-10	4-8	4-8
Speed per rep (% of max)	60-100	90-100	90-100
Training sessions per week	3-6	3-6	2-3
Type of exercises	Olympic lifts	Olympic lifts and Plyometrics	Olympic lifts and Plyometrics

Flexibility is important for performance in rugby, basketball and volleyball, but it is included as a conditioning component for purpose of preventing injuries. Year-round conditioning programs and periodization are designed to vary the intensity of training (Stone & Steingard, 1993:177). The guidelines for improving flexibility through stretching are not as cyclic or complex (Stone & Steingard, 1993:177).Flexibility and stretching programs can, and should be, followed consistently throughout the year (Stone & Steingard, 1993:177). The most effective stretching routines involve partner-assisted techniques such as proprioceptive neuromuscular facilitation (Stone & Steingard, 1993:177).

In conclusion it must be stressed that training regimes which suit one player do not necessarily suit another (Siff & Verkhoshanky, 1996:18). Each individual displays a different rate, degree ad efficiency of responding to the same type, quality and quantity of training. The power training program should be done with an appropriate expert (Blight, 1994:38).

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