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Speed**

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Speed:
Reaction speed, Speed of movement, Acceleration speed,
Sprinting speed, Speed endurance**

Introduction

Speed is the ability to execute motor actions, under given conditions, in minimum possible time. Speed ability is highly movement specific. Moreover, speed unlike the other two conditional abilities, (strength and endurance) depends much upon the nervous system and as a result is of more complex nature and is comparatively less trainable. Speed performances usually cannot be improved through training by more than 20% (eg. 100 M. Sprint performance (Letzelter, 1979). Speed depends much upon factors which are genetically determined. Hence, the statement, “Sprinters are born and not made.”

Speed is used in sports for such muscle reactions (motor movements) that are characterised by maximally quick alternate of contraction and relaxation of muscles. It is also the ability to execute motor actions, under given conditions, in minimum possible time. The most important forms in which speed appears are: reaction speed, movement speed, acceleration speed, sprinting speed and speed endurance. These different types of speed abilities are relatively independent of each other, i.e., they do not correlate with each other. A sportsman who is having good reaction speed. Speed of each type and of each body region is specific. A sprinter having good leg speed may have poor movement speed of upper extremities. The speed is a highly specific ability, especially in trained sportsman and, therefore, requires specific training for its improvement. All the speed abilities named above, though generally are less trainable, still some of them are better trainable than others.

The definition of speed also does not include reaction ability. The reaction ability is discussed here alone with other speed abilities because from practical point of view, reaction ability training forms a part of speed training. Almost all the sports require fast and explosive movements, therefore, the importance of speed cannot be under-estimated. But in different sports, different speed abilities under different conditions are at premium. A wrestler needs primarily reaction and movement speed abilities, a 400 meters runner needs speed endurance, thrower needs movement speed and 100 m. sprinter needs nearly all types of speed abilities. As a result, in different sports, different speed ability should be improved.

REACTION SPEED

Reaction speed is the ability to react meaningfully to a signal in minimum time possible. In sports, it is not only important to react quickly to a signal but the reaction should also be correct according to the situation. The problem of reacting quickly and meaningfully is of high importance in game and combatative sports. In sprints etc., the reaction ability is to react quickly to a signal. As the response is predetermined, the problem of wrong response does not arise. The reaction time is not equivalent to reaction ability but is only a component of it. The reaction time is the time elapsed between signal and start of the time is the time elapsed between signal and start of the response. The reaction ability in sprints etc. depends much upon reaction time.

Reaction time consists of the following:

- a) Time taken by the signal to reach the receptor organ, i.e., ear, eye, etc.
- b) Time taken by the receptor to generate a nerve impulse.
- c) Time taken by the nerve impulse to reach the central nervous system.
- d) Time taken by the CNS to generate a nerve impulse.
- e) Time taken by the nerve impulse to reach the muscles.
- f) Time taken by the muscles to begin contraction (latent time).

Reaction ability can be divided into various types according to type of signal, e.g., optic, acoustic (sound) and tactile. Reaction on tactile signals is fastest followed by acoustic and optic signals respectively.

The reaction ability is of two types-simple reaction ability and complex reaction ability.

Simple Reaction Ability

It is the ability to react quickly in a predetermined manner to a known signal. Here, the signal and response both are known to the sportsman. Such reactions are common in track & field, swimming, cycling, etc. the sportsman knows, in case of sprint, that he must run all out on hearing the pistol shot. It is interesting to note that females are poorer in reaction ability as compared to men and that the reaction time increases with the increase of distance.

The world class sprinters normally have a reaction time of about 0.12 sec. it has been proved by experiments that a reaction time less than 0.10 seconds is not possible (Schnauber, Singer, 1975). A sprinter giving a reaction time of less than 0.10 seconds obviously has anticipated the gun, i.e., has taken foul start. Reaction time is remarkably stable in case of good sprinters, i.e. a sprinter, most of the time, is able to achieve the reaction time or very near to that. It is also interesting to note that the reaction time of different body parts (e.g., Arms, legs) is different from that of left leg. This fact brings into sharp focus the fact that reaction ability is

highly specific. As a rule, more distal the body part is, more faster it can react. Reaction of arms is faster than legs.

Complex Reaction Ability

It is the ability to react quickly and correctly to unexpected signals, the signals are unexpected as the sportsman does not know when and to which signal he has to react. This is further complicated by the fact that most of the time, the sportsman has to select a response, out of many, to react quickly and correctly. The complex reaction ability is of high importance in combative sports and ball games (Kirchgassner,1981). The complex reaction ability depends to some extent on simple reaction ability. The complex reaction ability depends largely on the two factors:

- a. Ability to anticipate the movement/action of the opponent or ball etc. and
- b. Ability to select a correct response quickly, out of many possible responses.

Improvement of reaction speed

Reaction speed enables a sportsperson to react quickly and effectively to different types of stimuli i.e. visual, auditory and tactile. Research has shown that response to a tactile stimulus is the fastest and to visual stimulus is the slowest.

Games and sports can be categorised as requiring simple reaction ability and complex reaction ability. Simple reaction ability is needed for games and sports where the sportspersons are aware of the stimulus and the response e.g., starts in Track and Field and Swimming. Complex reaction ability is required for games and sports where there is uncertainty about stimulus or response or both. This category includes team games and combat sports.

The following training means can be adopted to improve reaction speed:

- (a) To solve specified simple standard situation in which the attacking and defending reactions are agreed upon between the players. The actions are performed first with low, then with medium and finally with high speed.
- (b) To solve tasks fixed before hand in which the sportsperson concentrates at first on two, then on three, four or more different actions of attack and defence. Speed of action is gradually increased.
- (c) To solve tasks not fixed before hand. The sportsperson is not aware of the attacking and defending actions which will be used. Speed of action is gradually increased.
- (d) To solve situations, the degree of difficulty of which is above the demands of competition (Pressure Training).
- (e) To solve situations in which the pause between announcement and execution is changed. Starts are given by different persons using different starting devices during training.

SPEED OF MOVEMENT

The movement speed is the ability to execute a movement with high speed and can be measured by the time taken to complete the movement. The movement speed depends upon technique, explosive strength, flexibility and coordinative abilities. The movement speed is important in acyclic sports such as wrestling, boxing, throws, jumps, gymnastics and ball

games. The performance in these sports depends on the movement speed, i.e., how fast the sportsman can throw, lift, jump, dodge, shoot etc. In cyclic sports also, the speed of certain movement phases like starts, turns etc. depend much upon the movement speed.

In combative sports, gymnastics and ball games, movement speed and agility are very intimately inter-related and cannot be separated from each other. The speed with which a closely guarded football forward can shoot into the goal, depends much upon his anticipation, orientation ability, coupling ability, experience, skill and tactical efficiency, as well as on his speed of movement. Similar examples can be cited from wrestling, boxing, basketball, volleyball etc. All this points out the fact that movement speed in such sports does not appear as an isolated factor, but in unique combination with other factors. Hence, movement speed in each sport is a highly specific ability and should be accordingly improved.

Improvement of Speed of movement

The speed of movement is important both for cyclic and acyclic sports. Good technique, explosive strength, flexibility and coordinative abilities are important pre-requisites for movement speed and hence can be indirectly developed by improving these four factors.

The following direct training means can be adopted for improving speed of movement:

- a) Repeating movement several times at highest possible speed. In order to make this training mean effective, feed back approach is effective. The total time of the movement is recorded and the sportsperson is informed after each repetition.
- b) Practising movements with implements which are slightly lighter and also smaller in size. A shot putter may use 6.5 to 6.75 kg. shot for practising movement. A rower may use the oars with slightly smaller blades.
- c) Providing easier conditions for practising movement. This can be achieved by changing the direction of throw to reduce air resistance, changing ground conditions, using gravitational force (down hill running).
- d) Performing movements using faster rhythm. The movement rhythm can be made faster by using different devices e.g., clap, drum beat, music etc. the rhythm should be increased ensuring that the movement is properly performed and it should correspond to the actual rhythm of the sports movement.

ACCELERATION SPEED

The acceleration ability is the ability to achieve high locomotor speed from a state of stationary position or low speed state in short time. Henry (1952) proved by his research, that the sprinters achieve their maximum speed, irrespective of the type of start they use, after approximately 6 seconds. Thus, a sprinter who achieves a higher speed after 6 seconds, is having better acceleration ability. The acceleration ability is a deciding factor in short sprints (e.g. 100m.). The acceleration ability depends largely upon explosive strength, technique and flexibility. Acceleration ability is important in all sports in which high speeds have to be achieved in a shorter time, e.g. sprints in track & field, swimming (short distance), hockey, football, waterpolo etc. It is also important in sports, in which approach runs with high speed are important, e.g., jumps, gymnastics etc.

Improvement of Acceleration Speed

Acceleration speed can be increased by both direct and indirect methods. For improving acceleration ability indirectly, explosive strength, technique and flexibility are important prerequisites.

Intensity- Maximum or near maximum.

Distance- The distance should be optimum, i.e., it should be long enough to enable the sportsman to accelerate to his maximum speed. The distances will differ in running, swimming, cycling, rowing etc. for running, the distance should be from 20m.-60m. The distances for world class sprinters should be longer as compared to beginners, children and sprinters of lower qualification. In sports like basketball and handball also, the distance should be shorter, e.g., 20-30m., because in these sports the sportsman rarely accelerate for distances longer than these. In hockey and football, distances of 40-50m. are more suitable.

Repetitions- The number of repetitions will depend upon the training state of the sportsman. Generally, 10-20 repetitions should be done, which should be arranged in series of 3-4 repetitions.

Recovery- The training for the improvement of all types of speed abilities is done according to the repetition method. Hence, complete recovery is necessary in between the repetitions. But as the distances for the improvement of acceleration ability are shorter, longer recovery in between the repetitions is not required. Longer recovery periods (4-10minutes) should be given in between the series. The recovery pause in between the series should be of active nature because the passive rest leads to lowering of the excitability of the nervous system which is indispensable for the optimum effect of speed training. If the recovery period is very long in case of longer distances being used, it is necessary to go for a short warm up, before starting the next series of repetitions.

The speed training should be stopped when fatigue sets in, because then speed cannot be improved. The improvement of acceleration ability can be made specific (in case of basketball, hockey, football, etc.) if the sportsman does the repetitions with the specific equivalent, e.g., with football, hockey and ball etc. the acceleration ability should be improved under specific sports conditions after it has been improved by general means.

SPRINTING SPEED

It is the ability to maintain the maximum locomotor speed for a long time. Gundlach (1963) states that the phase of maximum speed in sprinting is the distance over which the maximum speed in sprinting is the distance over which the maximum speed or a speed not less than 99% of maximum can be maintained. He has stated so because during the phase of maintenance of maximum speed, there are always minute fluctuations in the speed. The locomotor ability is most important in those disciplines where maximum or near maximum speed is achieved and is to be maintained for as long as possible, i.e, in 100m. and 200m. sprint in track & field. In 400m. running, swimming, hockey, football, etc., the locomotor ability depends largely upon the mobility of the nervous system, relaxation ability during running at maximum speed, explosive strength, technique, flexibility and bio-chemical reserves etc. the first two factors seem to be the limiting factors for the improvement of locomotor ability.

Improvement of sprinting speed (locomotor speed)

It is the ability to maintain high intensity over maximum duration possible. The research findings as well as top coaches have opined that intensity of 99% to 100% can be maintained only over a distance of 20-45 metres. However, this distance varies depending upon the training state and age of the sportsperson. In the case of a beginner or a less conditioned sportsperson this distance is less. Indirect development of locomotor speed can be achieved by improving the efficiency of the central nervous system even though it is less trainable. Explosive strength, technique and flexibility, which are trainable factors also improve sprinting speed indirectly.

Sprinting speed can be developed directly using the following training means:

(a) Acceleration Runs

Acceleration runs are performed over a distance of 80 metres ensuring that in each repetition effort is made to reach the limit of maximum intensity (99-100%). Between two repetitions full recovery is to be ensured. Total number of repetitions are between 5 to 8. Bouts of loads should be discontinued when the time of sprint starts decreasing i.e. one is unable to maintain high intensity (90%-100%).

(b) Ins and Outs

It is an effective method of developing sprinting speed. A distance between 120 metres to 250 metres is chosen and divided into four to five zones of 30 to 50 metres. If one decides to have four zones of 30 metres each, the total distance required is 120 metres and for five zones of 50 metres each, the total distance needed will be 250 metres.

The pattern of running different zones is done as follows:

Planning for four zones

Zone I- Zone of acceleration

Zone II- Zone of sub-maximum to maximum intensity

Zone-III- Running without applying additional force

Zone-IV- Zone of sub-maximum to maximum intensity,

Planning for fives zones

Zone I- Zone of acceleration

Zone II- Running without applying additional force

Zone III- Zone of sub-maximum to maximum intensity

Zone IV- Running without applying additional force

Zone V- Zone of sub-maximum to maximum intensity

This training means can be effectively planned on the track or on any open area or a play field. 3 to 5 repetitions are performed and between two repetitions full recovery is provided.

Differential Races

To use this training means to the best advantage, a distance between 150 to 200 metres is used and divided into two zones of equal distance. To plan intensity of running, the best time of the total distance chosen is recorded. The total time of the distance is assigned to two different zones in such a way that the first zone run faster than the second zone, and the difference in the timing of the two zones is not more than one second.

If one decides to choose a distance of 200 metres, it is divided into two zones of 100 metres each. Suppose the timing of running 200 metres is 25.0 seconds., it is divided in a way that first zone is run in 12.0 seconds and the second zone in 13..0 seconds.

Differential races can be systematically planned on the track or an open area or a play field. 3 to 5 repetitions are performed and between two repetitions full recovery is provided.

SPEED ENDURANCE

Speed endurance is the ability to execute cyclic or acyclic movements at high speed under conditions of fatigue. In locomotor movements, it denotes the ability to maintain high speed for a long time. In combative sports, ball games, throws, etc., it denotes the ability to repeat movements/ actions at high speed under conditions of fatigue. Speed endurance largely depends on anaerobic capacity. Harre (1979) limits speed endurance performance upto 45 seconds. In track & field, usually speed endurance is differentiated from sprint endurance (Bauerfeld and Schroter, 1979). Sprint endurance is the ability to maintain near maximum speed for about 20 seconds (e.g. in 100 and 200m.) and speed endurance is the ability to maintain high speed for about 45 seconds (e.g. 400 meters). Sprint endurance is largely a product of alactacid mechanism of energy production whereas speed endurance is largely the product of lactacid or glycolytic mechanism.

Speed endurance is a very complex ability depending upon explosive strength, speed and endurance. It further depends upon the capacity and ability of the nervous system (especially in case of locomotor movements) to maintain rapid contraction and relaxation of the muscles, over a long time. The speed endurance also depends upon technique, local muscle endurance and lactic acid tolerance ability (e.g. in 400m. sprint). As pointed out earlier, it appears in different forms in different sports, hence, speed endurance training should also be different.

Improvement of speed endurance

Speed endurance is a special quality and can be developed using both indirect and direct training means. Indirect development can be ensured by improving anaerobic capacity, technique and explosive strength. Optimal development of basic endurance is an important pre-requisite for improving speed endurance.

Speed endurance can be improved directly using the following training means:

- a) Pace Races
- b) Repeated High intensity Runs

Pace Races

This is an effective means for improving speed endurance. Distances between 120 to 600 metres are repeated at high speed, a speed which can be kept constant throughout the distance. The actual distance and number of repetitions will depend upon the game or the sport and also the training state of the sportsperson. Complete recovery is to be ensured between two repetitions, it is advisable to run them I two series of 2 to 4 repetitions. Between two series a short warming up session is recommended.

Repeated High intensity Runs

This method is recommended for developing speed endurance for team games, racket sports and combat sports. Bouts of load over a distance of 40 to 60 metres are performed. Between two bouts of load the recovery period is short (about 20 to 30 seconds) and the rest period between two series is 3 to 5 minutes.

It is also possible to develop circuit of four to eight exercises (stations) which are done at high speed. This method is highly effective in developing speed endurance for combat sports namely wrestling, judo, boxing etc.

The speed endurance of a 400 metres runner depends to a large extent upon the lactic acid tolerance ability which can be improved significantly. Repetitions of 300-400 m. at maximum intensity, improve the power of the glycolytic mechanism as well as lactic acid.

CONCLUSION:

Speed is the ability to execute motor actions, under given conditions, in minimum possible time. Speed ability is highly movement specific. Moreover, speed unlike the other two conditional abilities, (strength and endurance) depends much upon the nervous system and as a result is of more complex nature and is comparatively less trainable. Speed is used in sports for such muscle reactions (motor movements) that are characterised by maximally quick alternate of contraction and relaxation of muscles.

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