THE FUNDAMENTAL MECHANISMS AT THE LEVEL OF THE BODY MUSCLES NECESSARY IN SUSTAINING AND AMPLIFYING THE EFFORT IN MODERN TENNIS

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Abstract

Modern tennis practiced at the high-performance level implies an extremely complex, dynamic, high intensity physical activity in extremely short time units – from 3 to 18-24 seconds – for physical and mental recovery.

The specific positions of the player in the field, the forms of movement, the distances, the difficulty of their achievement, to which are added the preparation processes and the techniques of hitting the tennis ball, give the measure of higher physical and mental demands.

The present scientific work has an essay character based on an extensive study and observations, personal experience, specialized publications, all meaning a proof of the scientific knowledge of the field. It deals extensively with the fundamental mechanisms of muscular-ligamentous effort, on the three areas of the body: upper limbs, lower limbs and upper body.

The rotations of the upper body are very rarely performed on the vertical axis of the body, generally they are most often done outside or as a fixed point on one side of the body (for example, on the right-hand players, the movement for forehand is made on the imaginary area of the left shoulder.

The scapular belt, which connects the upper body to the upper limbs, contains many groups of muscles that play an important role in the dynamics of tennis hits, contributing substantially to the complexity and amplitude of the arm, decisive in the technique of tennis.

The muscles of the lower limbs make a solid connection with the upper body and are present in the movement and control of the center of gravity of the body.

Those three fundamental mechanisms at the level of the muscles are strengthened both on the ventral and dorsal sides of the body, constituting a muscular braid that ensures the complexity of the specific tennis movements: defeat, release, impulse, extension and flexion.

The graphic illustrations of the technics to which the tennis player is the subject, belong to us. This over 28 technical moments presented offers the chance to rethink the problem of training the tennis player, from a physical, technical and tactical point of view, at a higher level.

Keywords: *Technical mechanisms, groups of tennis ball hits, muscle groups, structural and functional changes, force-velocity vectors.*

Introduction

The idea of presenting and defining the "special techniques" of hitting the ball in extreme situations of the adversity of the game tactics, was made in order to identify, select and illustrate their graphics, which incorporates muscular mechanisms of the body at the upper level.

The hypothesis of this paper starts from the specifics and content of the game at a high-performance level, developed on fast and quite hard game surfaces, to which is added the increase of adversity in game tactics, through large openings of angles of attack, doubled by speed, ball circulation. In this context, the coach-tennis couple is urgently required to strengthen and maintain at a higher level of training the body segments that support hitting the ball, in order to avoid unwanted injuries.

The frequency and the area of placement of the ball on the entire geometry of the playing space, makes the opponent's reaction time limited for an effective counter-offensive, he resorting to difficult techniques.

According to D.D. Donskoi (1959), the general purpose of biomechanics is to study the laws and conditions in which driving forces cause a useful working effect in the body. Knowing the laws of motion one can predict their outcome under different conditions, one can thus emphasize what is the cause of mistakes made in different movements, one can correctly assess the effectiveness of movements, one can find ways and means to improve them and ultimately, they can create movements that correspond to the highest degree to specific motor requirements.

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The mechanisms of muscular effort in tennis

In the current game of tennis, each technical game procedure, either hitting the ball from the side or from above, involves in the course of the game a series of structural changes, larger or smaller, as well as the participation percentages of the fundamental mechanisms of the groups muscle on the component moments of each technical procedure.

The composition of the ground surfaces, the quality of the ball, the force of hitting the opponent, the weather conditions, the physical and mental fatigue, can influence some moments of the technique as well as the participation percentages of the body muscles.

The always different areas of return of the ball, the motor qualities involved, the position of the body, respectively the general center of gravity of the body, hitting the ball on the spot or on the move, taking the risk, lead to high-risk techniques.

All the specific movements in tennis are combined and diversified, from one phase to another, resulting in the localization of physical effort in a winning vector.

The paper deals extensively with the mechanisms of muscular effort, on the three areas of the body:

a) the fundamental mechanisms at the level of the trunk,

b) the fundamental mechanisms at the level of the upper limbs,

c) the fundamental mechanisms at the level of the lower limbs.

At the level of the three fundamental mechanisms, the muscles work both on the ventral and on the dorsal side of the body, constituting muscular braids that ensure the complexity of the movements required by the specificity of the game's technicality.

The range of body movements in the game actions is very varied: impulse movements, yielding, flexion, extension, bending, bending, etc. and all these movements provide plans to hit the ball with the racket throughout the playing space

The content of the paper is richly illustrated with images, which compose moments and plans of impact in extreme situations, which results in the charm and beauty of the game of tennis.

The suggestive graphics that present extreme situations of hitting the ball in tennis represent our contribution.

Tennis is one of the sports that involves an extremely complex, dynamic and high-intensity physical activity in short units of time, from 3 seconds to 18-30 seconds, followed by breaks of 20 seconds between game points and 90 seconds, seconds between odd games (after every 2 balls).

The tennis player must move very quickly on the field of play to be at the right time to hit the ball.

The various positions and forms of movement, the distances and the difficulty of achieving the point in the game, in conditions of increased adversity of the game, give the measure of the physical and mental demands to which the tennis player is subjected.

a) Mechanisms at the level of the trunk muscle

In tennis, the spine and torso play a key role in supporting the playing technique. We have also stated in our other publications (Moise G.D, (2002) - *Theory of Modern Tennis*) that the trunk itself retains the fundamental role in current tennis technique, which is required for efforts of: compression, traction, twisting, lateral tilt and of course flexion and extension, as essential attributes in supporting modern game techniques.

The location of the movements at the level of the trunk (located at the spine), is different depending on the regions of the spine, which are conditioned by the planes of the surfaces of the intervertebral joints and the spinous processes, etc.

The trunk muscles are formed by groups and kinematic chains that ensure the posture and the complex functions of the trunk, in the demands of the game technique.

The arrangement of the muscle groups, which in turn form the kinematic chains, which intersect both the ventral face and the dorsal face of the body, constituting large muscle braids or muscular arches that ensure the planes of movement at the trunk: for flexion, extension, twisting left and right and lateral inclinations.

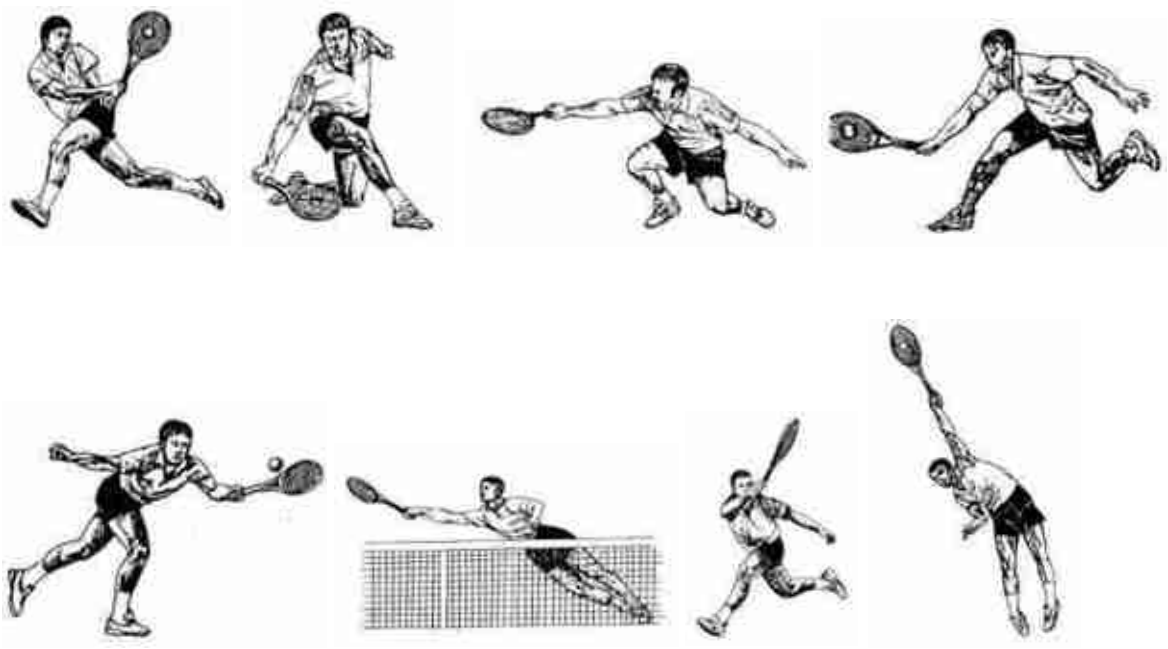

Fig. 1 Positions, forms of movement in the field and diversified plans for hitting the ball (Moise, G.D., (2011). *Physical training, the modernization factor of performance tennis)*

These data are particularly suggestive for the fundamental role of the torso in the technique of modern tennis, giving us the scientific opportunity to reflect and act in the process of physical training to avoid trauma, providing conclusive data that lead to strengthening, mainly muscles. trunk, being considered by us the "pivot of body movements" that ensures the motor and safety of hitting the ball in tennis.

As a specific characteristic of the movements at the level of the trunk consists in the combination of the dynamic actions with the static ones or even with the yielding movements. All these components of the movements at the level of the trunk are mainly due to the technicality of the tension, which manages to interrupt the muscular tensions at the level of the trunk, which are automatically transmitted to the upper segments, but which must transform the braking forces into driving forces, important in the dynamic structure of specific movements.

b) Mechanisms at the level of the muscles of the upper limbs

The scapular girder joins the upper limbs with the torso, has many muscle groups, creates a support for the upper limbs, has a large number of movements and degrees of freedom, and has an increased range of motion in its joints.

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The role and functions of these groups of muscles and kinematic chains around the scapular belt, represent, for the dynamics of tennis blows, together with the trunk muscles, everything that means handling the racket in different planes and of course the most important aspect is its impact on the ball.

The sliding of the shoulder blade on the thoracic cage ensures the dynamics of movements at the level of the scapular belt, and the degrees of freedom at the level of the shoulder, ensure the infinite possibilities of movement of the upper limbs.

The muscles of the shoulder joint, such as the deltoid, pectoralis major, large round and dorsal spine, attach to the humerus bone, contributing substantially to the complexity and amplitude of the arm, which plays a crucial role in the technique of tennis.

The movements specific to the tennis game technique are made in proportion of 100% with the help of the movements at the elbow joint, which have the role of increasing the speed of hitting the ball, the "whipping" performed on the forearm with the game racket, and the fineness, direction and the force of hitting the ball, is realized at the level of the forearm and respectively in the elbow joint, imperiously at the level of the hand which is the fundamental mechanism of directing the technical actions of the game.

The general and selective processing of the muscles of the upper limbs is a necessity of great importance in the practice of modern tennis, from children to great performance. The specialized means, the exercise regime for the physical training, cumulated with the technical ones, can give the measure of the importance and the necessity of the physical training at the level of the upper limbs, where the effort of hitting the ball reached the high-performance values, balls starting from 90-140 km / h when hitting the ball from the side and at work with 130-240 km / h.

Dynamic and static forces combine and diversify permanently, from one group of muscles to another, due to the fact that in ball-free play, the effort is generally made by the muscles of the lower train, and the upper limbs perform a series of preparatory movements for a new blow, respectively another technical procedure.

Upper limbs play a special in the infinite possibilities of movement and increased efficiency when hitting the ball, an aspect that refers to the mutual arrangement of the axes of the bones and the axes of the joints. As a result of the structures of the bones of the upper limbs, the movements of the arm and forearm can occur in different planes, which are also under the influence of other muscles. When the upper limbs are required to hit the ball from the side and from the top, there are easy conditions for complex ball action movements. At the level of the upper limbs there are four more basic movements such as: abduction and adduction, as well as those of pronation and supination. In these cases, the muscles interested in hitting the ball are found in the deltoid, pectoral and trapezius.

The muscular effort in the case of technical procedures for hitting the ball with the tennis racket is very high, because in an official game of 5 sets, the tennis player performs over 2,000 actions on the ball, which requires a very good knowledge of the structure of motor acts and of the means of local strengthening of the muscles.

c) Mechanisms at the level of the lower limb muscles

Data from the literature describe the following joints in the lower limbs: 3 hip joints, 2 knee joints and 2 ankle joints. The amplitude of movements in the lower limbs is lower than in the upper limbs, which limits the movements in this segment.

The movements at the knee joint are reduced to flexion and extension and to those of deportation and supination, performed in the position with the knee flexed.

The knee joint is strengthened by the lateral and crossed ligaments, and the special movements of the meniscus ensure the ease of movements in this segment.

In the game of tennis, the knee joint plays a fundamental role in specific motor skills (always different positions, starting, launching and stopping shapes), to which is added the complexity of the requirements for specific technicality.

At the level of the foot there are very strong and sudden movements and demands, which in turn are ensured by the large number of joints, ligaments and muscles with a very diverse functionality, where the main flexion and extension movements ensure the body's momentum and stability, the numerous actions of the game technique.

Among the basic functions of the lower limbs, the following stand out according to the data of anatomy science: support organ, impulse, damping and which in turn in the technique of tennis play takes place in complex forms of positions and movements on the playing field.

The movements that take place at the level of the joints of the lower limbs are based on the pushing function, which is performed starting with the extension of the coxo-femoral joint, the knee and the flexion at the ankle joint. This particularly complex mechanism, present in all the actions of playing tennis, must be very well known and developed at the highest level.

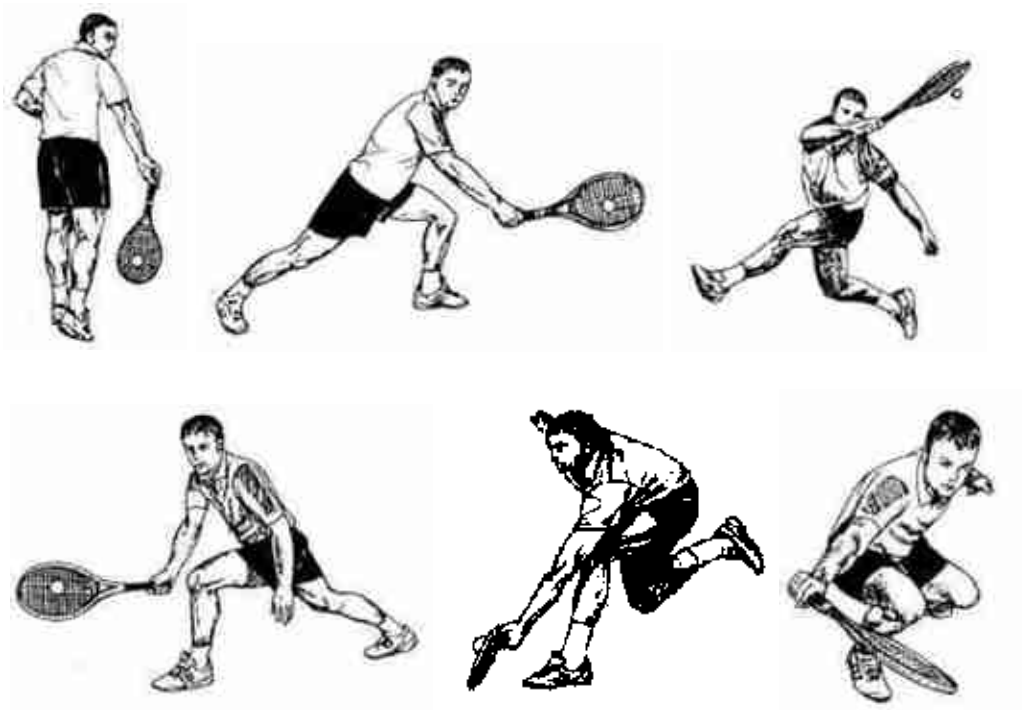

Fig. 2 Superior technique involves permanent control of the balance of the body, the general center of gravity of the body, as well as the correct handling of the tennis racket (Moise, G.D., (2011). *Physical training the modernization factor of performance tennis)*

The motor mechanisms at the level of the lower limbs are detached by a great complexity, in the sense of the specific demands of the game technique, of the long effort to which the tennis player is subjected in official training and games, on an official game, of about 4-8 km. active actions on the ball in the playing space, on a variety of acyclic displacements sprinkled with sudden efforts, starts and braking followed by breaks lasting 20 sec or 90 sec.

The alternation of muscle tension and relaxation in rhythmic work with a specific character is an integral part of the stability and longevity of muscle work, to which are added the conditions of blood circulation and pulmonary ventilation.

Knowingly alternating the static effort with the dynamic one, at the same segment (or alternating segments,) is a fundamental methodical rule for increasing general and mental motor skills.

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Achieving notable performance in the game of tennis at the highest level depends on the correct knowledge and use of a series of decision factors that multiply and amplify the performance in tennis, among which we mention:

- the degree of improvement and efficiency of all technical procedures and related variants;
- the level of functional and psycho-motor abilities of the athlete;
- higher degree of athletic training;
- the degree of improvement of the internal factors (special physiological states) and of the external ones - the volume and complexity of the training and game effort;
- the superior quality of applying the permanently offensive tactic;
- adaptability to highly diversified official training and game conditions;
- combining automatically and efficiently between dynamic, static and yielding efforts, with maintaining and amplifying the dynamic stereotype always to be perfected, etc.

Knowing the directions of action of the body segments and the basic muscles that ensure specific movements, is in our opinion a first step in the correct development of general and specific motor qualities to ensure a motor background where to develop in addition to a series of specific automatisms. and combined motor skills, with very well-defined effort regimes. In this way, technicians have multiple possibilities to easily notice the weak and very good parts regarding the development of specific motor qualities and to avoid in the process of physical training errors regarding the use of non-specialized exercises, without purpose, and ultimately to measure on specified stages, the effects of physical training on the basic segments of the body.

The muscles of the upper limbs are capable and provide humans with the most precise and complex movements that have been perfected in the process of life.

The movements of hitting the ball include a complex of movements, which in turn require joints, muscle groups, tendons and ligaments.

Conclusions

In the dynamics of the tennis game technique, in conditions of increased adversity they can lead to very varied and changing technical procedures (technical nuances), because they are conditioned by the variable factors of the game.

The problem of identifying and graphically illustrating the technical variants of the game was a challenge professionally and decisively.

As a result of the multitude of technical procedures subjected to extreme muscular demands, there is a need for the entire range of offensive and counter-offensive technical-tactical actions to be the subject of specialized training.

An element of methodical topicality in the context of the musculoskeletal and articular efforts that take place in the tennis player's body refers to the need to control the forms of tension and relaxation of the muscles, respectively the "game of muscle antagonisms",

Ignorance, neglect or superficial treatment of special techniques can lead to counter-performance, cracking;

Superior athletic training and a modern playing technique can be successful performance variants.

The correlation of the structures of the game technique, the exceptional physical training focused on muscle groups and chains is the keystone of success and performance in today's tennis.

The timely identification of the technical and psycho-motor mechanisms of performance in tennis is the scientific imperative of the technical activity in tennis.

The specifics and content of the game of tennis, as well as the training carried out by players on increasingly fast and quite hard playing surfaces, have led to increased demand for segments, joints, ligaments and body muscles, which has led to the need for special attention. from technicians and tennis players to prevent

unwanted accidents and to strengthen and maintain at a higher level the preparation of segments and muscles of prime importance for moving on the field (lower limbs) and hitting the ball (upper limbs).

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