

WSF Development & Coaching Conference 2014



Biomechanics and Prevention of injuries



Biomechanics and Prevention of injuries

**“ WHEN TRAINING, ANYTHING CAN BE
DONE, EXCEPT FROM PAYING THE
CONSEQUENCES.”**

Biomechanics and Prevention of injuries

Biomechanics is the science that allows us to perceive the mechanical movement of the body and the dynamic way in it.

Biomechanics contributes a different way of analysis and understanding of the movements an athlete does, how they use the physical laws, and how they affect positively or not the hit, and above all, this science leads us in search of efficiency and the constant efficiency of movement

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It helps us to:

- * identify what the optimal technique is;
- * better the diagnosis and corrections of the technique and movements;
- * understand how power is generated, and control the hits and movements;
- * increase the knowledge of the features of modern squash;
- * bring and use what has been analysed from the scientific area to the courts and training, with concrete methodology and didactics where the player can really feel and in a practical way correct and optimize their performance (Tai Chi Squash)

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BIOMECHANICS- TECHNIQUE- STYLE

BIOMECHANICS- Laws and principles CTB

TECHNIQUE- Basic technical concepts/ Complete Swing

STYLE – Practical application with individual expression

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TECHNIQUE:

That technique that allows a more efficient combination of power and control both in the technique of knocking and movement, and at the same time reducing to a minimum the risk of injuries.

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Elements of the technique:

Efficiency- Economy: less energy waste
Efficiency- Result: winning shot
Security- Injury free

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Beneficts of the technique:

Power- Control- Health

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BALL CONTROL

- Where?
- How?
- Why?
- When?

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B.T.C.: Basic Technical Concepts

- **Body position**
 - **Impact points: height of the ball bounce at the moment of the impact and the relationship of the impact with the fore leg line.**
- **Balance and equilibrium**
- **Grip: hand and wrist**

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COMPLETE SWING

Movement of the whole body at the time of the hit

- **Head**
- **Trunk**
- **Striking arm, and non striking arm**
- **Fore leg and back leg**

BIOMECHANIC

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STYLE:

It is the personal representation of a technique. It should be allowed as long as it does not produce injuries or a clear efficiency decrease in the play.

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BIOMECHANIC PRINCIPLES

1. BALANCE (equilibration): when the results of all the forces that perform in the body equal zero. There is balance in repose, in movement and in the air

STABILITY: depends on the surface of the support base, the height of gravity centre, the distance between the gravity centre and the level that has to be exceeded to break stability and weight.

Balance: the ability to keep equilibrium either in a static or a dynamic way.

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BIOMECHANIC PRINCIPLES

2- INERTIA: 1st Newton law: it is the opposition of a body to alter its movement. From Latin: sloth, laziness

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BIOMECHANIC PRINCIPLES

3. LAW OF ACTION AND REACTION: the generation of strength should be done upwards, from the bigger muscles to the smaller ones, in a synchronized way through the kinetic chain. In squash this is a double work since it is necessary to strike and uphold downwards at the same time after breaking inertia and the starting force.

“Each action is responded by a similar opposite reaction.”

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BIOMECHANIC PRINCIPLES

4. LINEAL AND ANGULAR MOTION: lineal motion is the movement that is done in a straight line, and consists of the transfer of weight.

5. STRETCHY ENERGY: the energy stored in the muscle, produced by the stretching that is made in the preparation for the hit phase. The muscle acts in an elastic way that stretches storing energy and releasing it in the impact

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BIOMECHANIC PRINCIPLES

6. KINETIC CHAIN: each segment of the body is an important component in the success of the production of a stroke, from the ground to the wrist, going through the ankles, knees, legs, hip, trunk, shoulder, forearm, and wrist.

The generation of the hit is produced by the addition of actively coordinated segments that transfer the power generated from the ground into each segment, ending up in the final acceleration of the racket onto the ball.

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BIOMECHANIC PRINCIPLES

7. ACCELERATION LAW: Apply power to the hit is not the same as acceleration, which is the variation of speed of the body. The power is and it is in the origin of acceleration (power is related to weight, not only of the individual but also of the element and its shape)

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BIOMECHANIC PRINCIPLES

8. FRICTION: It allows us to jump, run, turn round, throw, i.e. actions that depend in part on horizontal impulses against the ground (action and reaction) that give rise to actions of the same intensity but in the opposite direction.

It is produced by the contact of the foot with the ground or court floor , and it develops a transmission from the ground to the segments of the kinetic chain.

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BIOMECHANIC PRINCIPLES

9. LEVERS: The motor system is formed by bones, joints, muscles and nerves. This system produces its movements through the muscular forces that are applied by a levers system, fundamental to do the sports movements.

“All that is lost in power is won in distance”

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BIOMECHANIC PRINCIPLES

10. CENTRIPETAL AND CENTRIFUGAL FORCES:
centrifugal force is the effort made to increase the rotation speed. It is not advantageous for the player, and of course it is not for squash either. The opposing force is centripetal.

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BIOMECHANIC PRINCIPLES

11. RHYTHM: it is achieved when the hits have an impact sequence, a progressive movement in time with acceleration in the phase before the impact.

A player has a good rhythm when they have an excellent control during the whole hit, a transmission time upon the ball all the time, and rare impacts out of the centre.

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Observation system. Changes in the way to teach squash.

It is important to consider that the player learns through kinetic feelings, i.e. basically from what they feel; for that reason the exercises should have an objective that allows a sensory recognition of what we demand from them, when hitting the ball and achieving a good shot is not the only objective.

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A COMPLETE PLAYER is the perfect combination of mind, technique, tactics/strategy, and body. Senti-pensante-actuante

“Every hit is generated in the body by the use of leverage and physical laws, to be transmitted to the ball through a tool, the racket, during a time of contact, the impact. The wrist sometimes replaces this theory because of the speed of the game, but this situation should be minimised.”

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Visible squash: it is the cosmetics of the technical movement, the style.

Invisible squash: it is governed by the mechanical laws that rule the body behaviour, and these laws will allow primary coordination to better all the players motor skills.

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Functional analysis is the one that checks the purposes and defines the optimal movements for the player to achieve an objective of better and successful performance.

Optimal movement is a high level technique that enables the attainment of a successful hit respecting the player individuality and being biomechanically the best.

Motor learning improvement of the motor coordination. It consists of the organization of external and internal factors of conditioning, enabling the acquisition of behaviour techniques to adapt to a situation so that the player develops more skills.

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Remember:

“When there is less effort, more subtle will be the differentiation in the response of our muscles, and more accurately we will make the effort fit the task.”

“The less effort we make, the faster is the learning of any skill, and the level of perfection we get goes hand in hand with the subtlety we achieve.”

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Remember:

“When tension is more optimal, differentiation is clearer, learning is easier and more precise”.

“Whatever you are doing, do less; switch off those lights you are not using.”

“Instead of piling up one strength on another, how much simpler it is to release resistance, to relax. Strength is yours, resistance is yours, the option is yours.”

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Coordination Chain:

The body segments that act as a system of shackles of the same chain, where the power that is generated by a shackle or part of the body is transferred to the following shackle successively.

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Coordination Chain:

Segments sequence:

- Legs/ knees (flexion and extension)
- Hip / Flexo - extension and a very slight hit rotation
- Trunk/ Slight and controlled flexion and rotations of the trunk
- Arm / Shoulder /Rotation of arm from the shoulder
- Elbow / From flexion to extension at the moment of impact and returns to flexion at the end. Pronation of forearm.
- Wrist / Flexion of wrist

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Coordination Chain problems:

- Omit a part of the body
- Synchronization problems
- Inefficient use of parts of the body (wrong technique and displacements)
- Use of an unnecessary part of the body, wrist

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INJURIES

**“WHEN TRAINING, ANYTHING CAN BE
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CONSEQUENCES”**

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Injuries can be classified into two basic categories:

Traumatic injuries that appear suddenly, which immediately show that something has gone wrong and whose effects are felt soon; these effects could be: pain, swelling, contusion or an open wound.

A traumatic injury can be extrinsic or due to an external cause, as a direct blow, a sudden twist when changing direction, or a fall. It can also be intrinsic, for no obvious reason, like the break of the Achilles tendon in the squash player.

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- Injuries due to overuse. These are more subtle because they show simply as an increase of pain, directly associated with a determined activity, usually repetitive.

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Frequent injuries in squash:

- 1. *Muscular contracture, distention, moderate sprain:*** among the typical muscular groups are *cufflinks, soleus, anterior tibial, gluteal, anterior ischio-tibial, adductor, deltoid, supra stickleback, and wrist muscles.*
- 2. Talalgia, Plantar fasciitis:** produced by ill support plant and repetition of workloads with great impact.

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Frequent injuries in squash:

3. Tendon Injuries: can be divided into brakages and inflammations. Approximately from 30 years old tendons start losing elasticity due to the degenerative changes, but the process can be delayed with regular exercise.

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Frequent injuries in squash:

5. Low back pain/ contraction: a contraction can be produced by the search of low balls during the game, not performing a good lunge or as a result of an abrupt erection of the trunk not using the legs. The pain could not disappear and it could move to the lower limbs, producing a sciatic nerve irradiation, called lumbociatalgia. The majority of these episodes are produced in lumbar vertebrae L4, L5, and S1.

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Frequent injuries in squash:

6- Sciatic pain: it is characterized by an persistent acute pain in all the area of sciatic nerve innervation (low back, hip and leg), in most cases with compression of it. The causes of sciatic pain in squash players have a progressive character, as they accumulate as years pass by, after traumatismos (a fall or a blow), inflammation or arthrosis.

7. Bursitis: it is the inflammation of the bursa, bag shaped structure that is situated in between bones, tendons and muscles, and has a movement facilitating function of these structures with each other. It is present in all joints, especially in the shoulder, elbow, knee, hip, and ankle.

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Frequent injuries in squash:

8. *Spondylosis and Spondylolisthesis:* consists of a breakage of the lamina of the vertebra, in such a way that the joint is slightly separated from the rest. The most frequently affected vertebra is the 5th Lumbar, followed by the 4th. The lumbo-sacral hinge made up of the 5th lumbar and the 1st sacrum, represents the weak point in the spinal building. The sliding of L1 over S1 is called *spondylolisthesis*. When the isthmus between the L5 and S1 is broken or destroyed, there is *spondylosis*.

9- *Joint osteoarthritis or wasted joints:* it is the degeneration and excessive articular cartilage wear, provoking wear also in the bone that surrounds it, together with aging.

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Frequent injuries in squash:

Upper limb:

10- Elbow: epicondylitis: the epicondyle is the area where the fore arm muscles join the lateral elbow bone. The excessive use of these muscles occurs frequently in sports like tennis and squash, where extension and rotation of wrist and hand are performed, causing overstrain in extensors of wrist and less frequently in forearm supinator. Most of the injuries are related to the second radial (extender of wrist)

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Frequent injuries in squash:

- 11- Shoulder:** injuries of the external rotator cuff, the most common within the supra tendon- stickleback injuries , sometimes causing subluxations and luxations in the humerus joint because of a complete injury in the external rotator cuff.
- 12- Wrist:** tendinitis due to inflammation of tendons in the wrist joint.

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Conclusions:

- 45% injuries are cramps (29% lumbar; 15% gluteal area; 13% calfs; 11% *ischio-tibial*; 11% quadriceps; 9% cervical, 12% other)
- 50% of these cramps are situated in the trunk and 80% within muscles that are part of the posterior chain
- 22% tendinitis; 23% epitrocleitis/epicondilitis; 11% external rotator cuff; 10% wrist; 14% adductors; 11% Achilles; 8% ischio-tibial; 11% patellar; 12% other.
- 15% sprains (56% ankle; 15% wrist; 12% knee; 16% other)
10% sprain (breakage) (32% adductors; 25% ischio-tibial; 21% calf; 22% other), and 90% of them are produced in the lower limbs.
- 8% other
- 60% injuries are in the lower limbs

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These percentages show:

1. A great demand in sports gestures in the lumbo-pelvic area, due to extreme efforts in flexion positions and an abuse of trunk rotations to reach low balls.
2. Training deficits (few or unspecific stimuli). This deficit is the result of wrong information and education both in players and their coaches.
3. Demonstrating eccentric requirements (braking and reaction) and relating it again with a poor conscience of a good flexibility or specific training.

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These percentages show:

4. Sprains: owing to the squash requirements (reaction, power and accuracy sport) it is shown the non- existence of proprioceptive training of the lower limbs and strengthening of the stabilizing muscles of the ankles , fundamental in the prevention work for this injury.
- 5- The presence of a great quantity of sprains is due to lack of plans for general or specific strengthening, flexibility and coordination.
- 6- The lunge positions to reach low balls are a great requirement for the ischio-tibials, quadriceps and lumbar.

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These percentages show:

- 7- Lateral movements (displacements) are sometimes very demanding (for the speed of the game) and influence on the adductors.
8. The movements/ displacements multidirectional with explosive brakes and starts, with the addition of jumps, completely overcharge the lower limbs.
9. Relating a deficient training with the injuries caused by the sport requirements, it is clear that the practice of squash in a bad physical condition leads to fatigue sooner, being this the main cause of technical and tactic errors, exposing the player to more possibilities of being injured.

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Injure prevention:

“To educate and make players aware , both amateurs and professionals, and above all coaches that are in charge of teaching children and young sportspeople and of training in squash, that there should be information and conscience of the mechanisms and processes of sanitary education for a healthier practice of squash, and training methods.”

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General and specific preventive aspects

- a- Warming up
- b- Joint flexibility and muscular elasticity
- c- Hydration
- d- Back to calm (regenerative work)
- e- Eating habits
- f- General and specific muscular strengthening for squash
- g- General and specific physical preparation for squash
- h. Adequate and in good conditions shoes
- i- Mouth health
- j- Training of mental abilities
- k- Physical/ medical check ups and evaluations
- l- Foot support test

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General and specific preventive aspects

m- Proprioceptive work of feet and ankles

n- Management of the technique of squash: BASIC TECHNICAL CONCEPTS

o- Definition of a personal style of playing, as complete as possible, with tactic and strategic variables, that reduces the competitive stress and the excessive efforts in squash.

p- Style is necessary as long as it does not go beyond the limit of respecting the healthy technique of the sport

q- Training of the PERCEPTION AND PERIPHERIC VISION , reasons for bad displacements and excessive movements due to bad space-temporal orientation and the relationship with the object and the opponent.