



Developing shoulder-over-shoulder rotation in the serve

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ABSTRACT

Currently, high-level players have the tendency to perform serves with a strong vertical predominance. However, when looking at the basic technique of the execution of the serve, we notice that the movement is oriented horizontally forwards, with strong presence of trunk rotation in the longitudinal axis (twist). A crucial step in the development of the service is the transition from horizontal (twist) movement to the vertical. The objective of this article is to suggest exercises that help the transition from basic to more vertical mechanics.

Key words: shoulder over shoulder, trunk rotation, verticalization, service.

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INTRODUCTION

The basic technique of the serve, practiced by beginners, children and pre-adolescents, presents the dominance of trunk rotation in the longitudinal axis known as twist (Crespo, Miley 1999). In this type of serve the ball is thrown slightly forward off the body, releasing the ball 1 o'clock (for right-handed and 11 o'clock for left-handed players), the body rotates impacting the ball with forward projection (Borrel, 2012; Elliott et al., 2009), a movement that is mostly in the horizontal plane. After puberty, when the player begins to have greater ability to push upwards with the legs, mechanics increasingly manifest in the vertical, which we can commonly call "verticalization of the service" (Longo, 2016). There are two main points in this transition:

1. The impact of the ball begins to occur slightly more to the left of the front leg, around 20 cm (Elliott et al., 2009), or between 11:30 and 12 o'clock;
2. The torso begins to rotate in the cartwheel axis, what we usually call shoulder-over-shoulder rotation (Elliott, Reid, and Crespo, 2003). This rotation begins immediately after the action of the legs, and it is completed in the air with the shoulder of the dominant arm (which moves the racket) higher than the other shoulder.

The contact point and trunk rotation plane changes are quite complex for players from a motor point of view for the players. In a more detailed analysis, we found great differences in the kinematic behavior of the hip, trunk and in the forces transmissions from the legs to the trunk between

the most basic (twist) and the most advanced (shoulder over shoulder) serves (Elliott et al., 2009). This requires careful coaching technical work to successfully promote this transition, where new and complex motor patterns must be incorporated by the player (Grosser and Schönborn, 2002).

The first step in this journey is to change player's contact point, encouraging him or her to throw the ball slightly further to the left (or right if left-handed) (Roetert, Groppe, 2001). There are simple exercises to toss the ball with targets on the floor or on the fence that help the player in this task (Schönborn, 1998). The player will soon become used to the new release and consequently to the new point of contact. Once the new point of contact has been established, the new trunk rotation plane can be developed, along with generation and propagation of forces from the legs to the dominant shoulder (Ackland et al., 1994). This is the ideal time for coaches to refine the technique and be able to establish shoulder-over-shoulder rotation, without the presence of rotations in the longitudinal axis, when power of the leg drive starts to manifest. It is known that shoulder-over-shoulder rotation differentiates slow from fast servers (Bahamonde, 2000). The following is an exercise that can help this technical refinement, helping the "verticalization of the service".

PRACTICAL APPLICATIONS

When a player reaches puberty and begins to gain strength from the lower limb, he becomes able to increase his vertical velocity (Elliott et al., 2009). It is in this moment that shoulder over shoulder rotation gradually begins to prevail in relation to twist rotation. By changing the throwing of the ball and

consequently the point of impact (slightly to the left), the necessary conditions are created for the further development of shoulder-over-shoulder rotation. However, players have the habit of turning the body (twist) since the initiation in tennis. One of the most important elements to succeed in this transition is controlling the hip. The trunk will rotate if at any time the impulse of the legs twist the hips. It is important that while the legs extend, there is shoulder over shoulder is the only rotation present, allowing for greater speeds and vertical reach (Elliott, Reid, Crespo, 2003). Thus, the way the legs propel the hip is a key in the control of how the torso will rotate (longitudinal or cartwheel axis).

When the legs finish flexing and the player reaches the trophy position, we notice the dominant shoulder lower than the shoulder that threw the ball (Elliott et al., 2009). In order for the shoulder to go upwards, setting up the shoulder-over-shoulder rotation, it is critical that the back hip goes up as well. It is noticed that the back hip, in elite players, is 0.3 m/s faster (in vertical velocity) than the front hip (Elliott et al., 2009). This information indicates that the back leg is the protagonist in this process, being responsible for the elevation of the back hip. Thus, for a successful shoulder-over-shoulder rotation, players should learn how to coordinate the leg drive. This impulse should push the hips, especially the back hip, up and forward (Elliott et al., 2009), exclusively, without causing any rotation in the longitudinal axis. Once the leg-hip assembly is moving upward and forward, with the back hip faster than the front one, shoulder-over-shoulder rotation occurs naturally as long as the ball is correctly positioned (Elliott et al., 2009).

An exercise that is proving to be very efficient in the motor learning pattern of the player, coordinating the leg-hip-trunk ensemble in the cartwheel axis, consists in using a vertically downwards force from elastic resistance in the dominant shoulder of the player, when the player bends his legs and is ready to drive.



Figure 1. Part 1 of exercise using resistance band to simulate correct shoulder over shoulder motion serve – the resistance bands pulls/keeps the shoulder and back leg/hip of the player down.

The band offers resistance compatible with the strong leg, core and trunk muscles that will be used. The player holds the elastic tightly to the body, anchoring the end of it close to the dominant shoulder. From this moment on, the right arm will do no other action than holding the elastic. With legs bent, heels slightly off the floor, spine aligned with front plane, low dominant shoulder, non-dominant arm pointed upwards, practically vertically, the player will produce a force with legs, hip and trunk, raising the dominant shoulder as high as possible. During this action, it is intended that the hip and shoulders will not show any rotation in the longitudinal axis. The hip will be propelled upward, with the back hip higher than the front at the end of the execution. In addition, the hip should move slightly forward, moving away from the fence. The exercise does not have great amplitude, however it requires great strength of the player. At the end we see the player on his toes, legs fully extended, dominant shoulder higher than the non-dominant side, body straight and tilted to the side, and left arm close to the body.



Figure 2. Part 2 of exercise to simulate correct shoulder over shoulder rotation – Hip and shoulder move upwards past vertical level of other hip and shoulder, the player ends up on toes and there is zero to no twist.

By learning to perform this exercise perfectly, players end up understanding how the leg-hip-trunk ensemble should produce force to promote shoulder-over-shoulder rotation, overcoming the strong vertical force applied to the dominant shoulder.

However, there are several details that must be observed when players perform this exercise. The exercise seems simple, but in practice, players have some difficulty in performing it accurately. There are several systematic errors that appear:

1 - Lack of coordination with the non-dominant arm

The player extends the legs leaving the arm extended upwards. When beginning to extend the legs, the non-dominant arm should be brought down close to the body. The exercise helps players understand that, from the trophy position, the arm should only move after the beginning of the leg extension (two very common mistakes: lowering the non-dominant arm before pushing, moving the racket toward the nape of the neck before driving).

2 - Moving the arm that holds the elastic (raising the elbow)

To overcome the vertical resistance from the elastic, players try to use the arm that holds the elastic. The force should come exclusively from the leg-hip-trunk assembly.

3 - Raising the shoulder using excessive lateral flexion of the trunk

Something that often happens: by not achieving a good generation of strength, especially with the back leg, players tend to use only lateral bending forces of the trunk to raise the dominant shoulder.



Figure 3. Common issues - The player using the arm to pull against the resistance band, as well as using too much lateral flexion to raise the shoulder (without effective leg drive).

4 - Rotation of hip and trunk on the longitudinal axis

This almost always happens in the first attempts, due to the automation of turning the body (twist) to serve.



Figure 4. Incorrect movement in the exercise - Rotation of hip and trunk rather than shoulder over shoulder movement

5 - Moving the hip laterally to the back side

This has a higher occurrence in youngsters who are still developing strength in the lower limb. When attempting to raise the shoulder, the hip moves laterally towards the fence.

RESULTS AND CONCLUSION

After players learn the exercise to perfection, there will be a neuro-motor reprogramming of how the leg-hip-trunk ensemble should act to potentiate the shoulder-over-shoulder rotation. It is suggested that players do 4 to 6 repetitions at a time. At the end of the series it is recommended that players immediately serve 9 to 12 times to apply the motor experience felt in the elastic, creating the learning of the new pattern of execution. These protocols were elaborated through 8 years of application of this exercise, in different populations. One interesting variation is to apply vertical force downward on the dominant shoulder by replacing the elastic by a manual force from the coach (although ethical must be taken to respect boundaries). Another option is to serve normally, but standing only on the back leg. This exercise helps the introduction of the back leg as the protagonist in the generation of impulses in the serve.

It was noticed that this exercise, in addition to providing very useful body awareness to players of how the leg-hip-trunk ensemble should act for a better action of shoulder-over-

shoulder rotation on the serve, helps generation of strength of specific biomechanics chain elements, improving the coordination and understanding of the movement, being an excellent catalyst in the process of verticalization of the service.

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