

ACUTE EFFECT OF 3 STRETCHING TECHNIQUES ON SIDEWARD MOVEMENTS IN TENNIS

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ABSTRACT

Stretching exercises are widely used as a part of the warm-up in sports, although stretching benefits are still questioned. The aim of this study was to analyze the acute effect of three stretching techniques performed during the warm-up, on typical tennis sideward movements. 20 tennis players (6 women and 14 men, aged 17.75 ± 1.7 years, weight 67.05 ± 10.07 Kg, height $173, 4 \pm 10.12$ cm) participated. The effect of three of the most popular stretching techniques (PNF, Static and Ballistic) as well as the absence of stretching during the warm-up was analyzed using a sideward movement test (Brown, Piorkowski, Roetert & Woods, 1995). Results showed the best performance time ($p < 0.05$) for the "absence of stretching" condition versus the other three conditions. There were no differences ($p > 0.05$) on performance time between the three conditions in which stretching was included during the warm-up. It can be concluded that to stretch (PNF, Static or Ballistic) during warm up reduces performance in sideward movements in tennis.

Key Words: warm-up, performance, PNF, static stretching, ballistic stretching

EFEECTO AGUDO DE 3 TÉCNICAS DE ESTIRAMIENTO EN LOS MOVIMIENTOS LATERALES EN TENIS

RESUMEN

Los ejercicios de estiramiento son ampliamente utilizados como parte del calentamiento en el deporte, pero sus posibles beneficios son actualmente cuestionados. El objetivo de este estudio ha sido analizar el efecto agudo de tres técnicas de estiramiento realizadas durante el calentamiento, en los movimientos laterales típicos de tenis. 20 tenistas (6 mujeres y 14 hombres, edad de $17,75 \pm 1,7$ años, masa $67,05 \pm 10,07$ kg, altura $173, 4 \pm 10,12$ cm) participaron. El efecto de tres de las técnicas más populares de estiramiento (PNF, estáticos y balísticos), así como la ausencia de estiramiento durante el calentamiento se analizó mediante una prueba de movimiento lateral (Brown, Piorkowski, Roetert & Woods, 1995). Los resultados mostraron el mejor tiempo ($p < 0,05$) para condición la "ausencia de estiramiento" frente a los otros tres condiciones. No hubo diferencias ($p > 0,05$) en el tiempo empleado entre las tres condiciones en las que se incluyó estiramiento durante el calentamiento. Por tanto, se puede concluir que estirar (PNF, estática o balístico) durante el calentamiento reduce el rendimiento en los movimientos laterales en el tenis.

Palabras clave: calentamiento, el rendimiento, FNP, estiramiento estático, estiramiento balístico

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INTRODUCTION

In recent decades, warming up before training or a sports competition, and the inclusion of stretching exercises in the warmup became a widespread practice (Young, 2007). However, it has been questioned over the past few years, not only in terms of the ideal stretching technique for the warmup (Janot, Dalleck & Reymont, 2007) but also as regards the usefulness of this type of exercise before a competition or as the main element in a training session.

As for the type of stretching, most studies have come to the conclusion that static stretching reduces performance in sprinting, from 9 m to 30 m (Ayala & Sainz, 2010; Faigenbaum et al. 2006; Fletcher & Jones, 2004; Little & Williams, 2006; Gálvez, Tapia & Jurado, 2012). Conversely, dynamic stretching generally improves performance in sprinting, from 9 m to 20 m (Faigenbaum et al., 2006; Fletcher et al., 2004; Little et al., 2006). The grounds for this statement are an increase in body temperature compared to the rest of stretching techniques, which in turn is associated to increased sensitivity of receptor nerves and a greater nerve impulse rate, which allows muscle contractions to be more efficient (Shellock & Prentice, 1985). Another frequent argument is that of the activation of the stretch reflex (myotatic reflex) mediated by neuromuscular spindles, which allows the muscle to be more reactive (Baechle & Earle, 2007). Dynamic stretching has also been suggested to increase the range of motion (ROM) of the joint (Ayala et al., 2010), facilitating ampler joint movements during a competition or in the main part of the training session.

On the contrary, the reasons that point to a decline in performance after static stretching are based on the reduced active stiffness of the muscle-tendon joint, which makes the stretching-shortening cycle less effective, reducing the amount of elastic energy that can be stored and reused and a decrease in the sensitivity of neuromuscular uses, this causing some muscle relaxation (Avela, Finni, Liikavainio, Niemela & Komi, 2004).

Regarding the effect on performance in agility circuits, most studies (Sainz & Ayala, 2010; Faigenbaum et al., 2006; Little et al., 2006) found no significant performance differences when using one type of stretching or another before performing the agility test.

With this background in mind, this paper aims to compare the effect of three of the most popular stretching techniques (static stretching, ballistic stretching and PNF) as well as the absence of stretching during the warmup, on performance in typical sideward movements in tennis.

METHOD

Participants

20 federated tennis players participated in the study (6 women and 14 men; age: 17.75 ± 1.7 years; mass: 67.05 ± 10.07 Kg; height: 173.4 ± 10.12 cm).

Participation was voluntary. Participants were informed of the characteristics of the study, and they all signed a consent sheet.

Inclusion criteria were: being federated, training 3 days a week minimum, no records of injury or disease affecting the lower limbs in the 6 months previous to the study, and not taking anti-inflammatory drugs or other medication with effects on the neuromuscular system.

Measurement test

The sideward movement test proposed by Brown et al. (1995) was applied; it is used both academically and for competition purposes (Roetert & Ellenbecker, 2008). The movement starts from the "T" on the service line of the court. Looking at the net, the player must go past the service line up to the doubles line, then go to the opposite doubles line and finally return to the "T" point (Fig. 1). This is done by moving laterally and without crossing his/her feet. Right-handed players move sideways to the right, and left-handed ones move to the left. To start, participants put the foot closest to the "T" on a mark located 40 cm away from it. Players start the test when they are ready. Time is measured by a photocell system (Chronojump© α model), connected to a computer program (Chronojump 1.5.4.) with 0.001s accuracy (Figure 2).

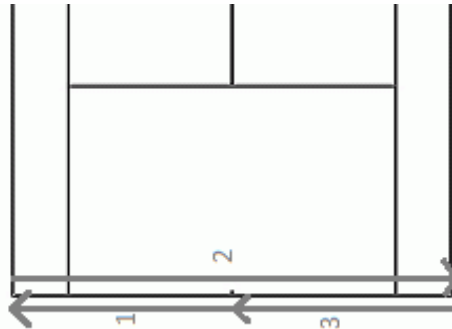


FIGURE 1: Sideward movement test (Brown et al. 1995).



FIGURE 2: Location of photocells, tennis player and researcher before the start of sideward movement test.

Study conditions

The four types of stretching (study conditions) were: static stretching (SS), ballistic stretching (BS), proprioceptive neuromuscular facilitation (PNF) and absence of stretch (AS). In the case of the first three conditions, the same exercises were used and for the same time (30 s) for the three techniques. 5 exercises were used (Figure 3) covering the main muscle groups of the lower limb: quadriceps, hamstrings, adductors, abductors and triceps surae. These stretching exercises were performed in the same order, a repeat by muscle group, and supervised by the same researcher. For the stretching to be done correctly in all cases, players were told to reach their joint limit but without pain.

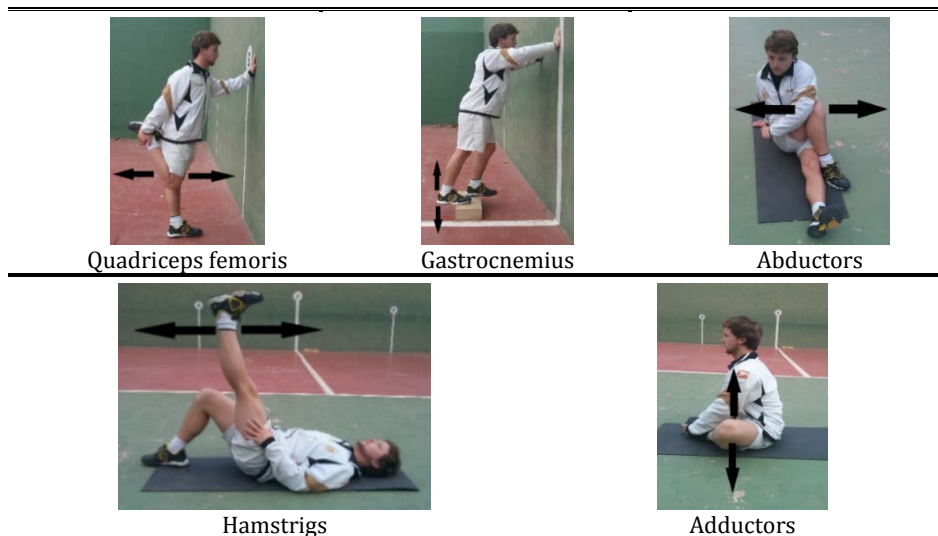


FIGURE 3: The five stretching exercises selected.

Procedure

Before the study, participants were asked to do a familiarisation session. They were explained the dynamics of measurement sessions and did the test as many times as necessary.

During the experimental phase, each participant was individually called to do each of the four measurement sessions. These were separated by a minimum of 48 hours, and 15 days maximum between the first one and the last one. In order to minimize the effect of possible contaminating variables, tests were carried out on the same tennis court, with the same researcher, participants wore the same shoes, at the same time of the day, and the four conditions of the study were randomly distributed.

Each measurement session consisted of a standardized 10-minute warm up, including: 2 minutes running followed by general calisthenics, then, the stretching planned for that session (SS, BS or PNF), and the test. In the AS condition, the test was performed straight away after the warm up. The participants repeated the test three times for each condition, with a 30 second break between repeats (Vila, 1999).

Statistical analysis

A descriptive analysis was conducted first. After checking data normality with the Shapiro-Wilk test, and homoscedasticity with Levene's test, a repeated measures ANOVA was performed, setting an $Alpha = 0.05$ significance level and performing a post-hoc Bonferroni test. The program used for data processing was SPSS 19.0.

RESULTS

Average time to complete the test was 6.531 ± 0.406 s. The highest average was for the SS condition, with 6.591 ± 0.440 s, while the condition with the shortest mean time was AS, with 6.439 ± 0.407 s (Table 1).

TABLE 1
Descriptive statistics

CONDITION	MEAN \pm SD
PNF	6.530 ± 0.370
EE	6.591 ± 0.440
EB	6.563 ± 0.408
AE	6.439 ± 0.407
Overall mean	6.531 ± 0.406

The repeated measures ANOVA showed significant differences ($p < 0.05$) in favour (less time) of the AS condition compared to the other 3 conditions

(Table 2). No significant differences were found ($p > 0.05$) between the three stretching.

TABLE 2
Repeated measures ANOVA results

Condition	Mean \pm SD	P
PNF	6.530 \pm 0.370	0.036
AE	6.439 \pm 0.407	
EE	6.591 \pm 0.440	0.001
AE	6.439 \pm 0.407	
EB	6.563 \pm 0.408	0.005
AE	6.439 \pm 0.407	

DISCUSSION AND CONCLUSIONS

The aim of the study was to determine the effect of three of the most popular stretching techniques (PNF, SS and BS), as well as that of not stretching (AS), on the speed of sideward movements in tennis players.

Tennis is a sport in which players perform movements of different types, and these movements vary according to the level of the players. In advanced tennis players, like the ones who participated in the study, Nigg, et al., (1989) argue that during a match, marching (used when the game is stopped), running and small jumps are the three most commonly used movement patterns, accounting for 30.5 % 29.8 % and 29 %, respectively. As regards the direction of the movement, forward movements (40.5 %) and sideward movements (34.5 %) are the most relevant. Sideward movements have given rise to a great deal of interest in tennis studies because they are specific to this sport (forward movements such as sprinting are similar in tennis and other sports). Therefore, both in footwear biomechanical studies (Luethi & Nigg, 1985; Van Gheluwe & Deporte, 1992, Llana et al., 2013), and in performance testing (Sánchez, Torres & Palao, 2011; Baiget, Iglesias & Rodríguez, 2008), sideward movements are a target movement. This is why the sideward movement test proposed by Roetert et al. (2008) was chosen for the study; besides being a test used for research, it is also used in the area of fitness and physical training of tennis players (Roetert et al., 2008; Eriksson, Johansson & Back, 2015), which gives it high ecological validity.

Given the existing debate (Ayala et al., 2011) about whether or not stretching during the warmup is beneficial, detrimental or indifferent in sports performance, the results of this study suggest that it is detrimental. The results on Table 2 show statistically significant differences in favour of the AS condition. More particularly, for the selected performance test, the absence of stretching improved the time used by 0.122 s (1.8 %) compared to the average time used in all three stretching conditions. Compared to each of them, it meant

an improvement of 0.091 s (1.4 %) against PNF, 0.152 s (2.4 %) against static stretching, and 0.124 s (1.9 %) against ballistic stretching.

These improvement percentages of condition AS versus the three stretching techniques are little relevant in terms of recreational sport but they are very considerable competition-wise. This can be easily seen if we analyse what these percentages mean in activities such as the 100-metre dash. In the men's final of the 100 metres in the 2012 Olympic Games in London, the difference between the Gold Medal (Usaint Bolt, 9.63 s) and the fourth athlete (Tyson Gay, 9.8 s) was 1.7 %, and it is even more evident in the women's final: the difference between the Gold Medallist (Shelly-Ann Fraser-Pryce 10.75 s) and the athlete who ranked eighth (Blessing Okagbare 11.01 s) was 2.3 %. According to this, and from a strict sports performance perspective, it seems logical not to recommend stretching in the warm up previous to a competition.

In a second level of analysis, regarding the effect of the different stretching types on motor performance, the results show no differences in the effect of three stretching techniques on the time spent on the sideward movement test. This is in line with the majority of studies analysing the effect of different stretching techniques on agility tests. Faigenbaum et al., (2006) Little et al., (2006) and Sainz et al. (2010) studied the effect on agility of static and dynamic stretching while warming up, and failed to find significant differences.

Based on the results of this study, we cannot conclude that tennis players should not do any stretching but, in terms of performance only, the best time for stretching is not the warm up before competing. The ideal time is probably at the end of the training session or the competition, as there are evidences (Fernández, Méndez & Sanz, 2012) that the musculature is shortened after intense exercise and stretching is the best way for the muscle to recover the length it had before exercising. The effect of stretching on tennis players with muscle/tendon pain that goes after stretching has not been analysed nor in tennis players who start playing again after an injury when stretching is prescribed to avoid another injury.

The main conclusion from this study is that lower-limb stretching (techniques: PNF, static stretching and ballistic stretching) versus no stretching during the warm up reduces motor performance in sideward movements in tennis. Therefore, the study suggests the non-inclusion of these three stretching techniques in the warm up previous to competition in tennis.

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