ELECTROMYOGRAPHY ACTIVITIES OF UPPER AND LOWER EXTREMITIES IN TABLE TENNIS DURING FOREHAND TOPSPIN AND NO SPIN STROKE: A CASE STUDY

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The purpose of this study was to compare upper and lower extremity muscles activations between the forehand topspin and no spin strokes. A right-handed male elite table tennis player performed 13 forehand topspin strokes and 13 forehand no spin strokes against a ball machine. Electromyography (EMG) activities from his 10 upper and lower extremity muscles were recorded during these strokes and analyzed using a wireless EMG device. According to descriptive statistics, there seemed to be high-level differences in muscular activities between forehand no spin and forehand topspin strokes.

KEY WORDS: Muscular activity, racket sports, stroke types.

INTRODUCTION: Table tennis, which is an Olympic sport and a Paralympics sport, is one of the most popular racket sport in the world. Rotation movements, speed and agility of a player are the most important factors that affect the result of table tennis competition. Therefore, table tennis requires high-level of speed, strength, power, flexibility, and good reflexes (Kondric *et al*., 2006). There are two characteristics of table tennis that include a psychological approach, since they refer to psychomotor development such as the multiple coordination of upper and lower extremities and the high speed of reaction (Tobar, 2003). Athletes perform a single stroke within a very short period of a second using these psychomotor skills. One of the most important stroke types in table tennis is forehand. Players use their ipsilateral extremities during forehand stroke. Their active leg was the one that is farther away from the table during the ready position for the forehand stroke. Athletes perform their forehand strokes either with spin or without spin.

The ball spin that effects on the ball and accordingly on the trajectory of the ball is a very important factor in racket sports (Cross, 2002). There are three types of spin in table tennis that are topspin, backspin and sidespin. In this study, topspin was handled during forehand strokes.

Topspin is produced by hitting the ball with an upward motion, starting the stroke below and/or behind the ball and contacting the ball as lightly as possible. Using excessive spin is particularly effective in the service (Iino and Kojima, 2011).

Elite players prefer to focus on attacking or counter-attacking and produce high velocity and high rotation while hitting spin strokes (Kondric *et al*., 2006). The forehand topspin is known to be the most effective attacking shot in table tennis (Liao and Masters, 2001). Most of the table tennis players prefer to use the forehand topspin as this is an effective shot with high velocity and rotation (Kondric *et al*., 2006). The ability to generate high racket speeds in the forehand is a profound factor for offensive players to win a match (Qun, *et al*., 1992).

EMG signal measures bioelectrical currents generated during muscular contractions and represents neuromuscular activity of muscles. Therefore, EMG signals provide profound information related to nervous system that controls the muscular activity and to various aspects of muscles (fatigue, contraction/relaxation) (Naït-Ali 2009). Previous studies about table tennis focused on activities of upper extremity and/or trunk muscles (Kondric *et al*., 2006; Baca *et al*., 2007; Tsai *et al*., 2012). However literature lacks experimental studies investigating muscular activities of both upper and lower extremities during forehand topspin and no spin strokes. These studies could provide important information about recruitment strategies and fatigue process of muscles during a table tennis match. From this point of view, information related to recruitment rates and patterns of muscles of upper and lower extremities could be used by trainers and athletes in the development of appropriate training plans. In addition, EMG-related data obtained during specific table tennis skills could be used to develop kinesiological models for these skills and provide athletes or coaches to organize training programs. Therefore, EMG analysis has a profound role in this study.

Furthermore, in order to increase ball velocity or control the path of the ball, a spinning ball is necessary (Qun, *et al*., 1992). Understanding upper and lower extremities joint movements during the forehand topspin and no spin strokes will provide a correct swing pattern for training programs of table tennis players to improve their skills and adjust the factors that produce injuries.

The purpose of this study was to compare upper and lower extremity muscles activations during forehand topspin and forehand no spin strokes using surface EMG. This study was performed to further elucidate plausible implications of adopting the forehand topspin versus the forehand no spin strokes.

METHODS: An elite right-handed male table tennis player (age: 26; height: 182; mass: 74 kg; training age at table tennis branch: 14 years) was recruited in this study. He performed 13 trials during both forehand topspin and forehand no spin strokes against a ball machine and EMG activities from his 10 upper and lower extremity muscles [Pronotor Teres (PT), Extensor Carpi Radialis (ECR), Biceps Brachii (BB), Deltoid Anterior (DA), Deltoid Meddle (DM), Teres Major (TM), Vastus Medialis (VM), Rectus Femoris (RF), Vastus Lateralis (VL), Biceps Femoris (BF)] were recorded during these strokes using a wireless EMG device (Delsys Trigno Wireless, USA). Maximal voluntary isometric contraction (MVIC) levels of these muscles were recorded for 5 seconds. The training ball (mass: 2.7g, diameter: 40mm) and racket (mass: 340g) were used in the present study. The ball machine threw ~40 white balls per minute to the left side of the players.

RESULTS AND DISCUSSION: EMG changes are reported as the difference between forehand no spin strokes and topspin strokes. EMG root mean square (RMS) values were expressed as a percentage of MVIC. There is a high-level difference in muscular activity between forehand no spin and topspin strokes both in lower and upper extremity muscles. During forehand no spin strokes, especially ECR (98%) and DA (62%) had a distinctive difference compared to forehand topspin strokes. However, muscle activities in the BB (43%) and TM (36%) were higher during topspin strokes (Figure 1). In lower extremity muscles, VM (61%) and BF (33%) had higher muscle activities during forehand no spin strokes compared to topspin strokes (Figure 2).

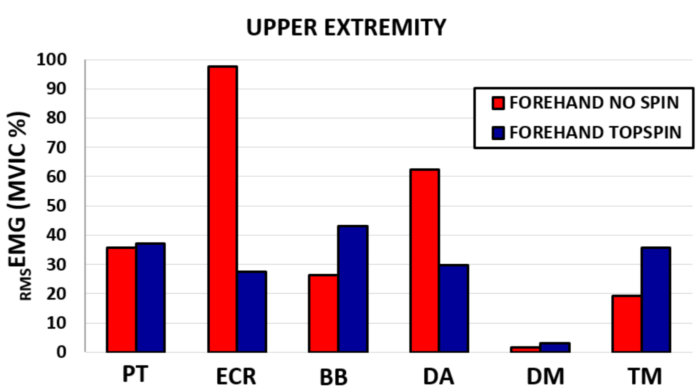

Figure 1: EMG activity of Upper extremity muscles during forehand no spin and forehand topspin strokes. (Pronotor Teres (PT), Extensor Carpi Radialis (ECR), Biceps Brachii (BB), Deltoid Anterior (DA), Deltoid Meddle (DM), Teres Major (TM)).

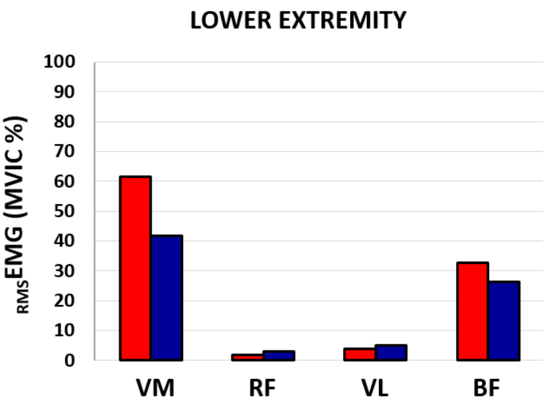

Figure 2: EMG activity of Lower extremity muscles during forehand no spin and forehand topspin strokes. (Vastus Medialis (VM), Rectus Femoris (RF), Vastus Lateralis (VL)).

CONCLUSIONS: We can conclude that lower extremity muscles were more active during no spin strokes compared to topspin strokes. Although BB and TM had a distinctive increase during topspin, ECR and DA had higher level of muscular activity during no spin. So, we can say that no spin stroke in table tennis is more demanding in terms of muscular activity compared to topspin stroke. Depending on these results, assessment of differences in fatigue levels between players dominantly using no spin strokes and those using topspin strokes could be a nice next step for future studies. In addition, studies conducted on large samples certainly provide more reliable results for the sports science field. In addition, investigating not only forehand topspin and forehand no spin but also other stroke techniques will provide a specific kinesiological model of table tennis. This study performed with only one elite table tennis player. Studies conducted on large samples certainly provide more reliable results for the sports science field.

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