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MUSCLE ACTIVITY DURING LUNGE FOR FENCERS

Muhammad Faeiz Ismail[1], Asha Hasnimy Mohd Hashim[2] and
Syahrul Ridhwan Morazuki[3]

Lunge is a basic and crucial technic in fencing. The movement requires the fencers to activate the quadriceps muscle simultaneously using arm muscles. Due to the nature of the games in different categories, the activation of quadriceps muscles mainly in the rectus femoris might slightly differ, hence requiring different types of training. However, in real scenario, most fencers train with the same method and techniques for lunge. Therefore, this study aims to evaluate the muscle activity of rectus femoris during lunge between fencers in the epee and foil category. The muscle activations were recorded using EMG Biopac Student Lab (BSL) Lesson 3: Electromyography (US) while the fencers performed lunge using Williams and Walmsley (2000) protocol. A total of 8 university male fencers (4 epees and 4 foils) were recruited in this study. The subjects are 23.13 ± 1.13 years of age, weigh 64.50 ± 5.53 kg, and stand 1.69 ± 0.04 m in height. The data were analysed using independent sample t-test with significant value of $p < 0.05$. The result shows that the maximum contraction of rectus femoris muscle was higher in the foil fencers compared to the epee fencers. This different might be due to the nature of the game in which epee fencers tend to perform offensive attacks on fleche to collect marks compared to foil fencers, who tend to collect marks by using lunge, hence taking longer musculos-neuromuscular action time for neuromuscular adaptation. Thus, fencers need to adapt this skill before learning other techniques and tactical skills.

Keyword: EMG, Fencing, Lunge, Muscle Activity, Rectus Femoris.

1. INTRODUCTION

Fencing is a combat sport that requires two fencers to fight using special swords and win points by making contacts with their opponents. There are three categories of fencing: foil, sabre, and epee, and each category requires the fencer to collect points at different areas of the opponent's body. According to Tsolakis and Vagenas (2010), fencing requires the fencer to compete regularly and repeatedly with different levels of intensity, depending on the duration of the game and the different skills.

Many skills and techniques have been used by fencers and the skills involve the combination of fitness and motor skills. Good fencers have balance in their gross motor skills and fine motor skills. The two basic skills in fencing are positioning and movement (Barth and Beck, 2007). Movement skills are exercised in three techniques: offensive, defensive and retreating. In the offensive technique,

[1] Univerisiti Teknologi Malaysia, *E-mail: mfaeiz93@gmail.com*
[2] Univerisiti Teknologi Malaysia, *E-mail: asha@utm.my*
[3] Univerisiti Teknologi Malaysia, *E-mail: p-syahrul@utm.my*

the fencer will usually lunge to hit the opponent (Bottoms, Sinclair, Gabrysz, 2011). Lunging is the basic and crucial movement in fencing because it indirectly requires higher efficiency of the neuromuscular system. Lunging also requires the strength and speed of the quadriceps muscle, especially the rectus femoris muscle and vastus lateralis muscle (Chauhan and Hamzeh, 2013). The contraction of rectus femoris muscle will help during a lunge movement, especially in fencing, football, and badminton (Cronin, 2003).

In a training session, fencers are usually focused on footwork rather than on the movement of blade or sword. However, most of the fencers will be trained in the same way even though they play in different categories. Therefore, the purpose of this study is to identify and compare the activities of the rectus femoris muscle during lunging particularly between epee and foil athletes.

2. MATERIALS AND METHODS

An experimental approach was conducted on a posttest group. The group consists of eight university fencers (four from epee and four from foil category) who are healthy and have two years of experience training under the university fencer's team. They are males aged 23.13 ± 1.13 years who weigh 64.50 ± 5:53 kg and whose height are 1.69 ± 0.04 m.

All the subjects were briefed on the protocol of the study and received an informed consent. Prior to the warm-up session, electrodes were placed on the subjects' right rectus femoris muscle. The subjects then needed to warm up for at least 15 minutes before performing the Williams and Walmsley (2000) protocol. In this protocol, the subjects received instructions to remain motionless in en garde position, placing their feet on two markers, A and B. The big toe of the rear foot was situated at a distance 1.5 times the subject's height away from the target area (plastron). When the circle (target) was projected onto the target area, the subject

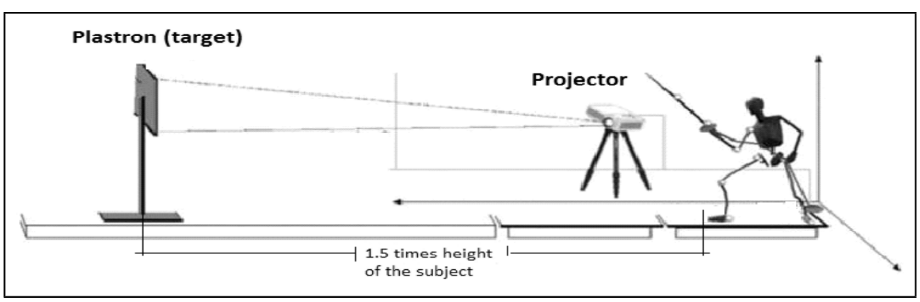

Figure 1: Williams and Walmsley 2000 Protocols adapted from *William L.R.T., Walmsley, A., (2000). 'Response Timing and Muscular Coordination in Fencing: A Comparision of Elite and Novice Fencers', Journal of Science and Medicine in Sports,* 3 (4): 460-475.

had to make a direct long lunge as quickly as possible, in a reaction time situation, to place the tip of the sword inside the circle. After various long lunges towards the target area at the pre-established distance, the fencers were allowed to adjust the distance until they felt comfortable at the new distance. Before beginning the recording trials, the fencers completed a session of several attacks against the target area until they became familiar to the protocol. The subjects needed to perform five lunges for the EMG recording for the data to be complete.

3. STATISTICAL ANALYSIS

The integrated EMG data depends on a number of factors which vary across the recorded muscles and subjects (*e.g.*, electrode impedance, distance between electrode, relationship of electrodes to motor points, and amount and location of subcutaneous fat) (Mohd Hashim, Ibrahim, Zainuddin, 2015). To control these factors, the data were standardised by expressing the integrated EMG as a mean value of integrated EMG for all trials. The data were then analysed using Statistical Package for the Social Sciences (SPSS) version 20.0 for Windows. For each variable and experimental condition, the means and standard deviations were calculated. The differences between the means of the variables were determined in independent samples *t*-test of the two experimental conditions (epee and foil). The level for acceptance of significance (α) was set at 0.05.

4. RESULTS

Table 1 shows the difference in the mean and standard deviation of the rectus femoris muscle activity during the lunge between the foil and epee fencers. The rectus femoris muscle activity during the lunge showed by the subjects in the foil category is higher than that of the fencers in epee category (0.636 ± 0.026 mV s^{-1}).

TABLE 1: MEAN AND STANDARD DEVIATION OF MUSCLE ACTIVITY DURING LUNGE

Category	*Mean ± SD (mV s^{-1})*
Foil	0.636 ± 0.026
Epee	0.492 ± 0.102

TABLE 2: ANALYSIS OF *T*-TEST FOR RECTUS FEMORIS MUSCLE ACTIVITY DURING LUNGE

	t-test for Equality of Means		
	t	*df*	*Sig (2-tailed)*
Average Mean	2.748	6	.033

Table 2 shows a comparison of the value of *t* for the rectus femoris muscle activity during the lunge for the foil and epee fencers (t = 2,748, p = 0.033). A significant value was set to be smaller than $p = 0.05$. The results mark a significant difference in terms of the rectus femoris muscle activity during lunge between the foil and epee fencers.

5. DISCUSSION

Muscle activation during the rapid movement in lunge plays an important role in the performance of fencers. The unveiling regularities of the interaction between the muscle activities of different fencing categories may be useful in determining a training process and in increasing athletes' performance. This study attests significant differences in terms of the activity of rectus femoris muscle between the epee fencers and the foil fencers while performing lunge.

According to Thorndike (1913), repeating the same motor movement during practice will improve the performance of motor skills and vice versa. In this case, fencers from foil category often perform lunge as their routine training, whereas epee fencers practise the fleche offensive technique (Frère *et al.*, 2011), which is similar to lunge only that the former requires the fencer to move and perform horizontal jumps at high speed followed by follow-through run passes towards the opponent. Due to the lack of reinforcement and repetition in lunge during normal training or competition, an epee fencer's neuromuscular adaptation during the lunge is longer than that of a foil fencer. Perhaps the epee fencer's muscle is not ready or unable to adapt in the first trial during the lunge movement, but then improve in the second and third trials as the fencer improves his or her movement technique.

In addition, physical anthropometry factors may affect the average mean of muscle activation for the subject because the height of the subjects and the length of their muscle group are involved during the lunge. According to Kumagai *et al.* (2000), the length of the muscle can affect the fencer's speed and performance during maximum contraction. Thus, the average mean recorded using electromyography would certainly show a difference in the foil and epee categories. The descriptive data shows that the epee fencers are exhibited longer muscles activation compared to the foil fencers. The longer the muscle activation, the slower it needs to contract for a maximum contraction. For this reason, the epee fencers recorded a lower tone of muscle activation compared to the foil fencers.

The reseachers also compared the average mean between the two categories by using SPSS, the purpose being to identify the significant differences between them. The analysis showed significant differences in the rectus femoris muscle activity during the lunge between the foil and epee categories. It is worth to note that two of the subjects from the foil and epee categories have been competing at national level, and the rest are athletes who have two years of experience competing in the sport; nevertheless, the data analysis found that the mean for the rectus femoris muscle activity during the lunge was almost the same for the subjects. This is supported by Zehr *et al.* (1997), who concludes that the comparison between novice athletes and high-performance athletes did not show any significant differences in terms of motor task.

Overall, the study indicated the treatment readiness or how real skills in the sport of fencing will affect muscle activation through tests. Understanding the process of learning and relearning of the neuromuscular adaptation can facilitate the planning of interventions hence the achievement of expected outcomes (Mohd Hashim and Lee, 2016), apart from anthropometric factors. Once the appropriate control parameter for an act is identified, it can lead to a consistent and automatic elicitation of outcomes.

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