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Research article

Effects of electrostimulation and plyometric training program combination on jump height in teenage athletes

Emilio J. Martínez-López [1]✉, Elisa Benito-Martínez [2], Fidel Hita-Contreras [3], Amador Lara-Sánchez [1] and Antonio Martínez-Amat [3]

[1] Research Group HUM653 Laboratory, Department of Didactic of Musical, Plastic and Body Expression, University of Jaén, Spain; [2] Royal Spanish Athletics Federation, Spain; [3] Department of Health Sciences, University of Jaén, Spain

Abstract

The purpose of this study was to examine the effects of eight-week (2 days/week) training periods of plyometric exercises (PT) and neuromuscular electrostimulation (EMS) on jump height in young athletes. Squat jump (SJ), counter movement jump (CMJ) and drop jump (DJ) were performed to assess the effects of the training protocols 98 athletes (100 & 200m and 100m & 110m hurdles) voluntarily took part in this study, 51 males (52%) and 47 females (48%), 17.91 ± 1.42 years old, and 5.16 ± 2.56 years of training experience. The participants were randomly assigned to four different groups according to the frequency and the timing of the stimulation. Analysis of covariance was used to analyze the effects of every training program on jump height. Our findings suggest that compared to control (Plyometrics (PT) only), the combination of 150Hz EMS + PT simultaneously combined in an 8 week (2days/week) training program, we could observe significant jump height improvements in the different types of strength: explosive, explosive-elastic, and explosive-elastic-reactive. The combination of PT after ≤ 85 Hz EMS did not show any jump height significant increase in sprinters. In conclusion, an eight week training program (with just two days per week) of EMS combined with plyometric exercises has proven useful for the improvement of every kind of vertical jump ability required for sprint and hurdles disciplines in teenage athletes.

Key words: Jump height, squat jump, counter movement jump, drop jump, combined training.

Introduction

Electrical muscle stimulation (EMS) consists of electrical currents application in muscles or peripheral nerves in order to obtain involuntary muscle contractions (Kots and Havilon, 1971). Several investigators have reported increased isometric muscle strength in athletes (Babault et al., 2007; Brocherie et al., 2005; Maffiuletti et al., 2002; Porcari et al., 2005), producing neuromuscular improvements (Bax et al., 2005; Colson et al., 2000; Gondin et al., 2005; Maffiuletti et al., 2002; 2009; Malatesta et al., 2003; Porcari et al., 2005). Nevertheless, EMS has some important disadvantages, such as Golgi tendon organ and myotatic reflex inhibition, which can lead to an increased injury risk (Jubeau et al, 2006; Requena et al., 2005), and some difficulties in obtaining improvements in agonist and antagonist muscle coordination (Holcomb, 2005; Paillard, 2008).

In the 1970's, Kots and Hvilon (1971) used EMS as a complementary tool for strength training in the former Soviet Union and they found strength improvements of up to 40%, providing the basis of this technique as a support in elite athletics training (Kots and Havilon, 1971). Over the last two decades, most of the EMS studies successfully aimed at lower limb power development applied to quadriceps femoris muscle (Bax et al., 2005) in athletic performance and other sport disciplines. After two months of EMS (85Hz) + PT training, an 11.2% increase was obtained for drop jump (DJ) in sprinters (Benito et al., 2010). Several studies have focused on the effect of EMS training on other sport disciplines: Volleyball, with a 6.5% and 5,4% increase for squat jump (SJ) and counter-movement jump (CMJ) respectively; Rugby, with a 10% and 6.6% improvement for SJ and DJ respectively after EMS (100Hz) training; tennis with a 10-m sprint time 3.3% shorter and a 6.4% enhancement of CMJ height (Maffiuletti et al., 2009) and soccer, with an increment of 6.7%, 2.27% and 1.71% in SJ, CMJ and ABK (Abakalov jump) respectively after 5 weeks of EMS training (Billot et al., 2010).

Vittori (1990) described two types of strength**,** active and reactive strength, and more specifically, three different types of strength manifestations: explosive, explosive-elastic, and explosive-elastic-reactive, which could be assessed by squat jump, counter-movement jump and drop jump respectively (Maulder et al., 2006). Although EMS training has been proved to be effective in improving explosive, explosive-elastic and explosive-elastic-reactive strength (Holcomb, 2006; Khlifa et al., 2010; Maffiuletti, 2008; Markovic et al, 2007; Paillard et al., 2005; Parker et al., 2003), it has been shown that the physiological adaptations produced by EMS as one single training method are slightly lower than EMS combined with sport practice (Brocherie et al., 2005; Deley et al., 2011; Holcomb, 2006), weight training (Delitto et al, 1989; Willoughby and Simpson, 1998) or plyometry (PT). EMS and PT combination have obtained improvements in vertical jump ability (Dervisevic et al., 2002; Maffiuletti et al., 2009; Malatesta et al., 2003), specific soccer skills such as ball speed (Bilot et al., 2010), sprint run (Dauty et al., 2002; Herrero et al., 2006) and anaerobic power (Herrero et al., 2010a; Herrero et al., 2010b) in both amateur (Holcomb, 2005; Jubeau et al., 2006) and professional athletes (Benito et al., 2012; Pichon et al., 1995). A recent review (Filipovic et al., 2011) reveals that EMS is effective for developing physical performance, offering a

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