Electromyographic Analysis of the Surf Paddling Stroke Across Multiple Intensities

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Abstract

Nessler, JA, Ponce-Gonzalez, JG, Robles-Rodriguez, C, Furr, H, Warner, M, and Newcomer, SC. Electromyographic analysis of the surf paddling stroke across multiple intensities. *J Strength Cond Res* XX(X): 000–000, 2019—Surfers spend a majority of their time in the water paddling. The purpose of this study was to examine activity in 5 muscles that contribute to paddling at different velocities and to characterize oxygen use, paddling cadence, and surfboard motion at each velocity. Twelve recreational surfers completed an incremental paddling test on a shortsurfboard in a swim flume. Surface electromyography was recorded bilaterally from latissimus dorsi, upper and mid trapezius, and posterior and mid deltoid. Electromyographic activity increased as water velocity increased for all muscles, but the change in activation between endurance and sprint paddling was greatest for latissimus dorsi ($p < 0.001$). At higher water velocities, the middle deltoid was activated earlier in the paddling stroke ($p = 0.005$). Oxygen use, paddling cadence, and surfboard roll/yaw increased with increasing water velocity. These data may be useful for athletes, trainers, and equipment designers interested in increasing power and efficiency of the paddling stroke.

Key Words shoulder, upper extremity, surfing

Introduction

The sport of surfing has grown in popularity in recent decades. Current estimates for participation are as high as 20 million persons worldwide (19,35). In 2020, surfing will be incorporated into the summer Olympic Games for the first time in history (36). Like many sports, physical conditioning and skill are crucial to an athlete's success (10,13,15,21,33), and there is growing interest in strength, cardiovascular conditioning, and motor learning to improve performance (6,12). Although there are numerous professionals and facilities that market themselves as resources to support the training and preparation of surfing athletes, much remains unknown regarding the physical demands of the sport and the optimal ways to train. Furthermore, an improved understanding of human performance in the sport of surfing may lead to improvements in equipment design.

Paddling is an important component of surfing and an area in which physical training can impact performance. Several studies have reported that a surfer spends between 40 and 60% of their time in the water paddling (3,11,17,21,23,25), and data suggest that there are measurable differences in paddling ability that are associated with skill level (10,15,33). Surfers who lack stamina become fatigued and are unable to maneuver and position themselves in the proper place to catch waves (17). Surfers who are unable to paddle at higher maximal velocities often experience difficulty while standing up on more challenging waves (6,31–33). This occurs because a surfer who is unable to paddle at an adequate velocity will catch the wave late and will be forced to stand while the wave is breaking, often while their board is positioned on the more vertical aspect of the wave's surface. Improper paddling or lack of physical conditioning may also lead to injury. Epidemiological data suggest that the most common chronic injuries among surfers include the low back and shoulder, both of which are often reported to be aggravated during extended bouts of paddling (14,26,28).

To date, studies that have analyzed the surf paddling motion are limited in number and scope. Two specific shortcomings in previous literature were addressed here. First, detailed analyses of surfboard paddling in previous studies have focused on performance at a single paddling speed (8,27–29). These analyses are inadequate because surfers paddle at a wide range of intensities in the water (1,3,11,17,21,23,24). For example, surfers often engage in endurance paddling, which occurs when an athlete paddles out into the lineup or paddles to maneuver themselves in position to catch a wave. This low to moderate paddling intensity can be maintained for at least 3 minutes in experienced, recreational surfers (27) and at least 6 minutes in competitive surfers (12). Global positioning system and video

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