Science & Sports (2017) xxx, xxx—xxx

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Elsevier Masson France EM|consulte www.em-consulte.com

ORIGINAL ARTICLE

Analysis neuromuscular activity during front crawl with and without a snorkel

Analyse de l'activité neuromusculaire lors de la nage avec et sans tuba

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Received 23 September 2015; accepted 23 May 2016

KEYWORDS
Aquatic therapy;
Front crawl;
Snorkel;
Surface electromyography;
Neck;
Shoulder

Summary
Objective. — The aim of this study was to analyze and compare changes in muscle activation neck-shoulder muscles in healthy participants during front-crawl with and without a snorkel for the prevention or/and treatment of musculoskeletal injuries future.
Methods and subjects. — We examined eight muscles of the shoulder and cervical spine with surface electromyography including cervical erector spinae, trapezius, supraspinatus, infraspinatus, pectoralis, anterior deltoid, middle deltoid and latissimus dorsi of the right shoulder of 16 participants (8 men and 8 women). Each subject was measured 5 complete cycles of front crawl (semi-tethered swimming) with/without snorkel with a speed of 40 beats per minute it marked for a metronome. Previously, carried out (land-based) test maximum voluntary contraction was used to normalize, in relative terms, the percentage of activation in swimming.
Results. — The results showed that front crawl with snorkel leads to the cervical erector spinae increasing activity of 22% ($P = 0.020$) when compared to front crawl without snorkel. Other muscles do not show statistically significant changes.
Conclusions. — The use of the snorkel leads to an increase in the activity of the cervical erector spinae in front crawl potentially due to fixation of the head relative to the movement of the shoulder girdle.

Abbreviations: sEMG, surface electromyographic; MVC, maximum voluntary contraction; μV, microvolts; IPAQ, International Physical Activity Questionnaire.

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http://dx.doi.org/10.1016/j.scispo.2016.05.004
0765-1597/

MOTS CLÉS
Thérapie aquatique ;
Nage ;
Tuba ;
Électromyographie de surface ;
Cou ;
Épaule

Résumé
Objectif. — Le but de cette étude était d'analyser et de comparer les changements dans l'activation musculaire des muscles du cou et des épaules chez les participants en bonne santé réalisant la nage du crawl avec et sans tuba pour la prévention et/ou le traitement des blessures musculo-squelettiques à venir.
Méthodes et sujets. — Nous avons examiné huit muscles de l'épaule et du rachis cervical par électromyographie de surface, y compris les muscles érecteurs du rachis, trapèze, sus-épineux, sous-épineux, pectoral, deltoïde antérieur, deltoïde moyen et grand dorsal de l'épaule droite de 16 participants (8 hommes et 8 femmes). Chez chaque sujet ont été mesurés 5 cycles complets de nage avec/sans tuba à la vitesse de 40 battements par minute (marqués d'un métronome). Auparavant (sur terre), la contraction maximale volontaire a été utilisée pour normaliser, en termes relatifs, le pourcentage de l'activation en natation.
Résultats. — Les résultats ont montré que le crawl avec tuba mène à l'augmentation de l'activité des muscles érecteurs du rachis 22 % ($p = 0{,}020$) par rapport au fait de nager sans tuba, les autres muscles ne montrant pas de changements statistiquement significatifs.
Conclusions. — L'utilisation du tuba conduit à une augmentation de l'activité des muscles érecteurs du rachis durant la réalisation de la nage type crawl, potentiellement en raison de la fixation de la tête par rapport au mouvement de la ceinture scapulaire.

1. Introduction

The etiology of swimmer's neck-shoulder muscles problems is complex and includes sudden increases in the amount of training, numerous repetitions of the same overhead movement during training, hypermobility, increased glenohumeral external rotation with subsequent decreased internal rotation and scapular dyskinesis [1]. Neck-shoulder muscles pain is considered the most common cause of disability in swimmers, with a prevalence variously reported as between 40% and 91% [1], as the biomechanics inherent in swimming can result in altered motor control of neck-shoulder muscles [2].

Additionally, there is some evidence of altered motor control of the neck-shoulder muscles as a risk factor for shoulder pain [3,4]. Wadsworth and Bullock-Saxton showed a reduction in the consistency of neck-shoulder muscle recruitment in swimmers with neck-shoulder muscles pain [5]. Evidence of motor control impairments in the neck-shoulder musculature during functional motor tasks has been documented in patients with neck-shoulder pain [6,7]. Falla reported that an altered neural control of the cervical spine may initiate neck pain and vice versa, and that these changes may in turn cause neuromuscular changes in the shoulder girdle musculature [8]. Accordingly, a number of researchers have assessed the activation pattern of neck-shoulder muscles in individuals with neck-shoulder pain [6,9] during functional upper-limb tasks.

Regarding the swimming technique, in alternating strokes such as the front crawl propulsion is mainly achieved by the arms rather than by the legs [10]. Coordination side breathing with swimming will influence kinematics and muscle activity in the upper limbs and cervical spine [11—13]. Also, to see if a lack of movement in the shoulder girdle can lead to a lack of balance between the kinematics of glenohumeral and scapulothoracic joints requires study using surface electromyography (sEMG) in response to empirical hydrodynamic models associated for many years with the use of a snorkel in training competitive swimming. Use of a snorkel and semi-tethered swimming influenced breathing patterns, kinematics and muscle recruitment [14—16].

Muscle activity in the aquatic environment has been investigated in different exercises through analysis with sEMG of upper-limb muscles during swimming was recorded [17—20]. The sEMG allows us to record the electrical activity of a studied muscle relatively easily and accurately (outside the aquatic environment) [21], at rest and in motion, testing the integrity of the motor system [22—25].

Numerous studies have evaluated the signal amplitude of different muscle groups and found differences in muscle activation exercises in water relative to land, both in static and dynamic exercises such as isometric [18,26—28]. Others studies have compared maximal oxygen uptake (VO2max), maximal heart rate [14,29], and anaerobic threshold obtained from semi-tethered swimming versus free swimming [30]. Athletes with less muscle mass [27] exhibited a higher VO2max and anaerobic threshold during semi-tethered swimming [16,29]; but only a few studies have used sEMG to measure the front crawl technique and extrapolated the results to the daily clinic [28,31—33].

The purpose of this study is to analyze, compare and understand statistically significant differences in muscle activation neck-shoulder muscles in healthy participants during front-crawl (semi-tethered swimming) with and without a snorkel for the prevention or/and treatment of musculoskeletal injuries future.

2. Methods

2.1. Participants

We studied the musculature of the right shoulder of 16 healthy participants (8 males and 8 females). Participants were infrequent but competent and safe swimmers with the front-crawl. Before collecting any data, participants voluntarily signed an informed consent previously approved for this study. The mean age of participants was 26.06 ± 4.48

Please cite this article in press as: Romualdo C-L, Antonio Ignacio C-V. Analysis neuromuscular activity during front crawl with and without a snorkel. Sci sports (2017), http://dx.doi.org/10.1016/j.scispo.2016.05.004