Original article

Electromyographic validation of the deltoid (anterior portion) and pectoralis major (clavicular portion) in military press exercises with open and middle grips

Bull, ML.[1]*, Ferreira, MI.[2] and Vitti, M.[3]

[1]Department of Anatomy, Instituto de Biociências, São Paulo State University – UNESP, Campus de Botucatu, Botucatu, CEP 18618-000, SP, Brazil
[2]Department of Anatomy, University Center Moacyr Sreder Bastos, Rio de Janeiro, RJ, Brazil
[3]Department of Morphology, Stomatology and Physiology, University of São Paulo – USP, Ribeirão Preto, SP, Brazil
*E-mail: marilena@ibb.unesp.br

Abstract

The deltoid (anterior portion) and pectoralis major (clavicular portion) were evaluated in several execution ways of military press exercises with open and middle grips in order to know their behavior pattern. It was analyzed 24 male volunteers, using a 2-channel TECA TE4 electromyograph and Hewllet Packard surface electrodes. It was observed that the execution variation with open and middle grips does not present any significant difference as for the demanding level neither for the pectoralis major muscle nor the deltoid muscle.

Keywords: electromyography, muscle deltoid, muscle pectoralis major, physical conditioning, exercises.

1 Introduction

In spite of a great advance observed for the methods and techniques used by sports professionals in the last decades, it is observed that most part of the material directed to athletes improvement or non-athletes attendance either in sports centers or scholar physical education, is still based in merely anatomical observations, anatomo-mechanical deductions or even electrophysiologic experiments.

Particularly, on deltoid (anterior portion) and pectoralis major (clavicular portion), there are a few studies to justify the indication of basic exercises for their conditioning.

Literature by O'shea (1976), Machado (1980) and Lambert (1987), who treat about physical preparation with anatomical base, mention the deltoid participation, however, do not make any differentiation to each portion of this muscle. Lambert (1987), cites the pectoralis major participation without mentioning its clavicular portion, while O'shea (1976) refers to this muscle superior portion in military press exercises as priorities for its conditioning.

These authors present controversial opinions about development exercises modalities for the deltoid and pectoralis major muscles conditioning, and Lambert (1987) emphasizes for these exercises the importance of the way the bar is approached, stating that the grip width determines the efforts distribution. The grip importance for rowing exercises was described by Ferreira, Büll and Vitti (1996) in the deltoid anterior and pectoralis major, and by Büll, Freitas, Vitti et al. (2003) in the trapezius and serratus anterior. On the other hand, in development exercises, similar studies were performed also in the trapezius and serratus anterior by Büll, Freitas, Vitti et al. (2001).

Thus, we proposed to evaluated the deltoid muscle (anterior portion) and pectoralis major (clavicular portion) in different ways of exercises development with open and middle grips to know their behavior pattern, enabling the selection of the Best modality for these muscles conditioning.

2 Material and methods

Twenty-four male non-athletic subjects, 17 to 30 years-old with no antecedents of muscular or joint injuries, were analyzed by using a two channel TECA TE4* electromyograph and Hewlett Packard surface electrodes connected to the pre-amplifiers of the electromyograph, using the superior channel for PMC and the inferior channel for the DA. Electrodes were placed, after depilation and thorough cleansing, on the PMC 2.0 cm below the anterior border of clavicle along the longitudinal axis which crosses the middle point of the clavicle; and on the DA 4.0 cm below the clavicular insertion of the muscle along the longitudinal axis which crosses the middle point of that insertion.

The electromyograph was routinely adjusted to 500 mv and the velocity of the bundle displacement was of 370 ms/division. The photographic documentation of the experiment was made in a dark room with Exa Thage Dresden camera with Isco-Göttingen Isconar 1:2, 8/50 mm objective and with TRI-X PAN (27 DIN, 400 ASA) Kodak film. All the electromyographic exams were carried out inside an electrostatic "cage" to avoid external interferences.

Before starting the data collect, all subjects were previously trained to perform each exercise. It was assessed the modalities: standing forward with open grip (StF/o); standing forward with middle grip (StF/m); standing behind neck with open grip (StB/o); standing behind neck with middle grip (StB/m); sitting forward with open grip (SiF/o); sitting forward with middle grip (SiF/m); sitting behind neck with open grip (SiB/o); sitting behind neck with middle grip (SiB/m).

* The electromyographic equipment was obtained with grants from CNPq (Proc. 3834/70) and FAPESP (Proc. Med. 70/511) and donated to the Department of Morphology of the Faculty of Odontology of Piracicaba/UNICAMP.

To perform the exercises, the subjects utilized a supine bench and a 120 cm long bar made of light wood. The execution form, with strictly controlled posture, was according to Machado (1980).

The electromyographic records were analyzed according to the rating method of Basmajian (1978).

The existence of differential effects of execution modalities on the musculature and the different significance level were tested by Friedman non-parametric method (Analysis of Double Variance for Small and Dependent Samples) and by Wilcoxon method (suitable for non-parametric data and paired small samples). The differences were considered significant when $p < 0.05$.

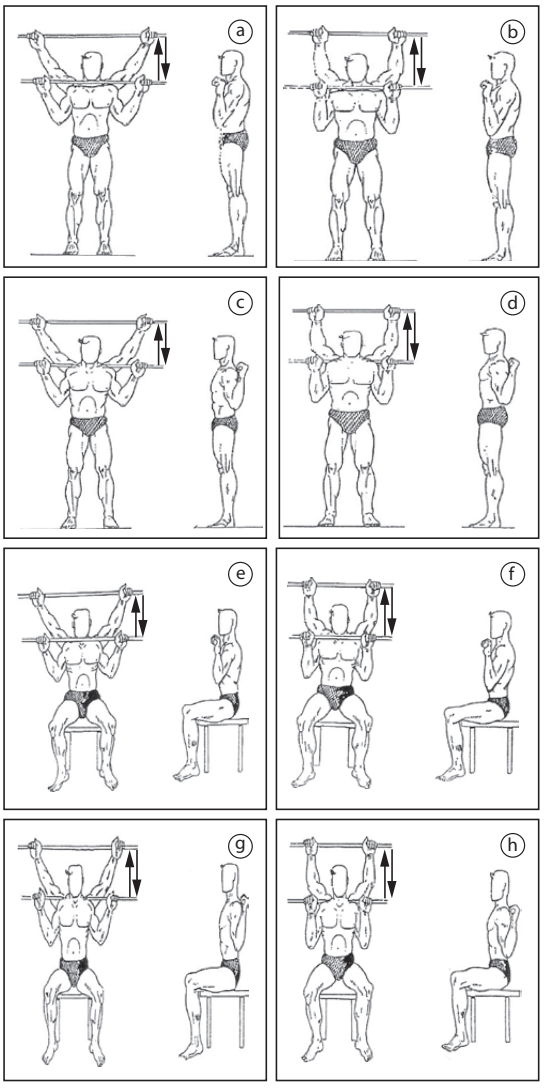

Figure 1. Military press exercises – execution pattern. a) Standing military press – forward – open grip; b) Standing military press – forward – middle grip; c) Standing military press – behind neck – open grip; d) Standing military press – behind neck – middle grip; e) Sitting military press – forward – open grip; f) Sitting military press – forward – middle grip; g) Sitting military press – behind neck – open grip; h) Sitting military press – behind neck – open grip.

3 Results

The execution pattern adopted is shown in Figure 1.

The action potential levels of PMC and DA in the different modalities of development exercises done with open and middle grips are shown in percentage of subjects in Tables 1 and 2.

Table 3 shows the statistical comparison between the development exercises done with open and middle grips.

4 Discussion

In the area of Kinesiology and Sportive Medicine, electromyography has given the scientific base required for the adequacy of the multiple possibilities of exercises sequence to the different sportive modalities which they are directed to. However, there is little citation on electromyographic studies of the pectoralis major (clavicular portion) and

Table 1. Action potential incidence (%) recorded for the pectoralis major muscle – clavicular portion (PMC) in development exercise with open and middle grips.

Intensity/ movements	-	+	++	+++	++++
StFo/G	45.8	41.6	8.3	0	4.1
StFm/G	33.3	41.6	20.8	4.1	0
StBo/G	41.6	54.2	0	4.1	0
StBm/G	45.8	45.8	4.1	4.1	0
SiFo/G	50.0	45.8	4.1	0	0
SiFm/G	25.0	62.5	12.5	0	0
SiBo/G	37.5	58.3	0	4.1	0
SiBm/G	45.8	54.1	0	0	0

Table 2. Action potential incidence (%) recorded for the deltoid muscle – anterior portion (DA) in development exercise with open and middle grips.

Intensity/ movements	-	+	++	+++	++++
StFo/G	0	0	0	20.8	79.1
StFm/G	0	0	0	4.1	95.8
StBo/G	0	0	4.1	37.5	58.3
StBm/G	0	0	0	8.3	91.6
SiFo/G	0	0	4.1	29.1	66.6
SiFm/G	0	0	0	12.5	87.5
SiBo/G	0	0	12.5	41.6	45.8
SiBm/G	0	0	8.3	12.5	79.1

Table 3. Comparison among development exercises done with open and middle grips by the pectoralis major – clavicular portion (PMC) and deltoid – anterior portion (DA).

Exercises	p-value	
	PMC	DA
StFo/G × StFm/G	0.205	0.068
StBo/G × StBm/G	1.000	0.008
SiFo/G × SiFm/G	0.025	0.110
SiBo/G × SiBm/G	0.109	0.074

deltoid (anterior portion), supporting the indication of basic exercises for their physical conditioning.

Controversial opinions are presented by O'shea (1976), Lambert (1987) and Machado (1980), about the military press exercise modality for the deltoid and pectoralis major conditioning.

In our studies, PMC with both grips presented high inactive levels in almost all the modalities, while DA showed very high action potential levels in all modalities. For PMC, only in the sitting forward modality was observed the grip influence, with superiority of the middle grip in relation to the open one for the muscular requirement. For DA, the influence was observed only for the standing behind modality, with high superiority of the middle over the open grip. Thus, we did not observe any significant difference among the modalities when executed with open grip only or middle grip only, for either PMC or DA, what makes us consider unnecessary the indication of so many variations contained in the physical conditioning manuals.

As for the importance of the grip highlighted by Lambert (1987) for the effort distribution, our studies showed that it was not confirmed for the military press exercises, since that in a general way it was not observed significant superiority of one grip over the other, neither for PMC nor DA, with exception for a superiority of the middle over the open grip in the sitting forward exercise for PMC, and the standing behind exercise for DA.

Thus, among the development exercises, it cannot be established a choice preferential order as for the execution with open and middle grips.

Acknowledgments: We would to thank Mr. Roberto Carvalho Prado and Benedicto Vinicius Aloise for the works they have done.

References

BASMAJIAN, JV. *Muscle alive*: their function revealed by electromyography. Baltimore: Williams & Wilkins, 1978. 561 p.

BÜLL, ML., FREITAS, V., VITTI, M. and ROSA, GJM. Electromyographic validation of the trapezius and serratus anterior muscles in military press exercises with open and middle grip. *Electromyography and Clinical Neurophysiology*, 2001, vol. 41, p. 203-207.

BÜLL, ML., FREITAS, V., VITTI, M. and ROSA, GJM. Electromyographic validation of the trapezius and serratus anterior muscles in rowing exercises with middle and closed grip. *Electromyography and Clinical Neurophysiology*, 2003, vol. 43, p. 4-8.

FERREIRA, MI., BÜLL, ML. and VITTI, M. Electromyographic validation of basic exercises for physical conditioning programmes. III. Influence of the grip in the capacity of the rowing exercises in determining action potential levels for the deltoid (anterior portion) and the pectoralis major muscle (clavicular portion). *Electromyography and Clinical Neurophysiology*, 1996, vol. 36, p. 86-90.

LAMBERT, G. *Musculação*: guia de treinamento. São Paulo: Manole, 1987. 162 p.

MACHADO, IL. *Modelagem do físico*: musculação ao alcance de todos. Rio de Janeiro: Tecnoprint, 1980. 174 p.

O'SHEA, JP. *Scientific principles and methods of strength fitness*. Massachussets: Addison - Wesley, 1976. 191 p.

Received August 23, 2011
Accepted November 11, 2011